

Dare to be first.



**Delaware Center  
for Transportation**

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### DAPA Hosts Warm Mix Asphalt Field Conference

The Delaware Asphalt Pavement Association (DAPA) hosted an open house on June 17th at the DelDOT campus in Dover to introduce a (relatively) new environmentally friendly paving technique called warm mix asphalt (WMA). Some 160 or so attendees included DelDOT personnel, Delaware municipalities, contractors, consultants, Federal Highway representatives, Maryland State Highway, and Maryland County representatives. WMA is a general term associated with lowering the production temperatures of making asphalt materials for roadways, parking lots, and driveways. The lower temperatures save energy costs, reduce greenhouse gas emissions, and minimize the odor associated with the production of normal hot-mix asphalt (HMA). All of these benefits have been seen on a national level with this new technology along with comparable in-place performance with conventional HMA.

The all day event began with a field conference under a large tent, where the diverse participants heard from James Clendaniel (Executive Director, DAPA), Kevin Jones (DAPA Vice-President & Event Chair), James Pappas (Assistant Director-Design, DelDOT), Randy West (Director, National Center for Asphalt Technology), Ron Corun (Manager, Nu-Star Asphalt Technical Services), and Harold Mullins (Executive Director, Texas Asphalt Pavement



Association) on various topics: the technical aspect of WMA, its origins in Europe, the US experience so far, policy and construction issues, and regulatory standards. A central theme that weaved through all the presentations was that the technology has had overwhelmingly positive results, requires little or no change in the techniques to transport and apply, and will be the dominant asphalt product in Delaware within the next 2-5 years; indeed, DelDOT has committed to full implementation of WMA in its paving program by 2015. Most participants came away with a better understanding that the only significant difference between warm mix and hot mix, as Jim Pappas said, would go away if you left your asphalt thermometer back at the office.

After lunch, the crowd walked to the nearby Delaware Transit Corporation (DTC), where George & Lynch demonstrated the placement of WMA with materials provided by Diamond Materials. As predicted, participants saw that the same techniques and equipment they are familiar with apply to this new technology and they could see (or not see, in the case of emissions and fumes) and feel (by way of the markedly lower temperatures) the benefits.



The Delaware T<sup>2</sup> Center assisted with marketing and registration for the event and we were pleased to observe such a broad audience in attendance to observe one of the cornerstone technologies in the Federal Highway Administration's Every Day Counts initiative. While the technical aspects of WMA are not as dramatic a change as was, for example, Superpave, the more the Delaware transportation community understands about this new technology, the better will be its transition and effectiveness. ■

## Message from the Director

On behalf of the Delaware Center for Transportation faculty and staff, I would like to welcome Mr. Shailen Bhatt as the new secretary of the State of Delaware Department of Transportation. As DelDOT's main research and technology transfer division, we look forward to working with Secretary Bhatt closely to address some of the most challenging transportation problems that the state faces. For nearly 25 years the Center employees have worked diligently to provide DelDOT with creative and innovative ways of solving problems using state-of-the-art tools and methods. Our success has been partly due to the fact that the research we conduct for DelDOT is mostly in the applied area, which means that the results can be implemented soon after the project is completed. This trend will no doubt continue especially during these challenging economic times which make it difficult to fund research projects more theoretical in nature.

Over the years the Center has established excellent cooperative relationships with almost all colleges and departments within the University of Delaware. Our College of Business and Economics has provided us with faculty to confront not only issues related to Transportation Economics, but also problems dealing with the optimization of resources at DelDOT. Likewise, the Center has collaborated with the faculty in the College of Arts and Sciences to solve problems on issues related to meteorology, urban affairs, planning and policy. UD's College of Earth, Ocean and Environment has been actively involved with the Center working on transportation-related pollution reduction, logistics and alternative modes projects. Principal investigators from the College of Agriculture and Natural Resources have been involved with the Center for years working on highway vegetation management, landscape architecture and pollution projects. Last, but certainly not least, our College of Engineering has provided expertise to tackle problems related to newly developed construction materials and techniques, structural safety and reliability, traffic safety and planning. In the near future, we will be knocking on the doors of our College of Health Sciences to work on the extremely important issue of the correlation between transportation and human health.

The Center will continue the series on Distinguished Guest Speakers, inviting some of the most prominent transportation figures in the United States and the world. For the many programs that we offer, please check our web-site at [www.ce.udel.edu/dct](http://www.ce.udel.edu/dct). ■



Ardeshir Faghri,  
Director

# ASHE Students Continue Busy Schedule of Field Trips



Sam Bostick leads students on a tour of the Newark, DE High Speed Toll Facility construction site.

The student chapter of the American Society of Highway Engineers closed out the 2010-2011 academic year with another blast of activity. In the fall, the ASHE at UD students hosted the First State Section's (FSS) practitioners at an October barbeque at White Clay Creek State Park and in November, students toured the then on-going reconstruction of Delaware's I-95 Toll Facility. Some of them even learned the fine art of relaxing at FSS's annual Holiday Gala in December.

As new student leadership came on in the spring, a fresh round of activities followed. FFS's own Rod Pieretti spoke at the students' meeting about his recent experience at the dedication of the Hoover Dam Bypass Bridge. In April, the students returned to the Indian River Inlet Bridge, this time seeing the deck form traveler in action. Also in April, several students joined FSS for its monthly dinner meeting at the Wilmington Riverfront, where they heard some of the challenges and triumphs that the DeIDOT team faced in the management of transportation and other elements of that long-standing project. Finally in April, they squeezed in an unusual opportunity to tour the New Jersey Turnpike Authority's Interchange 6to9 Widening project, a \$2.5 billion project.

In May, the students toured DeIDOT's sign and signal shop in Dover to better understand the broad

challenges of this subset of transportation design, construction, and maintenance. Also in May, they attended FSS's annual Hall of Fame Banquet, where they saw awards given to professionals who had contributed lifelong and meaningful service to the Delaware transportation community.

ASHE at UD's new leadership is just as anxious as the inaugural officers to provide substantial opportunities for engineering students to see real world projects, operations, and practitioners up close and personal, with Ryan Barton as President, Mike Kelly as Vice President of Organization and Events, Anthony Durante as Vice President of Membership and Recruitment, Chris Manco as Treasurer, and Emmanuel Anagnostakis as Secretary. But the students are quick to point out that they could do none of this without the champions they have found in the practitioners of the First State Section, who have consistently been supportive of them and found ways to get the students exposure to projects, operations, and people that will help them better understand the engineering world and its opportunities. ■



Rod Pieretti speaks at the Student Chapter general meeting.



## Stephen Mensah

Stephen Mensah, a Research Fellow, said goodbye to DCT at the end of July when his contract with the University of Delaware expired. Stephen joined DCT in August 2007 from Century Engineering Inc. Stephen's primary responsibility with DCT was oversight of the implementation of research outcomes. He collaborated with various project investigators and project managers to ensure that the value of each research program was realized through implementation and evaluation. Also in order to give visibility to research activities at DCT, Stephen ensured that all research projects were uploaded into the TRB research database Transportation Research Information Service (TRIS). Stephen also participated in some research work for DCT and assisted in crafting or evaluation of various proposals for DCT. We wish Stephen the best of luck in his future endeavors. ■

# 2011 PI/PM Showcase

The Principal Investigator-Project Manager Showcase held on May 9th drew attendees from Pennsylvania and Maryland, as well as those closer to home. Well represented this year were companies such as AECOM, URS Corp and Century Engineering who were interested in learning about the current transportation research underway the University of Delaware.

The annual showcase, a poster session hosted by the Delaware Center for Transportation, offers an opportunity for researchers and interested parties to meet and discuss ongoing projects in civil and environmental engineering, public administration and extension. Posters representing Pavement and Materials, Environmental, Planning, Bridge, Traffic and ITS, Transit and UTC were on display. Researchers, graduate students and undergraduate students discussed their results to date with representatives from various groups across the state and region.

We extend our thanks to the Federal Highway Administration, US Department of Transportation and the Delaware Department of Transportation for supporting our Center's research and outreach activities. ■



## Quality Assurance Workshop Coming to Delaware in 2012

The Delaware Department of Transportation (DelDOT) will host the Mid-Atlantic Region Quality Assurance Workshop February 7-9, 2012 at the Dover Downs Hotel, in Dover, Delaware.

The states of Delaware, Maryland, New Jersey, New Jersey, Pennsylvania, Virginia, West Virginia, and the District of Columbia make up the Mid-Atlantic Region QAW and this is an annual event held each year since 1967. The Workshop consists of five breakout sessions devoted to the latest information on highway materials in the areas of asphalt, concrete, metals, maintenance, and soils/aggregates. The mission of the organization is, in part, "to promote, adopt and emphasize new transportation technologies and the implementation of pro active policies, practices, and procedures that ensure the real life of the transportation infrastructure equals or exceeds its design life at a minimum overall cost."

With constrained budgets, this is a great opportunity to meet colleagues at all levels of government and the private sector, share experiences, and get caught up on technologies. Details of the event, including the agenda and registration will become available soon and announcements will be made by both DelDOT and the Delaware T<sup>2</sup> Center, among others. If you have questions in the interim, Jim Pappas (DelDOT) has asked that you contact him at (302) 760-2400 or at James.Pappas@state.de.us. ■

## Working Toward Complete Streets in Delaware

BY MARCIA SCOTT

Walk, bike, take public transit, or drive? Unfortunately, today many Americans lack choice in transportation modes. Automobile-oriented transportation planning, segregated land uses, and dispersed development patterns have contributed to a cycle of automobile dependency. After decades of building car-oriented roadway networks, many streets lack connectivity and do not safely accommodate pedestrians or bicyclists. In addition, mobility-constrained populations—including children, elderly, persons with disabilities, zero-car households, and low-income and minority groups—face substantial challenges and transportation inequities in such a car-dominated culture.

In recent years there has been a growing recognition of the need to plan, design, and construct and maintain streets that meet the needs of all roadway users—that is, creating “complete streets.” The National Complete Streets Coalition has advocated for the adoption and implementation of state, regional, and local government complete streets policies. On April 24, 2009, Governor Jack A. Markell issued an executive order to create a complete streets policy for the state of Delaware. The Delaware Department of Transportation (DelDOT) subsequently adopted a policy to “promote safe access for all users, including pedestrians, bicyclists, motorists and [transit] riders of all ages to be able to safely move along and across the streets of Delaware.”<sup>1</sup>

The University of Delaware Institute for Public Administration (IPA) is working on behalf of DelDOT to research and develop a complete streets—implementation strategy for Delaware local governments. While DelDOT transportation planners and engineers are designing streets with all users in mind, Delaware towns and cities have authority for local plans and policies—which may not be consistent or compatible with the statewide complete streets policy. To address this issue, IPA is researching complete streets “best practices,” to help Delaware municipalities incorporate those principles within comprehensive plans, regulatory policies, community design guidelines and maintenance



guidelines. Local government officials will be able to learn about complete streets concepts via IPA's online Toolkit for a Healthy Delaware ([www.ipa.udel.edu/healthDEtoolkit/completestreets/index.html](http://www.ipa.udel.edu/healthDEtoolkit/completestreets/index.html)) a Delaware Planning Education Program workshop, and a written implementation guide.

The IPA research team consisted of IPA associate policy scientist Marcia Scott and two IPA graduate research assistants. Claire Beck (MA '11) analyzed comprehensive plans and subdivision regulations of several Delaware municipalities to determine the extent to which complete streets principles are evident and support multi-modal transportation goals of the state's policy. Brandon Rabidou (MPA '12) researched national complete streets best practices and created visual tools to help local governments make better policy decisions for the physical environment. He says,

“As a researcher, I think it is rewarding to know that this project takes local government education and training to the next level. Beyond a ‘useable’ implementation guide, we are providing an educational workshop, online strategies, and several before-and-after visualization examples using Google SketchUp (a computer aided design software). I am proud to be a part of IPA's role in improving the planning capacity and expertise of Delaware's local government officials. It's great to know that this project will positively affect the built environment of Delaware communities for many years to come.”

<sup>1</sup> State of Delaware. (2009). Executive Order Number Six—Creating a Complete Streets Policy. Retrieved May 11, 2011 via [http://governor.delaware.gov/orders/exec\\_order\\_6.shtml](http://governor.delaware.gov/orders/exec_order_6.shtml).

# Pedestrian Lighting Options & Roles of Responsibility within Unincorporated Delaware Communities

EDWARD J. O'DONNELL, AICP, THEODORE A. PATTERSON & RYAN GILLESPIE



The Institute for Public Administration's (IPA) Ed O'Donnell and Ted Patterson along with graduate research assistant Ryan Gillespie have been working with the Delaware Department of Transportation to research roles of responsibility and options for improving pedestrian lighting in unincorporated areas in Delaware.

This working paper reviews current practices in Delaware, explores topics and problems related to pedestrian street lighting, and provides a comprehensive set of recommendations and best practices for addressing pedestrian lighting in unincorporated areas of Delaware. This working paper also includes input and recommendations from a working group consisting of community representatives and government officials in Delaware who are impacted by and impacting pedestrian street lighting policy.



Pedestrian lighting is crucial to creating a safe, multimodal environment in Delaware. The National Highway Traffic Safety Administration (NHTSA) reported in 2009 that nationally "almost 70 percent of pedestrian fatalities occurred during the nighttime." Transportation infrastructure in Delaware is of vital importance as our state grows in the 21st century. To create a balanced approach to transportation infrastructure development, pedestrian, cyclist, bus transit, train transport, and automobile infrastructure must all be integrated into one interconnected network providing the public with attractive options for getting from point A to point B. Historically, transportation planners have been more effective at designing the network to serve automobiles, trains, and buses—neglecting the need to develop bicycle and pedestrian facility infrastructure. Forward thinking Delaware government officials are spearheading efforts to change course by developing and implementing bold new policies related to multi-modal transportation systems such as DelDOT's new Complete Streets Policy.

Moving forward Delaware officials will be charged with enhancing the multi-modal network, while also living within budgetary constraints and ever-present environmental concerns. Lighting systems that utilize green technology and energy efficient technology will not only improve the utility of our transportation system in Delaware, but lead the First State to a more sustainable future. Lighting infrastructure, just as road, water, and sewer infrastructure

must be given more consideration in the overall planning process as sidewalks and multi-modal paths become a commonplace component to the transportation network. Likewise, as mixed-use communities and vibrant downtown business districts continue to grow in the 21st century, more demand will be generated for night time use of sidewalks, bike paths, and multi-modal ways. Installing the infrastructure for lighting on the front end of the planning process better equips utility companies and government agencies to serve public demand for adequate lighting in the future. ■

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## Integrated transportation management systems: a new way forward in Delaware transportation planning

BY EDWARD O'DONNELL, AICP, WILLIAM DECOURSEY, AICP, THEODORE PATTERSON, ARTHUR WICKS, & ABU MUSED

Researchers Edward O'Donnell, AICP, William DeCoursey, AICP, and Theodore Patterson with the University of Delaware's Institute for Public Administration have been working with the Delaware Department of Transportation on a new development in transportation technology: ITMS. This project has also been supported by the work of UD Graduate Research Assistants Arthur Wicks and Abu Mused.

Congestion is increasing faster than capacity and both are extremely expensive. "Americans lose 3.7 billion hours and 2.3 billion gallons of fuel sitting in traffic."<sup>1</sup> Recent Delaware-specific figures suggest that drivers in the state's most congested areas each waste 59 hours and 36 gallons of fuel each year.<sup>2</sup> These substantial costs don't even take into



account the inestimable expense of lost productivity, environmental degradation, time not spent with family, or precious minutes lost in emergency response times.

According to the internationally renowned Victoria Policy Institute, a single lane-mile of highway in "difficult" (congested) areas can total \$2.5 million in construction costs alone.<sup>3</sup> Moreover, there is a growing consensus this is a race that cannot be won. The 2009 America's Infrastructure Report Card (American Society of Civil Engineers) offers these grades—Roads – D-, Transit – D, Bridges – C. It estimates \$2.2-trillion needs to be spent nationally in the next five years, up from \$1.6-trillion in 2005, to improve our aging national transportation infrastructure.<sup>4</sup>

Delaware is no exception. In 2011, the DeIDOT Transportation Task Force concluded that total spending for transportation expenses (2012 – 2023) can reasonably be estimated to total \$12.4 billion and that current Transportation Trust Fund revenue streams will support only 70% of those needs.<sup>5</sup> The evidence is compelling: we can't build our way out of congestion and couldn't afford to anyway.

Regardless, civically and politically involved citizens continue to demand more and, like all taxpayers, would prefer it be done with less. DeIDOT's 2009 Customer Satisfaction Survey<sup>6</sup> lists 1) highways free of congestion and 2) well-planned sequencing and timing of traffic signals as its most prevalent public concerns every year since 2001. Concerning transit, having information on when to expect delays was a top concern eight of nine years. A 2011 forum on ITMS at the University of Delaware suggested similar concerns—integration of land-use and transportation planning, more inclusive transportation impact studies, the design of "smart roads," and the improved delivery of real-time information to system users and emergency responders.

ITMS technology is the answer! From the dawn of the modern age, the vast majority of human improvements in efficiency are due to technology. From the cotton gin to the assembly line, the transistor to the smart phone, the application of innovative



solutions has seen efficiency increase exponentially. For example, Intelligent Freight Technologies, a precursor to ITMS, began to revolutionize the transportation industry in the 1990's. FHWA estimates savings of \$7,866 to \$15,222 per tractor-trailer per year.<sup>7</sup>

Today, DeIDOT estimates that an effective ITMS system in our state could reduce incident durations by 65%, reduce secondary accidents by up to 50%, mitigate congestion, save countless tons of fuel, and significantly reduce emissions. The Federal Highway Administration agrees. It uses congestion and reliability, incident management, customer satisfaction, and environmental impact as its universal performance measures for ITMS implementation.<sup>8</sup>

Moreover, ITMS is scalable, upgradable, and extremely flexible – all terms not typically associated with our nation's hard-infrastructure. Though it may not solve every problem, ITMS will be a significant part of the future of transportation for decades to come.

DeIDOT plans to meet this challenge with four core priorities—1) Expansion of the statewide computerized signal system to improve traffic flows, 2) Investment in electronic detection to identify trouble spots, inform roadway users, and speed up response teams, 3) Provide real-time information to customers, and 4) Enhance the transit schedule adherence and automated vehicle locator systems to provide transit users a predictable, understandable, and reliable experience. ■

<sup>1</sup> *Intelligent Transportation Systems for Traffic Incident Management*, USDOT

<sup>2</sup> *The Cost of Traffic Congestion in Delaware: The State's 25 Worst Traffic Jams and Needed Steps to Relieve Traffic Congestion* June 2007.

<sup>3</sup> *Transportation Costs & Benefits, Resources for Measuring Transportation Costs and Benefits*, TDM Encyclopedia Victoria Transport Policy Institute

<sup>4</sup> [www.infrastructurereportcard.org](http://www.infrastructurereportcard.org)

<sup>5</sup> *Report on Conditions, Planning and Revenue Options For Support of the Transportation Trust Fund*, Presented by Transportation Trust Fund Task Force, March 31, 2011, Delaware Department of Transportation

<sup>6</sup> *2009 Customer Satisfaction Survey Report*, State of Delaware Department of Transportation, AECOM, Oct., 2010

<sup>7</sup> *The Freight Technology Story: Intelligent Freight Technologies and Their Benefits*, FHWA, 2005

<sup>8</sup> *NCHRP Report 660, Transportation Performance Management: Insight from Practitioners*, 2010

## T<sup>2</sup> Center's Partnership with Bethany Beach Expands

In the summer of 2010, Bethany Beach's Director of Public Safety, Ralph Mitchell, asked the Delaware T<sup>2</sup> Center to look at speed and pedestrian safety issues along the beachfront streets of Pennsylvania Avenue and Atlantic Avenue. Our report made recommendations for speed limits, signs, pavement markings, safety brochures, and other considerations. That work, combined with our Asset Management presentations over the last two years, prompted Clifford Graviet (Town Manager) and Brett Warner (Public Works Director) to invite us back to talk about asset inventory.

As we met over the winter, a partnership of resources emerged that will yield a significant, up-to-date inventory of signs, sidewalks, fire hydrants, park benches, storm inlets and a host of other street elements that Bethany Beach can use to better manage its assets, determine cost effective approaches to maintenance and rehabilitation, develop annual and long term budget needs, and use for regulatory reporting.

Our early confidence with a new GPS hand held data collector (see the Spring 2011 Delaware T<sup>2</sup> Center newsletter) was infectious – Bethany Beach bought two of the same model to support both their transportation and water department data collection efforts. They then hired a University of Delaware undergraduate, Ryan Morrissey, to collect data this summer with the new instruments. The T<sup>2</sup> Center agreed to oversee and support the data collection effort and also lent the Center's retroreflectometer to collect sign retroreflectivity data.

The data collection effort is expected to be complete in mid-August and the T<sup>2</sup> Center expects to complete a supporting document to the Town of Bethany Beach

in the fall. The effort will yield immediate information about their transportation assets that will enable them to manage, budget, and maintain their system better going forward. Ryan's work will also provide a platform for them to maintain the database as changes are made in the future. Finally, the transportation asset collection has demonstrated to the Town the benefits of such data in other sectors, such as the Water Department or the Building Department.

We have and are enjoying our partnership with Bethany Beach, wherein we can use our combined resources to yield a new tool for them and demonstrate how asset management can benefit other municipalities and agencies throughout Delaware.



## T<sup>2</sup> Center Assists UD Facilities with Asset Mapping

Similar to the partnership with Bethany Beach, the Delaware T<sup>2</sup> Center has also embarked on a project to assist the University of Delaware Facilities Management team with asset inventory and mapping.

Roger Bowman, Manager of Facilities-Grounds Services, helped the T<sup>2</sup> Center structure a data assembly and collection effort that would greatly expand his department's ability to manage features like streets, parking lots, signs, curb ramps, and drainage facilities, as well as park benches and landscape areas.

Charles Mitchell, a recent UD graduate, spearheaded an exhaustive effort to locate existing map and data sources and develop a plan to fill data gaps with desktop computer resources like orthophotography and ARCGIS together with field data collection using the T<sup>2</sup> Center's new Trimble GPS data collector.

Ken Gablewski, Director of Facilities-Maintenance & Operations, and Michael Loftus, the Assistant Director for Facilities-Grounds, were briefed after some initial work to see if they had additional thoughts on how to make the project as robust as possible within our budget and time constraints. Both Ken and Mike agreed that the project would yield new tools for them and Roger to manage their assets, develop funding needs, and communicate aspects of the operations to internal and external stakeholders.

Charlie's work will end in August 2011 as he leaves UD for "the real world," but the project is larger than just this summer and the partnership will continue and evolve between the T<sup>2</sup> Center and UD Facilities for some time to come. The challenging project has helped the T<sup>2</sup> Center demonstrate a fuller range of data collection and mapping techniques than might have been otherwise possible, which will benefit our efforts for supporting Delaware municipalities, as well as our on-going relationship with UD Facilities.



# Research

Following are the projects approved by the DCT Policy Council for our FY12 Annual Research Program beginning on September 1, 2011 and ending August 31, 2012:

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## INTEGRATING ZERO-VALENT IRON AND BIOCHAR AMENDMENTS IN GREEN STORMWATER MANAGEMENT SYSTEMS FOR ENHANCED TREATMENT OF ROADWAY RUNOFF

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This project will evaluate two technologies involving the addition of biochar and/or zero-valent iron to existing and new stormwater facilities which will reduce nutrients from DelDOT stormwater discharges.

### Principal Investigators

Dan Cha and Paul Imhoff, Department of Civil and Environmental Engineering

### Project Manager

Marianne Walch, Maintenance and Operations

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## REDEVELOPING STANDARDS FOR DELAWARE TRANSIT CORPORATION (DTC) FIXED-ROUTE PERFORMANCE MEASURES

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The outcome of this project will be a series of standards and objectives for existing performance measures to gauge the transit system's quality of service.

### Principal Investigator

Maria Aristigueta, School of Urban Affairs and Public Policy

### Project Manager

Cathy Smith, Delaware Transit Corporation

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## EFFECTIVE COUNTERMEASURES FOR CRASH REDUCTION AT UNSIGNALIZED INTERSECTIONS FOR TWO-LANE UNDIVIDED ROADWAYS

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The goal of this research project is to improve the safety of motorists at unsignalized intersections on two-lane undivided roadways.

### Principal Investigator

Arde Faghri, Department of Civil and Environmental Engineering

### Project Manager

Adam Weiser, Traffic Division

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## DEVELOPMENT OF GRATE EFFICIENCY FACTORS FOR TYPE 1 INLET GRATE

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The efficiency of a grate at intercepting runoff is critical to the success of the roadway drainage system. This project will review the interception flow efficiencies in order to update the Road Design Manual.

### Principal Investigator

Nobu Kobayashi, Center for Applied Coastal Research

### Project Manager

Jim Pappas, Materials and Research

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## SENSOR FUSION FOR TRAVELER INFORMATION SYSTEMS AND 511

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The project's goals are to develop a data fusion system for link speed and travel time based on best methods and available algorithms which utilize current and future detection systems for support of 511.

### Principal Investigator

Rusty Lee, Department of Civil and Environmental Engineering

### Project Manager

Gene Donaldson, Traffic Management Center

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## DESIGN AND CONSTRUCTION OF A GEOSYNTHETIC REINFORCED SOIL (GRS) INTEGRATED BRIDGE SYSTEM (IBS) IN THE STATE OF DELAWARE

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This demonstration project will provide

the necessary technical expertise to the design, construction, and long-term inspection process that can be used to enhance implementation of this technology in Delaware.

### Principal Investigator

Chris Meehan, Department of Civil and Environmental Engineering

### Project Manager

Jim Pappas, Materials and Research

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## IMPLEMENTATION OF CONTINUOUS COMPACTION CONTROL (CCC) SYSTEMS IN FIELD CONSTRUCTION

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This project will provide tools and technical expertise to aid the transition of CCC from pilot-scale to widespread use on active construction projects throughout Delaware.

### Principal Investigator

Chris Meehan, Department of Civil and Environmental Engineering

### Project Manager

Jim Pappas, Materials and Research

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## DEVELOPMENT AND EVALUATION OF A RESIDENTIAL ALLOCATION MODEL USING TIME SERIES TAX PARCEL DATA, PART II

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Continuation of FY10 project – a state-wide tax parcel based land use file is created to support transportation applications and travel demand forecasting in particular.

### Principal Investigator

David Racca, Center for Applied Demography and Research

### Project Manager

Mike DuRoss, Division of Planning

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## EXAMINATION OF THE RELATIONSHIP BETWEEN TRAFFIC COUNTS, LOOP OCCUPANCY, SPEED, AND CAPACITY

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This project will investigate the relationships between traffic volume, travel speed, travel time, signal loop occupancy, and capacity using a range of data specific to Delaware.

### Principal Investigator

David Racca, Center for Applied Demography and Research

### Project Manager

Gene Donaldson, Traffic Management Center

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## NON-DESTRUCTIVE TESTING METHODS TO EVALUATE THE INTEGRITY OF CONCRETE BRIDGE DECKS

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This research project will evaluate non-destructive testing procedures to help assess the current condition and quantify the extent of deterioration of concrete bridge decks.

### Principal Investigators

Thomas Schumacher and Dennis Mertz, Department of Civil and Environmental Engineering

### Project Manager

Jiten Soneji, Bridge Design

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## MOVING FROM COMPLETE STREETS TO COMPLETE COMMUNITIES IN DELAWARE

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The scope of this work will include researching complete community best practices, developing an evaluation framework for local governments, surveying Delaware municipalities, and hosting a working group meeting.

### Principal Investigator

Marcia Scott, Institute for Public Administration

### Project Manager

Ralph Reeb, Division of Planning

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## 2011-2012 GPS TRAVEL TIME AND DELAY DATA COLLECTION AND ANALYSIS

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This project entails data collection during peak travel times on roadway

[Continued on next page]

segments throughout the state. Each segment will be traveled at least four times for maximum accuracy. Once data collection is completed, data will be transformed into the GIS database and transported to the ARCGIS software.

#### **Principal Investigator**

Arde Faghri, Department of Civil and Environmental Engineering

#### **Project Manager**

Mark Eastburn, Division of Planning

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#### **CROSS-FRAME FORCES IN SKEWED STEEL I-GIRDER BRIDGES, YEAR 2**

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This research will assess the ability of bridges in Delaware to withstand strikes by overheight trucks and also identify critical bridges that need immediate reinforcement to prevent catastrophic failure if hit by a truck.

#### **Principal Investigator**

Jennifer McConnell, Department of Civil and Environmental Engineering

#### **Project Manager**

Jiten Soneji, Bridge Design

## Continuing active research projects sponsored by DeIDOT

As each project is completed, an abstract will be available on the DCT website: [www.ce.udel.edu/dct](http://www.ce.udel.edu/dct).

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#### **STUDY AND CALCULATION OF TRAVEL TIME RELIABILITY MEASURES**

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Travel time reliability is a better way to assess system performance and it is important especially for shippers, freight carriers and public safety personnel as well as other users.

#### **Principal Investigator**

David Racca, Center for Applied Demography and Survey Research

#### **Project Manager**

Gene Donaldson, Transportation Management Center

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#### **NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM (NPDES) AND NONPOINT SOURCE POLLUTION**

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This project will help DeIDOT and other permit holders meet the goal of educating the general public about pollution from runoff required by state laws.

#### **Principal Investigator**

Martha Narvaez, Institute for Public Administration

#### **Project Manager**

Marianne Walch, Maintenance and Operations

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#### **USE OF RECLAIMED ASPHALT PAVEMENT (RAP) TO REDUCE PAVEMENT THICKNESS**

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The main objective of this project is to develop protocols and methods of using RAP filled geocell in full depth pavement thickness, through field studies.

#### **Principal Investigators**

Dov Leshchinsky and Nii Attoh-Okine, Department of Civil and Environmental Engineering

#### **Project Manager**

Jim Pappas, Materials and Research

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#### **NEAR REAL-TIME MONITORING OF INDIAN RIVER INLET SCOUR HOLE EDGE EVOLUTION SEAWARD OF THE BRIDGE PIERS: PHASE II**

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Bridge pier scour is a problem that occurs in riverine and tidal environments. Funding for this project will be used to install a monitoring system that will image the seabed adjacent to the bridge piers. Additionally, current meter data will yield critical forcing conditions that can be related to scour hole variability. The resulting data can be used to make informed management decisions and develop appropriate plans of action.

#### **Principal Investigator**

Jack Puleo, Center for Applied Coastal Research

#### **Project Manager**

Doug Robb, Bridge Design

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#### **DELAWARE TRANSPORTATION OPERATIONS MANAGEMENT PLAN – NEW CASTLE COUNTY**

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This project, working collaboratively with AECOM, will provide data collection, traffic engineering analysis and transportation system performance analysis to update the county-specific TOMP to reflect current conditions.

#### **Principal Investigator**

Rusty Lee, Department of Civil and Environmental Engineering

#### **Project Manager**

Gene Donaldson, Transportation Management Center

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#### **DELAWARE SIGNAL TIMING ENHANCEMENT PARTNERSHIP (DSTEP)**

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The goals of the DSTEP project are to involve students in traffic engineering services for DeIDOT, to develop a continuous research program that addresses DeIDOT's needs while minimizing the use of DeIDOT's resources, and to maintain a high level of quality so that DeIDOT may apply the results to improve intersection operations across the state.

#### **Principal Investigator**

Rusty Lee, Department of Civil and Environmental Engineering

#### **Project Manager**

Gene Donaldson, Transportation Management Center

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#### **INSTRUMENTATION AND MONITORING OF THE INDIAN RIVER INLET BRIDGE**

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This project involves installing a long-term structural health monitoring (SHM) system on the Indian River Inlet Bridge during its construction and monitoring the bridge through the first bi-annual inspection. Following this installation, DeIDOT will be able to understand how the as-built bridge is functioning and through long-term monitoring, will be in a better position to efficiently and effectively manage this significant resource. (Ending 6/30/2012)

#### **Principal Investigators**

Tripp Shenton and Michael Chajes, Department of Civil and Environmental Engineering and College of Engineering respectively; Robert Hunsperger, Electrical and Computer Engineering

#### **Project Manager**

Doug Robb, Bridge Design

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#### **ITS LAB BASELINE SERVICE FY11**

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The objectives of this project is to establish the Delaware Center for Transportation ITS Lab as a state of the art facility with three main focus areas: 1) service to DeIDOT; 2) training for DeIDOT and support classroom instruction; and 3) research for faculty and students.

#### **Principal Investigator**

Rusty Lee, Department of Civil and Environmental Engineering

#### **Project Manager**

Gene Donaldson, Transportation Management Center

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#### **LONG-TERM PERFORMANCE MONITORING OF A RECYCLED TIRE EMBANKMENT IN WILMINGTON, DELAWARE**

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This is a continuation of a one-year project requiring additional data analysis. This project will determine the environmental and engineering properties that should be monitored during the construction of shredded tire embankments including instrumentation, installation, monitoring and an analysis plan. The project will investigate what instruments are needed and how to construct plus monitor them. Delaware summer temperatures will be taken into account.

#### **Principal Investigators**

Nii Attoh-Okine, Paul Imhoff, Victor Kaliakin and Chris Meehan, Department of Civil and Environmental Engineering

#### **Project Manager**

Jim Pappas, Materials and Research

# Research Pays Off: The Delaware Travel Monitoring System

BY MIKE DUROSS, PLANNER, DELDOT PLANNING

The Delaware Travel Monitoring System (DTMS) is a monthly, statewide travel survey conducted by the University of Delaware's Center for Applied Demography and Survey Research (CADSR) since 1997 on behalf of the Delaware Department of Transportation. The survey uses a "computer assisted telephone interviewing" (CATI) technique through which the typical daily travel routines and behaviors of household members are identified by CADSR staff. The research now includes over 40,000 trips in the comprehensive database.

This data is important for periodically updating key elements of the DelDOT Peninsula travel demand model (currently implemented using CUBE Voyager 5.1.3 and VISUM 11.5) including trip generation rate equations, trip length frequency distributions, and traveler origin-destination patterns. The data generated by this ongoing project has been used to support several DelDOT transportation studies, is used by WILMAPCO and the Dover/Kent MPO as one of their sources for travel trend reporting, and has provided a research platform for several DCT projects over the years.

DTMS data supported development of DelDOT's Peninsula travel demand model in 2004 and was integral for significant model updates completed in 2005, 2007, 2008, and 2010. Those models, in turn, have supported scenario analysis and air quality

modeling for the WILMAPCO and Dover/Kent MPO long range plans and transportation improvement programs (TIPs) during that period, as well as major planning efforts undertaken by DelDOT including studies of the US 301 and US 113 corridors.

The DTMS research has certainly "paid off" as it has provided detailed information on the travel patterns in Delaware through a cost effective, time-efficient process. The amount and quality of data provided compares extremely well with that collected in other states and regions through more traditional (but often considerably more expensive !) roadside interview or mailback survey methods. Examples of the detailed data which have been included in DelDOT's model via the DTMS method:

- 1) The addition of a special, distinct "trip purpose" focusing on so-called Home-Based Regional Shopping trips associated with major shopping malls in Delaware.
- 2) The revision of Non-Home Based Trip Types allowing better identification of "linked" trips such as convenience shopping and day-care drop offs/pick ups normally done "on the way" to work or home as part of major trip making activities.
- 3) The addition of a Home-Based Recreation trip type focusing on state parks, the Delaware seashore, and other recreational locations.

Peninsula Model Cross-Classification Table

HBW

Trip Rates		Household Size				Average Rate
		1	2	3	4*	
Workers	0	0.034	0.118	0.500	0.500	0.103
	1	1.304	1.304	1.420	1.420	1.340
	2		2.701	2.588	2.711	2.679
	3*			3.641	4.204	3.965
Average Rate		0.618	1.538	2.232	2.501	1.600

DEPARTMENT OF TRANSPORTATION  
WR&A

Figure 1. Sample of cross classification data generated through analysis of DTMS data.

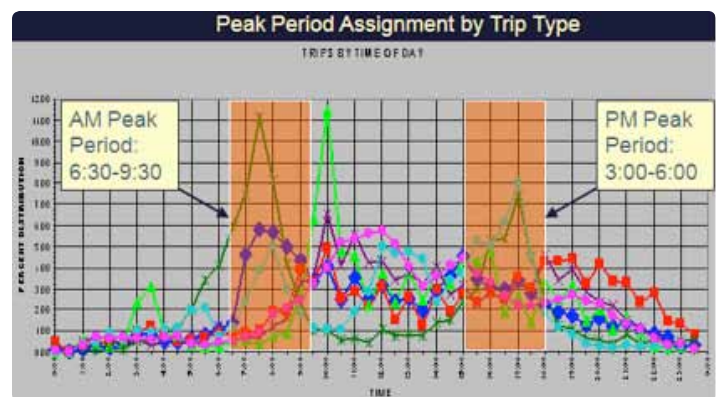


Figure 2. Peak Period Travel by Time of Day and Trip Purpose.

An example of the type of data generated through the DTMS research is shown in the table above. This is a cross classification table illustrating household trip rates stratified by number of workers and number of persons in the home. Such a trip generation table is preferred because it allows travel models to account for variations in household composition which can affect the number, length, and purpose of trips throughout a typical day.

A second example of the traveler data collected through DTMS is shown in

Figure 2, which conveys general trip making for each hour of a typical day. Although similar to a 24-hour diurnal traffic count, this example is more detailed in that hourly travel patterns are identified for each trip purpose such as work, shopping, and mall-related shopping, thus allowing more detailed travel patterns to be included in the models used to study land use and transportation issues in Delaware.

For more information on the DTMS please contact Mike DuRoss at 302-760-2110. ■

## Addressing Winter Pedestrian Accessibility Issues in Delaware

BY MARCIA S. SCOTT

"Slip-sidin' away..." It may bring to mind great song lyrics by Paul Simon, but it can also evoke bad memories for those who tried to navigate treacherous sidewalks after a winter snowstorm! While 2009 National Household Travel Survey statistics reveal that only about 10 percent of Americans over the age of 16 walk to work, it doesn't account for nearly one-third of the non-working population are unable to drive or don't own cars. While automobile travel is the predominant transportation mode for the majority of Americans, often overlooked is the fact that most trips start by walking. Slick and snowy sidewalks are problematic for all pedestrians, but can pose mobility, accessibility, and transportation justice issues especially for persons with disabilities, children walking to school, commuters on foot to public transit stations, and older adults who no longer drive.

Maintaining continuously accessible pedestrian pathways is essential, but often problematic for several reasons. In many cases, confusion exists over which entity or property owner is responsible for clearing snow from a sidewalk. If regulated through a local law, a jurisdiction may fail to adequately communicate ordinance requirements, regularly inspect sidewalks, and/or enforce compliance. Shoveling snow from sidewalks may be a hit or miss proposition in communities where there are seasonal residents, a high number of rental properties, or business districts with vacant stores. Many jurisdictions are not aware that the Americans with Disabilities Act (ADA) requires public entities to not only address the need for accessible pedestrian facilities, but to also maintain those features "in working order" once installed. In addition to snow- and ice-laden sidewalks being unsafe and inconvenient for pedestrians, they can also discourage people from walking and leading healthy lifestyles.

The Institute for Public Administration (IPA) at the University of Delaware (UD) recently tackled the issue of winter pedestrian accessibility in Delaware on behalf of the Delaware Department of Transportation (DelDOT). The project team was lead by IPA policy



scientist Edward O'Donnell, AICP and associate policy scientist Marcia Scott, with assistance from IPA graduate research assistant Brandon Rudd (MA '12), and public service fellows Lauren Cutajar-Wynne (BA '11) and Hilary Primack (BA '13).

There were three primary components of research. "Best practice" sidewalk snow removal policies and strategies were studied in Snow Belt regions of the United States to determine how they may inform practices in Delaware. Information was also obtained from Delaware local governments for a matrix, which compares sidewalk snow removal regulations, enforcement, penalties for non compliance, communication methods, and citizen assistance programs. A unique aspect to the project was field observations in Delaware cities and towns before and after major January 2011 snow events. Brandon Rudd notes, "During the field observations it became very apparent that snow was inconsistently cleared from sidewalks, curb ramps, crosswalks, and other essential pedestrian infrastructure. Other issues, which were universally shared by Delaware jurisdictions, included timeliness of snow removal, clearing to a width that accommodates wheelchairs, and gaps in connectivity. My initial thought was that intergovernmental cooperation and sharing of policies, procedures, and techniques would be extremely helpful in Delaware."

IPA also formed a working group of about 30 individuals that included representatives from DelDOT, state and local governments, public works departments, metropolitan planning organizations, and UD. On April 6, 2011, the working group met at the UD Perkins Student Center to provide feedback on research to the IPA research team, share perspectives on how to address sidewalk snow removal issues in Delaware, and formulate project recommendations.

It is hoped that IPA's research will elevate the recognition that walking is not only a basic human activity, but a sustainable transportation mode. Walking should not be regarded as a fair-weather activity. Accommodating pedestrians in all weather conditions needs to be addressed in state, regional, and local government transportation, circulation, maintenance, and emergency operations plans. Public entities need to clarify and better coordinate sidewalk snow removal responsibilities. The timely clearing of sidewalk snow can be improved by clarifying and better coordinating responsibilities, enhancing citizen outreach, consistently enforcing local regulations, and assisting disabled or elderly property owners. ■

**The mission of the Delaware Center for Transportation is to improve the movement of people, goods, and ideas, and be viewed as a valuable resource for transportation-related issues and challenges within the state, the mid-Atlantic region and beyond.**

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Sue McNeil

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University of Delaware College of  
Engineering communications team

## Director's Message

This is our fifth and final year as the University of Delaware University Transportation Center. We have awarded our fifth round of research projects, and our fourth group of UTC Fellowships. This is our final year, as the UTC program is changing. Through emails and an announcement in the Federal Register, the Research and Innovative Technology Administration (RITA) has issued a "Notice of Competition for University Transportation Centers (UTC) Program Grants." The competition is expected to follow the guidelines presented in the President's 2012 budget (see "Competitive University Transportation Center (UTC) Consortia" in [http://www.rita.dot.gov/publications/budget\\_estimates/fy2012/html/research\\_development\\_allocation\\_reimbursable\\_other.html](http://www.rita.dot.gov/publications/budget_estimates/fy2012/html/research_development_allocation_reimbursable_other.html)), summarized as follows:

*RITA plans to make grants to eligible nonprofit institutions of higher learning to establish and operate up to twenty university transportation center consortia in the amount of \$4,000,000 each for FY2011.*

*Consortia must have at least two universities and no university can participate in more than one consortium. Consortia are also expected to address key USDOT priorities in terms of strategic goals, diversity, international collaboration, and multi-state consortia. The strategic goals are safety, economic competitiveness, environmental sustainability, state of good repair, and liveable communities.*

Needless to say, we have been assessing our strengths, talking to potential partners and reviewing opportunities. The request for proposals is expected soon, and we are aiming to be well-prepared as active participants in a winning consortium. In the meantime, there are important research ideas to be pursued, interesting transportation problems to be solved, students to be taught, and research results to share and implement. We have a busy year ahead!

In this issue of our newsletter we showcase some of our students' accomplishments and activities, provide summaries of the most recent projects, review the distinguished lectures and brown bag seminars presented this fall and describe an exciting project funded by the U.S. Chamber of Commerce Foundation that serves as UTC matching funds.

Finally, we have four brown-bag seminars slated for the fall semester. Specific dates, times and locations will be posted on the UTC website. In the meantime, browse through the projects and explore the work done by the students and researchers.

**Sue McNeil**  
Professor, Department of  
Civil & Environmental Engineering

## Congratulations to our May 2011 Graduates!



**Michelle Oswald answers questions during her dissertation defense.**

### CIVIL ENGINEERING UNDERGRADUATES

**GEOFF DILG** (Hons) (Undergraduate Researcher, Summer 2010)

**ELISA KROPAT** (Undergraduate Researcher, Summer 2010)

**LAUREN LOBO** (Undergraduate Researcher, Summer 2009)

### SPPA MA

**MICHELLE OSWALD** (Research Assistant and UTC Fellow, 2007-2011);  
Analytical Paper: "Evaluation of Climate Change Adaption Tools for Transportation and Land Use Planning;"  
Advisor: Sue McNeil

### CIVIL ENGINEERING MCE:

**LAURA BLACK** (Research Assistant, 2008-present); Advisor: Earl (Rusty) Lee

**TREVOR BOOZ** (Research Assistant and UTC Fellow, 2009-2011);  
Thesis: "Modeling the Effects of Removing Motorized Vehicle Lanes to Create Space for Bicycle Facilities: A Case Study of MLK Drive, Philadelphia, PA;"  
Advisor: Earl (Rusty) Lee

**CHARLES MITCHELL** (Research Assistant and UTC Fellow, 2009-2011);  
Thesis: "Impact of the Expansion of the Panama Canal: An Engineering Analysis;" Advisor: Earl (Rusty) Lee

**DUNG NGO** (Research Assistant, 2009-2010); Thesis: "The Impacts of I-95 Closures on Traffic and Air Quality;" Advisor: Earl (Rusty) Lee

### CIVIL ENGINEERING PHD

**MICHELLE OSWALD** (Research Assistant and UTC Fellow, 2007-2011);  
Dissertation: "Development of a Decision Support Tool for Transportation Adaption Practices in Response to Climate Change;"  
Advisor: Sue McNeil

## Transportation Engineers "Ride the Rails"

Willem Ebersöhn's guest lecture in CIEG655 Civil Infrastructure Systems in the Fall of 2010 and the UTC Distinguished lecture in May made many of us eager to get out into the field and see how Amtrak collected data. When Willem offered to organize a trip to New York city on Amtrak's track geometry car, there was an enthusiastic response. On a rainy Tuesday in April, a group of faculty, staff and students gathered at the newly renovated Joseph R. Biden Jr. railroad station in Wilmington to join Amtrak personnel in the track geometry car as part of train 184 from Washington DC to New York and then returning as part of train 129.

While the track geometry car runs from Washington DC to Boston and return as part of a regular operations once a month, this run was testing new software. The track geometry car is a specially outfitted car with cameras, sensors, computing and data storage. The car operates as the last car of an in-service train. In addition to

track geometry, the sensors on the car record the rail profile and video the track. Areas of concern are flagged in real time and correlated with previous runs to help develop work plans. The data is used to not just keep the operations safe but to support an effective asset management plan for Amtrak.

The track geometry car is equipped with large screen displays of the track and data, and large viewing windows out the rear of the train. We were all quite mesmerized by the rear facing unobstructed view of the tracks as the train passed over the lines.

Our Amtrak hosts not only told us a lot about the operations of the track geometry car but the challenges of running a railroad. A good day was had by all and we look forward to doing this again!



**Matt Carter, T<sup>2</sup> Engineer** chats with the Amtrak's manager of the track geometry program.

"Riding the Rails" from left to right: Nii Attoh-Okine, Matt Carter, Michelle Oswald, Mike Trosino (Amtrak), Sara Patterson, Chuoran Wang, Laura Black, Charles Mitchell, Sizheng Li, Trevor Booz, Palm Apivatanagul, Du Zhang and Sue McNeil

## Spring UD-UTC/ DCT Distinguished Lectures

### SUSTAINABLE MOBILITY AND MOBILITY JUSTICE

Mimi Sheller, Director of the Center for Mobilities Research and Policy at Drexel University presented a UD UTC Distinguished Lecture on February 28, 2011. Dr. Sheller introduced the concepts of motility – the potential for movement and mobility including people, goods and information - and mobility justice as an integral part of sustainability.

Dr. Sheller presented three examples – Songdo City (South Korea), New Orleans and Haiti to demonstrate that vulnerability stems from uneven and inequitable mobility systems and these are unsustainable and unjust. Songdo City is a “new” city built to support an airport. These cities provide uneven access to network capital. When Hurricane Katrina hit New Orleans it demonstrated the impacts of immobility and the impacts of forced migration. Finally, Haiti relied on the airport for access after the earthquake hit but this presented a barrier as people coming into and out of the country had to pass through many steps.

Dr. Sheller also emphasized the importance of connecting past experiences with a different future. She said “While we might recognize the links between mobility and sustainability as they relate to auto mobility, we need to begin to recognize the role they also play in air mobility.” Todd O’Boyle, a PhD student



**Professor Mimi Sheller delivers a UD-UTC/ DCT Distinguished Lecture.**

in the School of Public Policy and Administration, who invited Dr. Sheller to campus, said “Dr. Sheller’s research provides a great window into how many different research areas like disaster management, transportation planning, and social justice coincide. Her work shows that sometimes the relationships are not apparent at the surface level, but are nevertheless quite profound.”

Mimi Sheller is Professor of Sociology and Director of the Center for Mobilities Research and Policy at Drexel University. She is also Senior Research Fellow and former co-director of the Centre for Mobilities Research at Lancaster University, UK and founding co-editor of the journal *Mobilities*.

### ASSET MANAGEMENT AT AMTRAK

Dr. Willem Ebersöhn, Program Director for Engineering Systems at Amtrak, offered a glimpse on March 15 into the current strategies being used by Amtrak to maintain and improve service on one of the busiest high speed rail lines in the nation, the passenger service between Boston and Washington, DC.

Beginning with a short video which gave attendees an overview of Amtrak operations, Dr. Ebersöhn shared the challenges of intercity travel on the northeast corridor.

These include operating complexities, maintenance of assets, and revenue generation on a multiuse rail line. With comparisons to trains in Europe and Asia, it was clear that in sharing the rails with heavy haul freight, the company must balance its schedule with those of other users such as CSX and Norfolk Southern. To move passengers from one location to another, there has to be coordination of the mechanical systems (trains and track), signal system (switches and relays), staff resources (ticketing agents and crew), electrification of the pantograph, and dispatching system. “All of these systems support the train service provided; transportation is the asset that Amtrak sells,” he said.

Dr. Ebersöhn’s current research involves integrating the management systems at Amtrak. There may be many separate incidents occurring throughout one train service, perhaps caused by a mechanical system, perhaps a planned activity. This information, combined with customer feedback and experiences, provides data for management staff at the company – the goal is to transform the data into information which will increase operational and financial performance.

Dr. Willem Ebersöhn is the Engineering Lead in the Amtrak Strategic Asset Management (SAM) Project. Prior to joining Amtrak at the end of 2000 he worked at the University of Pretoria for 14 years as Professor in the Faculty of Engineering. For all thirty-two years of his professional career, Dr. Ebersöhn has either been teaching railway engineering or researching solutions to rail problems. He has published 13 accredited papers in professional journals and 19 conference papers.

## UD-UTC Graduate Fellows

Erik Archibald, Matthew Becker, Elisa Kropat, Lauren Lobo, Mindy Laybourne, and Arthur Wicks have been selected to receive the 2011-2012 UD-UTC Graduate Fellowships. The fellowships are awarded to students pursuing master’s and PhD degrees in areas of relevance to the theme of the UD-UTC; selection is based on academic qualifications and relevance to the UDUTC theme and goals. Archibald, Becker, Lobo and Wicks received full UTC Fellowships covering graduate

school tuition, a stipend of \$2000 per month for 12 months, beginning September 1, and a \$1000 allowance for travel and supplies and a \$1500 allowance for computing. Kropat and Laybourne will receive partial fellowships covering travel and computing.

Erik Archibald is a first year MS student in the Disaster Science and Management Program. He graduated this spring with a degree in Civil Engineering from Brigham Young University. Erik will be working with Sue McNeil

Matthew Becker, Elisa Kropat, Lauren Lobo and Mindy Laybourne are first year students in the MCE

program in Civil Engineering. All four students graduated with a BS in Civil Engineering in May. Both Elisa and Lauren worked as undergraduate researchers during the summer of 2009 and 2010 respectively. Matt will be working with Chris Meehan. Elisa, Lauren and Mindy will be working with Rusty Lee.

Arthur Wicks is a second year MPA student in the School of Policy and Public Administration. He graduated in 2010 from University of Delaware with a major in history and a minor in political science.



# 2011–2012 Projects

Five projects were selected for funding as part of the 2011–2012 UTC research projects. Three projects are continuations of projects funded in 2011 and 2012 and two are new projects. These projects involve two colleges and three departments, and engage both graduate and undergraduate students.

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## THE EFFECTS OF LEARNING THROUGH THE ARTS ON TRANSPORTATION KNOWLEDGE AND SKILLS OF ELEMENTARY SCHOOL STUDENTS, UNIVERSITY STUDENTS AND CLASSROOM TEACHERS – PHASE 3

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### Principal Investigator

Lynnette Overby, Theater

The purpose of this study is to enhance knowledge of geographic concepts, particularly transportation, through the lens of dance and theatre. Students and their teachers will gain knowledge through an interdisciplinary approach that combines the teaching of geography with the arts. This project will benefit current and future educators, artists, and geography researchers. The participants will include 4th and 5th grade students attending elementary school in Newark, Delaware, their teachers, and University of Delaware students with expertise in the arts and geography.

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## INVESTIGATION OF LOAD-PATH REDUNDANCY IN AGING STEEL BRIDGES – PHASE 2

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### Principal Investigators

Jennifer McConnell

A key factor affecting the resiliency of transportation infrastructure is aging. Furthermore, the current age of the nation's transportation infrastructure relative to the financial resources available for infrastructure investments causes aging to be one of the biggest challenges facing civil engineers in the coming years. As a result of these demands, the project entitled "Investigation of Load-Path Redundancy in Aging Steel Bridges" was initiated in 2010 to systematically quantify the actual system capacity of steel bridges as a function of deterioration of the concrete bridge deck. The aim of the proposed work is

extend these results into a rating procedure that can be readily applied by bridge owners. This will be accomplished by first incorporating the influences of load path redundancy into the existing AASHTO rating format and then refining this approach based on the aging effects that were quantified in Phase 1. The ultimate result of the project is a systematic and quantified procedure that will allow the aging structures that are in greatest need of rehabilitation or replacement to be better identified.

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## RESILIENT CARTOGRAPHY: USING INTERACTIVE ONLINE MAPPING TO REPRESENT CORRIDOR (AERO)MOBILITIES – PHASE 2

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### Principal Investigators

Doug Tuttle; Graduate Research Assistant:  
Geoff Edwards

Most maps that influence our everyday mobility decisions privilege representations of space over those of time. Maps and cartograms providing spatiotemporal information are used primarily to identify and track patterns of change in the past and predict future occurrences in the future. But they also have potential for use by transportation researchers and the traveling public. New approaches to corridor resilience require innovative cartographic approaches that call attention to the time travel takes.

This project proposes to implement two such approaches to create two sets of maps for use by corridor airport users, transportation policy – makers and regional researchers. The purpose of the first set of maps is to reinforce and demonstrate the idea that travel-duration within urban areas throughout the corridor network is highly contingent on mode and location. The second set of maps demonstrates

## Brown Bag Seminars – Spring 2011

### MARINE HIGHWAYS – AMIT MOKASHI - MARCH 24

Amit Mokashi reported on preliminary survey results to determine the influence of marine transportation stakeholders in prioritizing voluntary environmental actions. Stakeholders include regulators, marine highway operators, shippers, suppliers and environmental advocates. The survey results suggest that no stakeholders stand alone – each group is influenced by and influences other stakeholders. Based on ten attributes including emissions, garbage, wake, sewage, noise and erosion, voluntary actions such as liquefied natural gas, speed reduction, scrubbers and onshore garbage disposal are prioritized.

### MAPS OF TIME AND CORRIDOR TEMPORALITIES - GEOFF EDWARDS - APRIL 5

Put a map in front of a group of transportation junkies, researchers, and students (the typical UTC brownbag audience) and you will generate lots of comments and opinions. In presenting the brownbag on "Maps of Time and Corridor Temporalities" in April, Geoff Edwards walked us through the concepts that we try to present in maps, examples of counter mapping and critical cartography before presenting the concept of travel time maps. The maps have many different uses: maps to play with, maps to help with the access and the interpretation of data, and maps to give us new ways to look at data. Needless to say the presentation generated much discussion and new ideas for Geoff to explore in his research!

### NACTO URBAN BIKEWAY DESIGN GUIDE – TREVOR BOOZ - APRIL 26

In March 2011, the National Association of City Transportation Officials (NACTO) released the NACTO Urban Bikeway Design Guide. This guidebook for bicycle facilities includes bike lanes, cycle tracks, intersections, signals and signs and markings. The

*[Continued on next page]*

*[Continued on next page]*

the change over time in the relationship of the corridor to domestic and international aeromobility networks. Based on these maps, the project will develop and report on cartographic methods for representing uneven (aero)mobilities and the relative position of corridor transportation nodes to one another as well as to those at the national and global scales.

As the second phase of a UD-UTC project, the proposed project builds upon and extends the cartographic methods of Phase I to account for nested scales, more variable and historical-data interactivity, thereby providing a richer illustration of the rapidity and redundancy properties of regional resiliency.

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#### DEVELOPMENT OF RAPID ASSESSMENT TOOLS FOR STRUCTURAL PARTS AFTER EXTREME EVENTS USING STRESS WAVE METHODS

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##### Principal Investigators

Thomas Schumacher and Nii Attoh-Okine

Recent extreme events such as earthquakes and hurricanes have shown the need for improved rapid structural assessment tools. It has been recognized that successful recovery missions greatly rely on the reliability and safety of the existing transportation infrastructure. In particular, bridges represent crucial parts of an infrastructure network and authorities need to know whether they can rely on the bridges that survived an extreme event in order to plan their recovery missions. This research will develop tools for rapid inspection of critical structural parts after extreme events using stress wave methods. Tests on small steel parts in conjunction with numerical stress wave simulation will be used to establish quantitative analysis tools that can objectively detect flaws. The developed tools will increase the resilience of the infrastructure after an extreme event and enable a faster recovery.

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#### RESEARCH OF TRANSPORTATION POLICY ISSUES FOR LOW-COST, INTERCITY EXPRESS BUS INDUSTRY WITHIN THE NORTHEAST CORRIDOR

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##### Principal Investigator

Marcia Scott

Intercity bus service is now the fastest growing mode of intercity transportation in the United States – outpacing air and rail transportation. However, despite the rapid growth in this mode of transportation, intercity bus industry operations raise a number of policy questions as well. Transportation policy issues that need to be studied include the industry's unregulated environment, lack of intermodal linkages, operating inconsistencies among carriers, level of service vs. demand for service, impact on federally-supported transportation modes and competition among other intercity modes within the Northeast transportation corridor. Because intercity bus travel is important to the resiliency of the Northeast corridor and the overall transportation network, it merits further attention and discourse among transportation planners, stakeholders and policy makers.

The objective of this project is to research transportation policy issues for the low-cost, intercity express bus industry within the Northeast corridor – from Washington, D.C. to New York City. To accomplish this objective, research tasks include conducting a literature review and data collection on the intercity bus industry, a field assessment of curbside operations in the Philadelphia metropolitan areas, and a workshop of stakeholders. Research results will be summarized in a hard-copy and online-briefing paper.



Charlie Mitchell delivers a brown bag seminar.

guide draws on the state of the practice in cities throughout the US over the past decade. Drawing on the guide (<http://nacto.org/cities-for-cycling/design-guide/>) and personal experiences, UTC Fellow Trevor Booz provided an introduction to the guide that not only provided exposure to this new resource but showed examples of innovative bicycle facilities to support, encourage and make safer bicycling as a mode of transportation.

#### IMPACT OF THE EXPANSION OF THE PANAMA CANAL: AN ENGINEERING ANALYSIS - CHARLES MITCHELL - APRIL 28

The rhetoric related to expansion of the Panama Canal often seems ungrounded in either good policy analysis or sound engineering. With completion expected by 2014, a new class of container ships will be able to utilize the expanded capacity of the present lock and lake system. These container vessels will be more than twice the size of vessels capable of transiting the canal prior to the expansion completion. With these larger ships come more shipping containers per ship and a new set of challenges for U.S. East Coast ports. The effects the expansion of the Panama Canal will have on U.S. East Coast and Gulf Coast ports are explored through three research questions:

- What is the existing transfer of containerized freight from the West Coast to the East Coast?
- What are the tradeoffs between the all water route to the East Coast and the intermodal route via the West Coast?
- How will the expansion of the Panama Canal affect port operations for East Coast ports?

The research indicates there is not a significant freight movement from the West Coast to East Coast that is going to create a significant shift after the canal expansion. The largest impact is expected to be larger container ships calling on ports less frequently which will create new operational challenges for ports to consider when planning for the future.

Attendees enjoyed the simulation model of the port of Savannah, Georgia.



# Measuring Transportation Infrastructure Performance for the United States

U.S. transportation infrastructure is understood to be the foundation for economic health and competitiveness. However, no study has taken a comprehensive, quantitative look at infrastructure performance over time. Most of the past studies have focused on trying to correlate infrastructure expenditure rather than infrastructure performance with economic productivity. The objective of this project is to develop a rational, consistent and repeatable measure of infrastructure performance and then, working with an interdisciplinary team, correlate the index to economic health. The project is funded by the U.S. Chamber of Commerce Foundation and serves as matching funds for our UTC projects related to infrastructure management. To date the project has developed a Transportation Performance Index (TPI). Work continues to refine this index and also develop measures for broadband, energy and water performance.

The TPI was constructed using publically available data for a representative sample of 36 Metropolitan Statistical Areas (MSA). An iterative process was used to identify and select the indicators. In the first iteration, a set of indicators was identified based on a literature review including reports and websites. The second iteration involved an in-depth evaluation of the available data and ease of data collection. The third iteration involved discussions with a small group of transportation academicians with expertise in air, freight and transit. The experts suggested additional data sets and alternative measures. They also stressed the value of initiating discussion rather than seeking perfect indicators. In the fourth iteration, stakeholders were recruited by the U.S. Chamber of Commerce to participate in half-day meetings. The meetings were held in Chicago, Atlanta, Houston and San Jose and focused on understanding what aspects of infrastructure performance are important to businesses. The fifth iteration involved experts from U.S. Chamber member organizations with transportation interests. These experts were asked to comment on the indicators and adjustments made as needed. Finally, the academic experts were invited to comment on the revised list, and further adjustments were made.

Twenty one indicators representing supply, quality of service and utilization for highway, transit, air, rail and intermodal passenger and freight transportation were identified. Data for these 21 indicators were assembled for the period 1990 through to 2008. Although the process is replicable and transparent, there are significant limitations in the data. These include the varying levels of data aggregation, missing or incomplete and erroneous data, the challenges involved in prediction and forecasting, and institutional issues related to ownership and access to the data, changing data formats and changing jurisdictional boundaries and names.

The index itself is constructed by normalizing the data and developing weights derived from the relative importance of the indicator determined using the Analytic Hierarchy Process and the relative contribution to the economy of each of the sampled MSAs. As shown below, the calculated Transportation Performance Index and 5-year moving average show relatively little change over the last two decades despite growing awareness of aging infrastructure, improved operations, and greater investment in infrastructure.

Relationships between per capita economic growth, and transportation infrastructure performance

and foreign direct investment have also been demonstrated. Specifically, a one point change in the Transportation Performance Index increases gross domestic product per capita by 0.3%. The transportation index was also shown to correlate with the American Society of Civil Engineers report card for the period 1998-2008 – the period over which the two measures have similar inputs. Finally, the transportation performance index can play a role in communicating national needs, and the importance of infrastructure.

Additional details may be found in the technical report documenting the construction of the index and the analysis of the results ([http://www.uschamber.com/sites/default/files/lra/files/LRA\\_Transp\\_Index\\_Technical\\_Report\\_100919.pdf](http://www.uschamber.com/sites/default/files/lra/files/LRA_Transp_Index_Technical_Report_100919.pdf)).

Sue McNeil serves the principal investigator for this project. The project has been staffed by post-doctoral researcher Qiang (Joshua) Li and PhD student Michelle Oswald. Graduate student Laura Black, and undergraduates Jonathan Calhoun and T.K. Foulke assisted with data collection. The UD team is part of the large project team led by Michael Gallis of Michael Gallis & Associates including Susanne Trimbath from STP Advisory Services and Tom Skanke of Global Solutions.



Historical Trend in Transportation Infrastructure Performance (1990-2008)

## Congratulations and thanks to Reza Taromi

Congratulation to Dr. Reza Taromi! Reza defended his dissertation "A Multi-Objective Land Development Optimization Model" this spring and is a summer graduate.

For the past four years Reza Taromi has served as the student representative on the UD-UTC Project Selection Committee and the UD-UTC Advisory Committee. In this period Reza has read and commented on 44 research proposals and 22 fellowship applications. He has participated in several meetings and responded to requests for input. Over this time Reza's input was greatly appreciated. Many thanks!

Reza has joined ARCADIS as a Transportation Engineer in their Atlanta office. We wish Reza and his wife Behnaz all the best and look forward to continued interaction at conferences and meetings.

## Transportation Research Board Annual Meeting— Washington DC, January 2011

The Transportation Research Board Annual Meeting is an opportunity for faculty, staff and students to present their work, hear about new developments in their area of interest, network, catch up with friends and sometimes see a few of the sights in Washington DC.

For UTC Fellow, Trevor Booz the 2011 annual meeting turned out to be more than that. Trevor got to participate in a unique field trip – a tour of bike facilities in the Washington DC metro using bicycles from the Capital Bikeshare program.

Trevor, an avid bicyclist, enjoyed not only seeing the facilities but the opportunity to get outside the "stuffy" conference rooms and out on the road for a cold winter ride.



**Trevor Booz at the Whitehouse with the Capital Bikeshare bike**

## Students Participate in AISIM 7

The seventh Annual Interuniversity Symposium on Infrastructure Management was held at Northwestern University in Evanston, Illinois on Saturday June 4th. AISIM is an informal forum to allow graduate students from various institutions and their faculty to share what they are researching with colleagues in the same field. Mosi London, a first year Masters of Civil Engineering student, presented a paper

titled "Application of Data Envelopment Analysis Method to the Transportation Performance Index" and Sekine Rahimian, a PhD student in Civil Engineering, presented a paper titled "Modeling Transportation Systems after a Disaster". Gill McCarthy and Sue McNeil also attended. For more information see <https://sites.google.com/site/aisimseven/home>.



## Upcoming Events and Opportunities

**Brown bags for Fall 2011—  
watch the UTC website for dates  
and times.**

### SEPTEMBER

"Understanding the Impacts of Climate  
Change on the I-95 Corridor in Maryland  
and Delaware", David Ames and Sue McNeil

### OCTOBER

"The Implications of Climate Change on  
Pavement Performance and Design",  
Joshua Li, Leslie Mills and Sue McNeil

### NOVEMBER

"Transportation and Dance", Lynnette  
Overby

### DECEMBER

"Investigation of Load-Path Redundancy  
in Aging Steel Bridges", Jennifer Righman  
McConnell

### Deadlines

#### SEPTEMBER 15, 2011

Student of the Year nominations. See  
<http://www.ce.udel.edu/UTC/SOY.html>

#### NOVEMBER 1, 2011

Winter undergraduate research  
applications [http://www.ce.udel.edu/UTC/  
Undergraduate.html](http://www.ce.udel.edu/UTC/Undergraduate.html)

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