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Delaware Center for Transportation

2007-2012



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Introduction



Spring 2013 marks the 25th anniversary of the establishment of the Delaware Center for Transportation (DCT). Launched as a joint partnership between the University of Delaware (UD) and the Delaware Department of Transportation (DelDOT) to provide quality research, training and public service, DCT has established itself as a major resource for multimodal transportation-related issues and challenges within the State of Delaware, the mid-Atlantic region, the nation and beyond. Between 2007 and 2012, DCT continued providing services in the traditional areas of transportation including policy and planning, design, construction, maintenance and operations and control. Responding to new global challenges of the 21st century, our center tackled transportation-related issues including alternative energies, sustainability, plus human health and the built environment. As before, our researchers continue presenting the results of their DCT-sponsored projects at major national and international conferences and publishing their results in prestigious journals. Many factors contribute to the success we are currently enjoying: the hard work and dedication of the DCT staff, the generosity and cooperative spirit of all professionals within the DelDOT and Federal Highway Administration (FHWA), the leadership at UD, and the quality of research and teaching staff at UD who provide their professional services for the center. Dozens of undergraduate and graduate students who actively participated in the research projects obtained excellent jobs within the United States and abroad. Because of the experience gained at DCT, our graduates are filling leadership roles at national and international government plus private transportation organizations. In addition we also have an increasing number of our doctoral graduates working as academic and research faculty at renowned domestic and international universities. We look forward to dealing with major transportation challenges in the next 25 years, and continuing to provide quality research, training and public service, all of which educate the future global transportation leaders of the 21st century.

About the Center

DCT's primary goal is to serve as a research, education and technical arm for federal, state and local transportation agencies. We promote, organize, coordinate, and support research, development, and educational activities to address the transportation needs, challenges, and opportunities facing the State of Delaware, the mid-Atlantic region, the nation, and, indeed, the world. Transportation plays a vital role in this age of information technology and a global community, and top-quality transportation research and education cannot be provided in isolation. At DCT, we maintain a

continuous partnership with all the parties involved in transportation. We also strive to integrate all transportation-relevant research and education at the University with the ongoing activities of the Center, so that our undergraduate and graduate students, as well as transportation professionals, can take advantage of what we have to offer in a mutually helpful environment. Our goal is simple – to be the best transportation research and education center in the world.

Mission:

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 the transportation-related issues and challenges within the state, the mid-Atlantic region and beyond.



DCT staff members sitting from left: Associate Director, Jerome Lewis & Director Ardeshtir Faghri ; standing from left: Ellen Pletz, Sue McNeil, Sandi Wolfe, Earl "Rusty" Lee, Matt Carter, Mixing Lee,

Overview

DCT serves the research and technical training needs of federal, state and local transportation agencies. Initiatives include:

- ◆ **Research**— Selecting, conducting and disseminating multidisciplinary research.
- ◆ **Education**— Semester-long courses, short courses, workshops, seminars and conferences for the university community, DelDOT, other DOTs, government agencies and private organizations dealing with transportation issues.
- ◆ **Technology Transfer**— Organization of annual workshops for transportation providers, technical assistance with transportation issues, and distribution of research and other reports from universities and government agencies.
- ◆ **Distinguished Guest Speaker Series**— Guest speakers from around the world who are invited to visit the Center and present talks on important transportation issues.
- ◆ **Technical Assistance**— Short-term projects for DelDOT and other organizations, including literature searches and hands-on training.
- ◆ **Industrial Collaboration/Private Partnership**— Members of private companies and consulting firms who join the Center and become actively involved in decision making processes.
- ◆ **Global Research**— Partnership with top quality worldwide transportation education and research institutions including the exchange of ideas, scholars, research findings and conduct of joint research projects, conferences, seminars and workshops.

These initiatives are integrated with the undergraduate and graduate education programs of the Department of Civil and Environmental Engineering to enhance the learning environment of our students.



DCT Staff

Ardeshir Faghri—Director



Dr. Faghri is a professor in the Department of Civil and Environmental Engineering. He teaches and conducts research in the area of Transportation Systems Engineering and Planning. He was the interim director of the Transportation Center during 1995-1996 and is currently in his third term as the director of DCT serving since 2001. Professor Faghri is active in many national and international organizations including the Transportation Research Board of the National Research Council, the American Society of Civil Engineers, the National Science Foundation and the Institute of Transportation Engineers.

Jerome Lewis—Associate Director



Dr. Lewis is the Director of the Institute of Public Policy and Professor in the College of Human Services, Education and Public Policy. Dr. Lewis served as interim Director of DTI from 1993—1995. He has served as Associate Director for DCT since 2001.

Earl “Rusty” Lee—T² /LTAP Program Coordinator



Dr. Lee is an Assistant Professor in the Department of Civil and Environmental Engineering and has been a member of the faculty since 2007. In 2010, he took on the additional duties as the T² /LTAP Program Coordinator. He is responsible for working with DelDOT and Delaware communities to provide training and technology transfer in the form of workshops, seminars and conferences. Dr. Lee is also a member of the Executive Committee of the National LTAP Association (NLTAPA) representing the mid-Atlantic region and chairs the NLTAPA Professional Development work group.

Sue McNeil—Director, University Transportation Center



The UDUTC is led by Prof. Sue McNeil, Professor of Civil and Environmental Engineering at the University of Delaware. Dr. McNeil earned her Ph.D. in civil engineering at Carnegie-Mellon University. Her research and teaching interests focus on transportation infrastructure management, with an emphasis on the application of advanced technologies, economic analysis, analytical methods, and computer applications. Dr. McNeil is a member of the Executive Committee of the Transportation Research Board and the Board on Infrastructure and the Constructed Environment. She chairs the Transportation Research Board Committee on Asset Management. She chaired (1988-1993) the ASCE Urban Transportation Division Committee on Transportation Facilities Management and is the Editor-In-Chief for the ASCE *Journal of Infrastructure Systems*. She is a registered professional engineer.

DCT Staff, cont.

Ellen Pletz—Business Administrator I



Ellen Pletz joined the DCT staff in 2008 and assists the Director with all aspects of DCT. She has a bachelor's degree from the University of New Hampshire and has worked at the University of Delaware in accounting and grants management functions since 1999.

Matheu Carter—Circuit Rider Engineer



Matt Carter joined the Center in 2008. He is the Delaware T² /LTAP Engineer and Municipal Circuit Rider for the Delaware T²/LTAP Center. Matt is a civil and environmental engineer, licensed as a professional engineer in Delaware, Maryland, Pennsylvania, New York, New Jersey and Georgia. He received his Bachelor of Science in Civil Engineering at The George Washington University in Washington, DC. Matt has had extensive experience working in both the public and private sector.

Sandra Wolfe—Event Coordinator/Website Administrator



Sandi Wolfe has been with the Center since 2004. Her responsibilities include scheduling and handling the logistics of Delaware T²/LTAP training workshops, classes and seminars. She coordinates, manages and markets DCT and T² events. Sandi also maintains our DCT/T² Website. She is responsible for the coordination of the DCT newsletter publication and maintains the email distribution lists.

Mingxin Li



Dr. Li joined the DCT staff as a postdoctoral researcher in the Department of Civil and Environmental Engineering at the University of Delaware. He studied at Oregon State University before getting his Ph.D. at the University of Utah in 2011. He obtained a bachelor degree in Railway Operations Management from Beijing Jiaotong University in 1996. His research interests include transportation operational planning, rail /transit planning and management, traffic operations and analysis. His current research interests focus on travel demand modeling and learning techniques in Intelligent Transportation Systems.

POLICY COUNCIL

The DCT Policy Council advises the Director on the strategic direction of research programs and priorities; procedures and practices for allocating research support; methods for maximizing the effectiveness of DCT programs; and developmental initiatives that may enhance DCT resources and contributions to the State and its people.

Current Policy Council Members

Natalie Barnhard
Chief Engineer, Delaware Department of Transportation

William Carson
Delaware House of Representatives

Babatunde Ogunnaiké
College of Engineering, University of Delaware

Shannon Clark
Representative of the Director of Delaware Development Office

Karen Peterson
Delaware General Assembly

Ajay Prasad
Professor, Department of Mechanical Engineering, University of Delaware

Ralph Reeb
Division of Planning, Delaware Department of Transportation

Holly Rybinski
Rybinski Engineering

Harry (Tripp) Shenton, III
Chair, Department of Civil and Environmental Engineering, University of Delaware

Policy Council Members 2007-2011

Timothy Barnekov
Dean, College of Human Services, Education & Public Policy
University of Delaware

Natalie Barnhard
Chief Engineer, Delaware Department of Transportation

Richard Cathcart
Delaware House of Representatives

Michael Chajes
Dean, College of Engineering, University of Delaware

William Carson
Delaware House of Representatives

Shannon Clark
Representative, Director of the Delaware Development Office

Anthony DeLuca
Delaware State Senate

Michael Gamel-McCormick
Dean, College of Education and Public Policy, University of Delaware

James Johnson
Executive Director, Delaware River and Bay Authority

Eric Kaler
Dean, College of Engineering, University of Delaware

Patrick Kennedy
Federal Highway Administration, Delaware Division

Stephen Kingsberry
Director, Delaware Transit Corporation

Policy Council Members 2007-2011 Cont.**David McBride**

Delaware General Assembly

Babatunde Ogunnaike

Dean, College of Engineering, University of Delaware

William Osborn

Transportation Management Association

Karen Peterson

Delaware General Assembly

Ajay Prasad

Department of Mechanical Engineering, University of Delaware

Hassan Raza

Federal Highway Administration

Ralph Reeb

Division of Planning, Delaware Department of Transportation

Roger Roy

Transportation Management Association

Holly Rybinski

AECOM

Harry “Tripp” Shenton

Chair, Department of Civil and Environmental Engineering, University of Delaware

Michael Strange

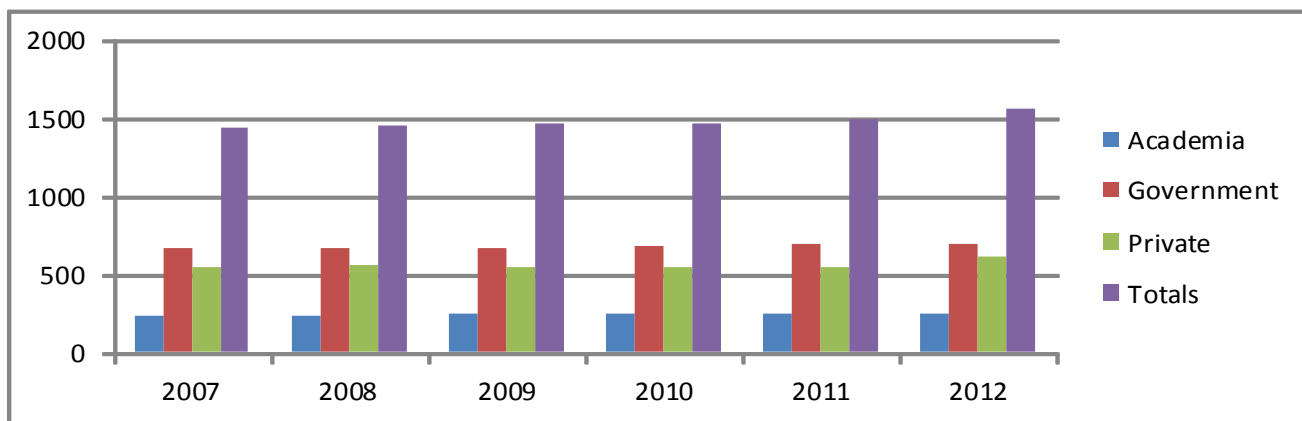
Planning Department, Delaware Department of Transportation

Robert Taylor

Chief Engineer, Delaware Department of Transportation

DCT NEWSLETTER—TranSearch

The Delaware Center for Transportation publishes a semi-annual newsletter, *TranSearch*. The first issue was published, printed and distributed by US mail in 2002. In the Summer 2010 issue, we announced that we would “go green” with the publication and distribute it via electronic mail. In Spring 2011 we launched the first electronic issue which was emailed to over 1400 contacts. Our email distribution list has been growing with each issue. By “going green”, we have reduced printing and mailing costs and, the amount of paper used for printing the publication. Past and present issues of *TranSearch* can be viewed on our website <http://www.ce.udel.edu/dct/Newsletter.html>

EMAIL DISTRIBUTION LIST

Funding Agencies/Industrial Collaborations

DCT's executive directorship has a strong desire and interest to invite members of private companies and consulting firms to join the Center and become actively involved in decision making processes. There is a great deal of mutual benefits that can be realized from our industrial collaboration/private partnership program. Another important initiative for DCT is to seek cooperation and partnership

with major international transportation education and research centers around the world. We gratefully acknowledge the assistance our partners have given to us during the past five years. Whether funding, staff time, or other contributions, our partners have tremendously helped us to do our jobs. Listed are our major contributors:

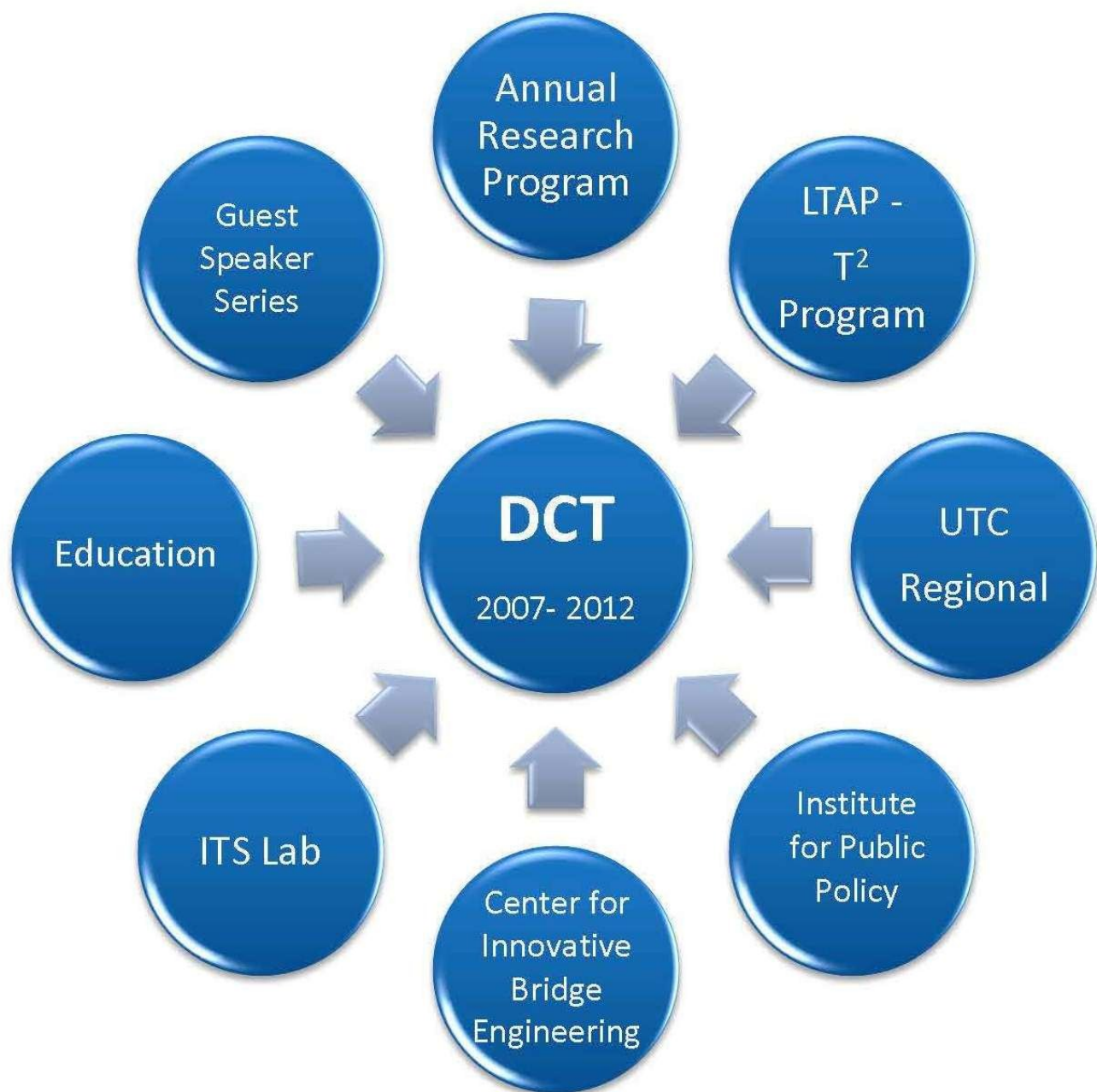
Federal Highway Administration, Delaware Department of Transportation , Federal Transit Association, Delaware Transit Corporation & WILMAPCO



Delaware Department
of Transportation



Delaware Center for Transportation



ANNUAL RESEARCH PROGRAM

Research Committee

The Research Committee meets in February to identify the transportation problems within the state of Delaware. The committee then evaluates the problems and prioritizes them. Proposals for these projects are submitted in March and the committee reviews them for funding.

Current Research Committee Members

Curt Cole

Division of Maintenance and Operations, Department of Transportation

Gene Donaldson

Delaware Department of Transportation

Patrick Kennedy

Federal Highway Administration—DelMar Division

Greg Oliver

Delaware Department of Transportation

Edward O'Donnell

University of Delaware—Institute for Public Administration

James Pappas

Delaware Department of Transportation

Ralph Reeb

Delaware Department of Transportation

Sandy Roumillat

Public Relations, Delaware Department of Transportation

Michael Simmons

Delaware Department of Transportation

Cathy Smith

Delaware Transit Corporation, Delaware Department of Transportation

Marianne Walch

Delaware Department of Transportation

Research Committee Members 2007-2012

Chandra Aleong
Delaware State University

Denise Beaston
Human Resources, DelDOT

Gene Donaldson
Traffic Management Center, DelDOT

Asmat Hussain
FHWA

Michael Kirpatrick
Division of Planning, DelDOT

Wayne Kling
Division of Materials and Research, DelDOT

Daniel LaCombe
Division of Planning, DelDOT

Cheryl Lamb
Division of Finance, DelDOT

Mark Luszc
TMC, DelDOT

Daniel Montag
FHWA

Gregory Oliver
Division of Planning, DelDOT

Dennis O'Shea
Transportation Solutions, DelDOT

James Pappas
Division of Materials and Research, DelDOT

Ralph Reeb
Division of Planning, DelDOT

Sandy Roumillat
Public Relations, DelDOT

Bradford Saborio
Maintenance and Operations, DelDOT

Rosemary Samick
Transportation Specialist, FHWA

Mike Simmons
Transportation Solutions, DelDOT

Cathy Smith
Delaware Transit Corporation

Jiten Soneji
Bridge Design, DelDOT

Michael Strange
Planning, DelDOT

Donald Weber
Transportation Solutions, DelDOT (TMC)

RESEARCHERS AND PROJECTS

Following is a list of DCT researchers who have been awarded research grants through the Annual Research Program from 2007—2012.



David L. Ames—Professor, School of Public Policy and Administration
Director, Center for Historic Architecture and Design

◆ Scenic and Historic Highways in Delaware

Researchers Cont.



Nii Attoh-Okine—*Professor, Department of Civil and Environmental Engineering
College of Engineering*

- ◆ Long-Term Performance Monitoring of a Recycled Tire Embankment in Wilmington, Delaware
- ◆ Pavement Performance Models
- ◆ Review of Existing Pavement Condition Rating System
- ◆ Use of Reclaimed Asphalt Pavement (RAP) to Reduce Pavement Thickness

Susan Barton—*Associate Professor and Extension Specialist, Plant and Soil Science
College of Agriculture and Natural Resources*

- ◆ 2007-2012 Enhancing Delaware's Highways: A Natural Vegetation Project
- ◆ Guardrail Vegetation Management Study

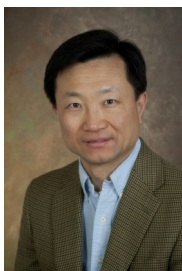
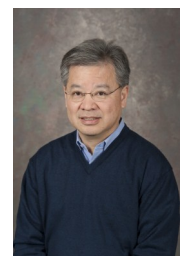


Michael Chajes—*Professor, Department of Civil and Environmental Engineering
College of Engineering*

- ◆ 2009-2012 Instrumentation and Monitoring of the Indian River Inlet Bridge (IRIB)
- ◆ Baseline Monitoring and Testing of the Indian River Inlet Bridge (IRIB)
- ◆ Bridge Management Using In-Service Data (Phase II)
- ◆ Field Testing and FEM Analysis of the Route 141 Newport Viaduct
- ◆ Instrumentation and Monitoring of the Indian River Inlet Bridge: Phase I

Daniel Cha—*Professor, Department of Civil and Environmental Engineering
College of Engineering*

- ◆ Integrating Zero-valent Iron and Biochar Amendments in Green Stormwater Management Systems for Enhanced Treatment Runoff



Bintong Chen—*Professor, Business Administration
Lerner College of Business and Economics*

- ◆ Incremental Park and Ride Demand Model

Researchers Cont.



William DeCoursey—Assistant Policy Scientist, (Planning), Institute for Public Administration
College of Arts and Sciences

- ◆ Safe Routes to School for Children—Mode Share Data Analysis

Bernard Dworsky—Assistant Professor and Policy Scientist, Institute for Public Administration
College of Arts and Sciences

- ◆ A Feasibility Study of Bus Rapid Transit (BRT) in Delaware
- ◆ Assessing the Needs of Delaware's Older Drivers



Ardeshir Faghri—Professor, Department of Civil and Environmental Engineering
College of Engineering



- ◆ 2007-2012 GPS Travel Time and Delay Data Collection and Analysis
- ◆ A Meta-Analysis of Studies, Projects and Practices on Planning for a Sustainable Environment with Special Emphasis on the States of Vermont and Delaware
- ◆ Effective Countermeasures for Crash Reduction and Unsignalized Intersections for Two-Lane Undivided Roadways
- ◆ In-Depth Evaluation of Delaware Transit Corporation Fuel Efficiency and Emissions
- ◆ Use of Roundabouts as Alternatives to All-Way-Stop Controls

Chin-Pao Huang—Professor, Department of Civil and Environmental Engineering
College of Engineering

- ◆ Impacts of Bird Droppings and Deicing Salts on Highway Structures: Monitoring, Diagnosis and Prevention



Paul Imhoff—Professor, Department of Civil and Environmental Engineering
College of Engineering

- ◆ Integrating Zero-valent Iron and Biochar Amendments in Green Stormwater Management Systems for Enhanced Treatment of Roadway Runoff
- ◆ Long-Term Performance Monitoring of a Recycled Tire Embankment in Wilmington, Delaware

Researchers Cont.



Victor Kaliakin—Associate Professor, Department of Civil and Environmental Engineering
College of Engineering

- ◆ Long-Term Performance Monitoring of a Recycled Tire Embankment in Wilmington, Delaware

Daniel Leathers—Professor, Department of Geography
College of Earth, Ocean and Environment

- ◆ Delaware Environmental Observing System DelDOT Snow Depth Monitoring



Earl “Rusty” Lee—Assistant Professor, Department of Civil and Environmental Engineering
College of Engineering

- ◆ 2008– 2012 ITS Lab Baseline Service
- ◆ 2009-2012 Delaware Signal Timing Enhancement Partnership (DSTEP)
- ◆ 2010-2012 Regional Travel Demand and Modeling Support
- ◆ Delaware Transportation Operations Management Plan—New Castle County
- ◆ Delmarva Freight Study
- ◆ Enhanced Pedestrian Crossings
- ◆ Evaluation of Smart Growth Development Patterns and Effects
- ◆ Pavement Markings and Signing to Support Senate Bill 120



Dov Leshchinsky—Professor, Department of Civil and Environmental Engineering
College of Engineering

- ◆ Construction of Approach MSE Walls to IRIB: Reduction of Geotechnical Field Data
- ◆ Use of Reclaimed Asphalt Pavement (RAP) to Reduce Pavement Thickness
- ◆ Verification of Design of a Novel Mechanically Stabilized Earth Wall at the Christiana Interchange



Jennifer McConnell—Associate Professor, Department of Civil and Environmental Engineering, College of Engineering

- ◆ Cross-frame Forces in Skewed Steel I-Girder Bridges
- ◆ Scour Monitoring of the Indian River Inlet Bridge



Researchers Cont.



Sue McNeil—*Professor, Department of Civil and Environmental Engineering
College of Engineering*

- ◆ Abandon, Repair or Improve Roads in the Face of Climate Change
- ◆ Advancing Asset Management in DelDOT
- ◆ Asset Management as a Strategic Decision-Making Tool in DelDOT
- ◆ Infrastructure Security and Emergency Preparedness
- ◆ Pavement Performance Models

Christopher Meehan—*Associate Professor, Department of Civil and Environmental Engineering, College of Engineering*

- ◆ Design and Construction of a Geosynthetic Reinforced Soil (GRS) Integrated Bridge System (IBS) in the State of Delaware
- ◆ Development of Specifications for the Use of Continuous Compaction Control Systems
- ◆ Using Electrical Density Gauges for Field Compaction Control
- ◆ Long-Term Performance Monitoring of a Recycled Tire Embankment in Wilmington, Delaware
- ◆ Establishment of a Geotechnical Information Database
- ◆ Investigation of Intelligent Compaction Technology, Phase I & II
- ◆ Construction of Approach MSE Walls to IRIB: Reduction of Geotechnical Field Data
- ◆ Implementation of Continuous Compaction Control (CCC) Systems in Field Construction



Stephen Mensah—*Post Doctoral Researcher, Department of Civil and Environmental Engineering, College of Engineering*

- ◆ Use of Roundabouts as Alternatives to All-Way-Stop Controls

Dennis Mertz—*Professor, Department of Civil and Environmental Engineering
College of Engineering*

- ◆ Non-Destructive Testing Methods to Evaluate the Integrity of Concrete Bridge Decks



Martha Narvaez—*Associate Policy Scientist, Institute for Public Administration
College of Arts and Sciences*

- ◆ National Pollutant Discharge Elimination System (NPDES) and Nonpoint Source Pollution

Researchers Cont.



Edward O'Donnell—*Policy Scientist, Institute for Public Administration
College of Arts and Sciences*

- ◆ Transit-Oriented Development (TOD): Identification of Optimal Characteristics in Delaware
- ◆ Integrating Transportation/Transit Planning in the Overall Planning Process

Ajay Prasad—*Professor, Department of Mechanical Engineering
College of Engineering*

- ◆ Fuel Cell Bus, Phases I—IV



Jack Puleo—*Associate Professor, Department of Civil and Environmental Engineering
College of Engineering*

- ◆ 2007-2012 Near Real-Time Monitoring of Indian River Inlet Scour Hole Edge Evolution Seaward of the Bridge Piers

David Racca—*Policy Scientist, Center for Applied Demography and Survey Research
College of Arts and Sciences*

- ◆ Development and Evaluation of a Residential Allocation Model Using Time Series Tax Parcel Data in GIS, Part II
- ◆ Study and Calculation of Travel Time Reliability Measures
- ◆ An Examination and Presentation of Travel in Sussex County
- ◆ Examination of GIS and Current Information System Plans and Responsibilities
- ◆ Examination of the Relationship Between Traffic Counts, Loop Occupancy, Speed and Capacity
- ◆ Development of a Comprehensive Multi-modal Travel Accessibility Indexing System at the Tax Parcel Level
- ◆ Interactive Data Set/Database for Trip Patterns (GIS and Traffic Count Projects)



Edward Ratledge—*Associate Professor, Center for Applied Demography and Survey Research
College of Arts and Sciences*

- ◆ Delaware Travel Monitoring System

Researchers Cont.



Thomas Schumacher—*Assistant Professor, Department of Civil and Environmental Engineering, College of Engineering*

- ◆ Non-Destructive Testing Methods to Evaluate the Integrity of Concrete Bridge Decks
- ◆ Capacity of Reinforced Concrete Moment Frame Culvert

Harry “Tripp” Shenton—*Professor, Department of Civil and Environmental Engineering College of Engineering*

- ◆ Baseline Monitoring and Testing of the Indian River Inlet Bridge (IRIB)
- ◆ In-Service Monitoring for Improved Maintenance and Management of DelDOT Bridges
- ◆ 2009-2012 Instrumentation and Monitoring of the Indian River Inlet Bridge
- ◆ Testing and Operation of Delaware’s First “Smart Bridge”
- ◆ Bridge Management Using In-Service Data, Phases I & II



Douglas Tuttle—*Instructor, Institute for Public Administration College of Arts and Sciences*

- ◆ Improving Access to Taxi Service—Delaware’s “Missing” Transit Mode
- ◆ Optimizing Accessible Taxi Service to Augment Traditional Public Transit Services in Delaware

Young-Doo Wang—*Associate Director and Professor, Center for Energy and Environmental Policy, College of Arts and Sciences*

- ◆ Estimating Vehicle-Miles-Traveled by Vehicle Class for the State of Delaware
- ◆ A Meta-Analysis of Studies, Projects and Practices on Planning for a Sustainable Environment with Special Emphasis on the States of Vermont and Delaware



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DCT RESEARCH FORUM

2007 Transportation, Education, Research and Security Forum

Every 4 – 5 years the Delaware Center for Transportation hosts a research forum where stakeholders in the transportation sector gather to identify the most important transportation-related issues in Delaware and surrounding region. This forum generates many ideas and is a principal source that DelDOT and the University employ to select the projects that they may fund and work on each year. The 2007 forum covered a broad array of multi-modal transportation issues with a special emphasis on transportation security. Participants included representatives from federal, state, regional and local transportation agencies; government officials; public safety officials; faculty, students, staff from the University of Delaware and other academic institutions; the private sector and civic groups. You can obtain a copy of the Forum Results Booklet by contacting Ellen Pletz, DCT Administrator at ebourett@udel.edu. The next forum will be held in November 2013.

2007 Forum Topic:

*Identifying
Important
Education, Research
and Security Issues
Facing the
Transportation
System in
Delaware and
Northeast Corridor*

* * * * *

November 14, 2007

Clayton Hall
University
of
Delaware



Guest Speakers:

Carolann Wicks, Secretary of Transportation, Delaware Department of Transportation,
Patrick Harker, President, University of Delaware,
Ralph Reeb, Director of Planning, Delaware Department of Transportation



Keynote Luncheon Speaker

Dr. Ajay Prasad, Professor, University of Delaware
Topic: Zero Emission Hydrogen Fuel Cell Bus



Moderators

Administration, Government & Policy

Robert Warren, University of Delaware
Marti Dobson, DelDOT
Patrick Kennedy, FHWA, Delaware

Bridges & Structures

Jennifer McConnell, University of Delaware
Barry Benton, DelDOT
Doug Robb, DelDOT
Joe Englot, HNTB Corp.

Construction, Pavement & Materials

Christopher Meehan, University of Delaware
Sue McNeil, University of Delaware
Wayne Kling, DelDOT

Design

Lorene Athey, University of Delaware
Ray Harbeson, Rummel, Klepper & Kahl, LLP

Environment

Paul Imhoff, University of Delaware
Saurabh Srivastava, New Castle County, DE

Local (Towns) Issues

Bernard Dworsky, University of Delaware
Ed Stellfox, Maryland T² Center
Scott Koenig, City of Dover

Maintenance

Alan Kercher, Kercher Engineering
S. Curt Cole, DelDOT

Planning & Multi-Modal

James Corbett, University of Delaware
Ralph Reeb, DelDOT
Jeffery Riegner, Whitman, Requardt & Associates, LLP

Security

Patricia Faust, FHWA, Delaware
James Turner, III, DEMA

Traffic & ITS

Donald Weber, DelDOT, TMC
Karen Jehanian, KMJ Consulting
Mitsuru Tanaka, McCormick-Taylor

Transit & Public Transportation

Ajay Prasad, University of Delaware
Stephen Kingsberry, Delaware Transit Corporation
Sean Ricketson, Federal Transit Association

DCT Research Forum Cont.

Breakout Sessions

- ◆ **Bridges & Structures** – Design of steel, concrete and timber bridges; bridge safety, economy and service life; field testing and dynamic responses of bridges; tunnel design, construction and performance; structural use of composite materials
- ◆ **Planning & Multi-Modal** – Planning process; state, regional and urban transportation planning; land use; forecasting, market estimation and modal selection; travel behavior; transportation demand management · Pedestrian and bicycle planning and forecasting · Aviation planning, forecasting, finance, socioeconomics, market analysis, airside and landside airport design and operations, air traffic control, intergovernmental relations, airlines (including regional and commuter), business and general aviation, safety, user needs · Rail planning, administration, regulation, safety, and operation of rail systems, both passenger and freight; design, construction and maintenance of track systems and train control; and communication systems · Marine planning and management of marine operations including: ports, inland waterways, barge and ship cargo systems, ferryboat operations, and intermodal terminals; global freight logistics, intermodal information technologies, marine environment issues and related regulations · Freight transportation; truck, rail, water, pipeline and intermodal freight transportation; planning, administration, design, construction, maintenance, regulation, operations, and safety; and transportation of hazardous materials
- ◆ **Administration & Government Policy** – Agency organization: personnel management; finance and economics; data and information systems; strategic management; soft skills
- ◆ **Maintenance** – Maintenance management; runway and guidance maintenance; structures, roadway and roadside maintenance; traffic service maintenance; snow and ice control; equipment maintenance; work zone safety
- ◆ **Traffic & ITS** – Transportation systems operations; traffic flow and highway capacity; law enforcement; parking and parking facilities; operating effects of roadway elements; traffic control devices and systems; railroad-highway grade crossings; transportation communication systems; traffic measurements and evaluation methods; high occupancy vehicles; Intelligent Transportation Systems (ITS) · Safety and human performance; system safety; accident countermeasures; right-of-way and vehicular design, operations and maintenance; human behavior and performance associated with transportation; emergency medical services; trauma treatment; work zone safety; the measurement of safety performance (e.g., accident data and exposure) and the planning, management and financing of safety
- ◆ **Construction, Pavement & Materials** – Construction, quality control; bituminous materials and mixes, cement and concrete, general materials, mineral aggregate specifications · Exploration, properties, identification, classification and treatment of surface and subsurface soil and rock, subsurface drainage; earthquake and landslides; environmental effects on soil; mechanics of soil, rock and layered systems · Pavement management, flexible and rigid pavement design, rehabilitation strategies, response of pavements to load and environmental forces, pavement data collection and analysis, surface unevenness, pavement distress, skid resistance, systems for vehicle counting, classification and weigh-in motion
- ◆ **Transit & Public Transportation** – Planning, administration, economics, finance and performance of rail, bus and new technology transit systems; commuter rail; paratransit and transportation of the disadvantaged; rural public transportation; safety; design, operations, and maintenance of vehicles and fixed facilities
- ◆ **Environment** – Alternative fuels, fuel economy, ecological systems, noise and air quality, water quality; wetlands; historic preservations; hazardous wastes; highway vegetation
- ◆ **Local (Towns) Issues** – Developing employee skills, GASB 34 implementation, pavement repair and management systems, sign inventories, pooled equipment purchases, shared equipment use, land use/transportation plans
- ◆ **Design** – Photogrammetry, digital mapping, remote sensing and surveying; highway geometrics; traffic barriers, sign supports and highway safety appurtenances; environmental design and mitigation; archeological, scenic vistas, utility accommodation; design of culverts and hydraulic structures; hydrology and hydraulics
- ◆ **Security** – Transportation security issues at the federal, state and local level; multi-modal transportation security issues

RESEARCH PROJECTS

The following projects have been active during the period between 2007 and 2012. For more information on these projects, please visit <http://www.ce.udel.edu/dct/Research.html>.

Environmental

2007 – 2012 Enhancing Delaware Highways: A Natural Vegetation Project

This ongoing research is in the process of developing and introducing alternatives to current roadside management strategies to restore Delaware's roadside landscapes to a more natural state reflecting the regional flora.

Year Initiated: 2001 (ongoing)

Budget: \$1,346,382 (multiple years)

Principal Investigator: Susan Barton, Plant and Soil Sciences, College of Agriculture

Project Manager: Chip Rosen, Roadside Environmental Supervisor, Field Services

2007 – 2012 Near Real-Time Monitoring of Indian River Inlet Scour Hole Edge Evolution Seaward of the Bridge Pier

Project will install a near real-time monitoring system that will image the sea bed adjacent to the bridge piers. 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.

Year Initiated: 2007

Budget: \$969,934 (multiple years)

Principal investigator: Jack Puleo, Center for Applied Coastal Research, Department of Civil and Environmental Engineering

Project Manager: Douglas Robb, Division of Bridge Design



2007 – 2012 Scenic and Historic Highways in Delaware: Phase V

Funding for this project will complete a series of preliminary assessments of potential scenic and historic highways. This continuing project will develop policies and procedures for protecting viewsheds of scenic and historic highways from negative visual intrusions.

Year initiated: 2007

Budget: \$770,410 (multiple years)

Principal Investigator: David Ames, Center for Historic Architecture and Design

Project Manager: Maria Andaya, Division of Roadside Environment

Guardrail Vegetation Management Study

This project is investigating methods to reduce the use rates and toxicity of pesticides and carriers utilized to treat guardrail vegetation without compromising safety and aesthetics.

Year Initiated: 2008

Budget: \$179,828 (multiple years)

Principal Investigator: Susan Barton, Plant and Soil Sciences, College of Agriculture

Project Manager: Marianne Walch, Division of Maintenance and Operations



Long-Term Performance Monitoring of a Recycled Tire Embankment in Wilmington, Delaware

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.

Year Initiated: 2008

Budget: \$69,499

Principal Investigators: Nii Attoh-Okine, Paul Imhoff, Victor Kaliakin & Christopher Meehan, Department of Civil and Environmental Engineering

Project Manager: James Pappas, Division of Materials and Research

Research Projects Cont.

Impacts of Bird Droppings and Deicing Salts on Highway Structures: Monitoring, Diagnosis, and Prevention

This research project will develop decision-making criteria and tools useful to DelDOT in monitoring, diagnosis and corrosion prevention brought about by bird droppings and deicing salts. The information to be established in this research will be valuable to life cycle cost modeling of transportation structures.

Year Initiated: 2009

Budget: \$15,484

Principal Investigator: Chin-Pao Huang, Department of Civil and Environmental Engineering

Project Manager: Jiten Soneji, Bridge Design

In-Depth Evaluation of DTC Fuel Efficiency and Emissions

There is a tremendous need to make the DTC fleet as energy efficient and air quality friendly as possible. For this study, 1) the DTC fleet will be analyzed for its fuel efficiency and emissions, 2) the latest world-wide technological developments for buses with new alternative fuels will be researched, and 3) technologies most suited for Delaware will be identified.

Year Initiated: 2009

Budget: \$29,797

Principal Investigator: Ardeshtir Faghri, Department of Civil and Environmental Engineering

Project Manager: Mark Glaze, Division of Planning

National Pollutant Discharge Elimination System (NPDES) and Nonpoint Source Pollution

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

Year Initiated: 2010

Budget: \$48,264

Principal Investigator: Martha Corrozi Narvaez, Institute for Public Administration

Project Manager: Marianne Walch, Division of Maintenance and Operations



Integrating Zero-valent Iron and Biochar Amendments in Green Stormwater Management System for Enhanced Treatment of Runoff

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.

Year Initiated: 2011

Budget: \$115,518 (multiple years)

Principal Investigators: Dan Cha and Paul Imhoff, Department of Civil and Environmental Engineering

Project Manager: Marianne Walch, Division of Maintenance and Operations

Pavement and Materials

Pavement Performance Models

DelDOT collects Pavement Condition data from all the pavements in their network, and uses this data to develop Annual Paving Programs that address the roads requiring work for each year. This condition data, collected over several years, could be analyzed

to predict future condition, predict when maintenance should be applied, and predict the end of a pavement's useful life. Combined with data from initial construction quality records and maintenance activity records, one could develop performance prediction models for similar pavements in the DelDOT network. With these models, DelDOT could better anticipate future needs of each pavement, and could better target the appropriate rehabilitation techniques to pavements at the opportune time.

Year Initiated: 2007

Budget: \$50,000

Principal Investigators: Sue McNeil and Nii Attoh-Okine, Department of Civil and Environmental Engineering

Project Manager: Jennifer Pinkerton, Division of Materials and Research

Researcher Projects Cont.

Use of Reclaimed Asphalt Pavement (RAP) to Reduce Pavement Thickness

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.

Year Initiated: 2010

Budget: \$56,654

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

Project Manager: James Pappas, Division of Materials and Research

Review of Existing Pavement Condition Rating System

This project will assess various pavement data collection equipment and match those which are appropriate for DelDOT's needs.

The goals of the research are to develop the following:

- 1) Appropriate equipment for DelDOT pavement condition data collection
- 2) Objective analysis of the outputs of various equipment using statistical models

Year Initiated: 2012

Budget: \$40,451

Principal Investigator: Nii Attoh-Okine, Department of Civil and Environmental Engineering

Project Manager: Jennifer Pinkerton, Division of Materials and Research

Planning

A Feasibility Study of Bus Rapid Transit (BRT) in Delaware

The State of Delaware, like most states in the Mid-Atlantic region is experiencing increasing volumes of traffic and traffic congestion. Delaware is also experiencing an increasing proportion of its aging population (60+) and as a coastal state, an increasing influx of retirees seeking residence in the state. These changes in demographics and traffic volumes will produce greater demands and needs for transportation services and programs. They also suggest the need to explore alternative means to meet the anticipated transportation demands.

Year Initiated: 2007

Budget: \$72,577

Principal Investigator: Bernard Dworsky, Institute for Public Administration

Project Manager: Cathy Smith, Delaware Transit Corporation

Assessing the Needs of Delaware's Older Drivers

The study examined demographic trends and statistics related to older drivers; highlighted case studies of recently adopted road-design policies and practices in other states; and summarized issues and recommendations on intersection design for older pedestrians and drivers, signage and traffic-signal design, and assessment, education, and outreach strategies. Priorities and recommendations were made for the state of Delaware.

Year Initiated: 2007

Budget: 68,960

Principal Investigator: Bernard Dworsky, Institute for Public Administration

Project Manager: Mark Luszcz, Transportation Management Center

Asset Management as a Strategic Decision-Making Tool in DelDOT

Asset management has been receiving greater attention at both the state and national level. Escalating demands by the public for increased accountability, aging infrastructure, increasingly constrained resources, new funding challenges, and increasing emphasis on the private provision of public service and public-private partnership all point to the need for asset management. Asset management is a data driven process that is rooted in comprehensive inventory of physical assets and their condition, and the quantification of the impacts of alternative decision.

Year Initiated: 2007

Budget: \$50,000

Principal Investigator: Sue McNeil, Department of Civil and Environmental Engineering

Project Manager: Ralph Reeb, Division of Planning

Research Projects Cont.

Estimating Vehicle-Miles-Traveled by Vehicle Class for the State of Delaware

The objective of this project is to provide vehicle-miles-traveled (VMT) data to fortify the *Annual Mileage Accumulation by Vehicle Class* MOBILE6 input requirement and to conduct accurate MOBILE6 analyses for the state of Delaware.

Year Initiated: 2007

Budget: \$56,337

Principal Investigator: Young-Doo Wang, Center for Energy and Environmental Policy

Project Manager: Mark Glaze, Division of Planning

Advancing Asset Management in DelDOT

Asset management is about the best way to use limited resources. The concepts are based on performance measures and goals and focus on both the long and short term goals of the organization. Asset management provides an opportunity to respond proactively to land use changes, growing demands, aging infrastructure, and safety and security challenges. Many asset management activities are ongoing, however, there is a need to link these various activities, begin to fill the gaps in data and procedures, and explore new tools to support the integration of existing tools to decision-making tools.

Year Initiated: 2008

Budget: \$50,000

Principal Investigator: Sue McNeil, Department of Civil and Environmental Engineering

Project Manager: Curt Cole, Maintenance & Operations

Delaware Travel Monitoring System

The purpose of this project is to provide consultant services to the Division of Planning for the "Delaware Travel Monitoring System" (DTMS). Work will include developing the survey instrument, collecting the data, formatting and keypunching responses, and geocoding.

Year Initiated: 2008

Budget: \$108,362

Principal Investigator: Edward Ratledge, Center for Applied Demography and Survey Research

Project Manager: Michael DuRoss, Division of Planning

Infrastructure Security and Emergency Preparedness

Delaware is in need of an emergency notification plan. This project will evaluate the ripple effect of evacuating, the need to monitor bridges and tunnels, a plan for rapid construction of roads and bridges, and gas supply during emergencies to prevent vehicles from stalling during evacuation. Additionally, security issues will be investigated if there is a bottleneck for travel along I-95 from Washington to New York.

Year Initiated: 2008

Budget: \$52,741

Principal Investigator: Sue McNeil, Department of Civil and Environmental Engineering

Project Manager: Dwayne Day, Transportation Management Center

Integrating Transportation/Transit Planning in the Overall Planning Process

Since DelDOT is responsible for so many roads in Delaware, there is a need for transportation/transit planning to be proactive rather than reactive. Possible elements of the proposed project may include:

- ◇ Creating patterns of future land development that support transit-ready communities
- ◇ Using Local Area Plans as a vehicle for ensuring connectivity, mobility-friendly design, transit-ready components, and layout of subdivision and roads that are conducive to mobility, walkability, and all modes of transit.
- ◇ Addressing MOU's in the planning process: standardization of MOU's and development of additional MOU's regarding implementation and maintenance.

Year Initiated: 2008

Budget \$64,000

Principal Investigator: Edward O'Donnell, Institute for Public Administration

Project Manager: Catherine Smith, Delaware Transit Corporation



Research Projects Cont.

Safe Routes to School for Children – Mode Share Data Analysis

The consequences of children not walking or biking to school include environmental impacts, increased traffic in the vicinity of schools, increased rates of obesity in children and other associated health problems, and often a decrease in the social health of communities. The purpose of this project is to provide mode share data for a sampling of elementary school students for the Delaware Safe Routes To School (SRTS) program. Federal funding is now available specifically for Safe Routes to School (SRTS) initiatives, the need for data on transportation modes of K-8 grade children to and from school is more urgent. Having baseline data and trend analysis for Delaware would enable comparison and evaluation of the progress and success of the program once data is collected after projects and local programs have been implemented.

Year Initiated: 2008

Budget: \$58,000

Principal Investigator: William DeCoursey, Institute for Public Administration

Project Manager: Sara Coakley, Division of Planning



Delaware Transportation Operations Management Plan—New Castle County

Transportation management and operations has long been a priority for DelDOT, and has advanced as a major emphasis in the national transportation program. DelDOT first conducted county-specific “Transportation Operations Management Plans” (TOMPs) in 2000, 2001 and 2002. The data and findings of these plans proved to be very useful throughout the agency. For DelDOT’s Transportation Management program, DelTrac, the plans were instrumental in prioritizing funding and operations resources. DelDOT seeks to update the county-specific TOMPs to reflect current conditions.

Year Initiated: 2009

Budget: \$64,216

Principal Investigator: Earl “Rusty” Lee, Department of Civil and Environmental Engineering

Project Manager: Gene Donaldson, Transportation Management Center

Development and Evaluation of a Residential Allocation Model Using Time-Series Tax Parcel Data in GIS

The product of this research will be a GIS model allowing interactive analysis of growth management problems using tax parcels at the community level while at the same time accounting for countywide growth allocation forecasts. The project will greatly support travel demand forecasting responsibilities and initiatives at DelDOT and will support comment and analysis of development proposals at a more detailed level of geography.

Year Initiated: 2009

Budget: \$91,398 (multiple years)

Principal Investigator: David Racca, Center for Applied Demography and Survey Research

Project Manager: Michael DuRoss, Division of Planning

Transit-Oriented Development (TOD): Identification of Optimal Characteristics in Delaware

The concept of TOD is being more widely implemented by communities throughout the U.S. as a tool to promote smart growth, enhance mobility, curb sprawl, foster multi-modal transportation options, and boost transit ridership. This project will identify optimum site characteristics and if these optimum characteristics apply to potential sites in Delaware. Additionally, strategies will be developed on how to apply these to our state.

Year Initiated: 2009

Budget: \$49,412

Principal Investigator: Edward O'Donnell, Institute for Public Administration

Project Manager: Catherine Smith, Delaware Transit Corporation

2010 – 2012 Regional Travel Demand and Modeling Support

Through this service project, UD will set up, evaluate, and refine an organizational process through which a portion of the current travel demand modeling workload will be conducted at UD.

Year Initiated: 2010

Budget: \$145,245 (multiple years)

Principal Investigator: Earl “Rusty” Lee, Department of Civil and Environmental Engineering

Project Manager: Michael DuRoss, Division of Planning

Research Projects Cont.

Study and Calculation of Travel Time Reliability Measures

The primary goal of the project is to develop and document time reliability performance measures, and methods for management of Delaware-specific vehicle-based time travel data. Standard methods of quantifying and calculating the value of improved reliability will be researched and demonstrated.

Year Initiated: 2010

Budget: \$58,514

Principal Investigator: David Racca, Center for Applied Demography and Survey Research

Project Manager: Gene Donaldson, Transportation Management Center

Abandon, Repair or Improve Roads in the Face of Climate Change?

The objective of this research is to provide DelDOT with a defensible strategy for determining road repeatedly damaged by flooding. This proposed research:

1) explores the legal, institutional and economic dimensions of the decision of whether to abandon, repair or improve roads subject to repeated inundation and damage due to climate change 2) structures a decision tree to quantify systematically the impacts for the decision to abandon, repair or improve a road given the uncertainty associated with climate change.

Year Initiated: 2012

Budget: \$52,065

Principal Investigator: Sue McNeil, Department of Civil and Environmental Engineering

Project Manager: Robert McCleary, Transportation Solutions



Delmarva Freight Study

The DELMARVA Freight Plan will need to reflect intra-regional, inter-regional, and national trends in freight movement and planning. In order to ensure consistency with existing plans and the current state-of-the-practice for freight planning, Whitman, Requardt & Associates (WR&A) will conduct a document review of freight studies and plans in the Delmarva Peninsula, adjoining MPO's, and nationwide. The University of Delaware will assist WR&A with these efforts.

Year Initiated: 2012

Budget: \$34,642

Principal Investigator: Earl "Rusty" Lee, Department of Civil and Environmental Engineering

Project Manager: Michael DuRoss, Division of Planning

Development of a Comprehensive, Multi-model Travel Accessibility Indexing System at the Tax Parcel Level

This project will identify, measure, evaluate, and compare access levels (for auto, transit, bike, and pedestrian modes) at the tax parcel level in Delaware. It will research components of accessibility, develop alternative weighting mechanisms for each mode, and develop a GIS analysis framework (queries and routines) through which accessibility (and potential improvements to accessibility) can be evaluated and presented at the tax parcel level.

Year Initiated: 2012

Budget: \$83,991

Principal Investigator: David Racca, Center for Applied Demography and Survey Research

Project Manager: Michael DuRoss, Division of Planning

Evaluation of Smart Growth Development Patterns and Effects

The objective of the research is to develop, use, and refine a GIS and travel demand model-based evaluation process able to compare independent elements of form and location as they relate to travel characteristics for a series of hypothetical residential subdivisions that could occur throughout Delaware.

Year Initiated: 2012

Budget: \$93,095

Principal Investigator: Earl "Rusty" Lee, Department of Civil and Environmental Engineering

Project Manager: Michael DuRoss, Division of Planning

Research Projects Cont.

Incremental Park and Ride Demand Model

The incremental park and ride demand model calculates and projects expected demand for park and ride facilities. It can be used to predict the incremental demand for a specific parking lot based on housing development projects in nearby areas, or to forecast future demand for the whole park and ride system. It can also be used to identify optimal locations for constructing new park and ride facilities and to project how the new facilities will relieve the traffic for existing facilities.

Year Initiated: 2012

Budget: \$64,365

Principal Investigator: Bintong Chen, Department of Business Administration

Project Manager: Catherine Smith, Delaware Transit Corporation



Soils, Bridges & Structures

Bridge Management Using In-Service Data (Phase II)

The goal of this project is to enhance DelDOT's bridge management efforts through the collection and utilization of in-service strain data. This is a continuation of an earlier project which initiated the effort to collect in-service data on a series of bridges in Delaware.

Year Initiated: 2007

Budget: \$53,908

Principal investigator: Harry "Tripp" Shenton and Michael Chajes, Department of Civil and Environmental Engineering

Project Manager: Douglas Finney, Division of Bridge Design

Construction of Approach MSE Walls to IRIB: Reduction of Geotechnical Field Data

Project objectives are to organize, interpret and analyze collected data from the geotechnical instrumentation at the Indian River Inlet Bridge site construction.

Year Initiated: 2007

Budget: \$62,158

Principal investigator: Dov Leshchinsky and Christopher Meehan, Department of Civil and Environmental Engineering

Project Manager: Douglas Robb, Division of Bridge Design

Establishment of a Geotechnical Information Database

The objective of the proposed work will be to develop a geotechnical information database that can be used by DelDOT for storing, organizing, and easily accessing historical geotechnical data obtained throughout the state.

Year Initiated: 2007

Budget: \$42,000

Principal Investigator: Christopher Meehan, Department of Civil and Environmental Engineering

Project Manager: Wayne Kling, Division of Materials and Research

Investigation of Intelligent Compaction Technology

This research will investigate the possible use of new technologies to gauge soil compaction related to new construction of roadways and bridges.

Year Initiated: 2007

Budget: \$100,729 (multiple years)

Principal Investigator: Christopher Meehan, Department of Civil and Environmental Engineering

Project Manager: James Pappas, Division of Materials and Research



Research Projects Cont.

Testing and Operation of Delaware's First "Smart" Bridge

Funding for this project will support diagnostic tests, analysis and interpretation of data from Bridge I-82I located on Interstate 495 in New Castle County. Additionally guidelines for maintenance of the SB system and integration of new sensor systems will be developed.

Year Initiated: 2008

Budget: \$56,646

Principal Investigator: Harry "Tripp" Shenton, Department of Civil and Environmental Engineering

Project Manager: Jiten Soneji, Bridge Design

2009 – 2012 Instrumentation and Monitoring of the Indian River Inlet Bridge

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, DelDOT 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.

Year Initiated: 2009

Budget: \$1,917,671 (multiple years)

Principal Investigator: Harry "Tripp" Shenton and Michael Chajes, Department of Civil and Environmental Engineering

Project Manager: Douglas Robb, Bridge Design



Field Testing and REM Analysis of the Route 141 Newport Viaduct

Funding for this project will support diagnostic and in-service field tests on the Route 141 Newport Viaduct to quantify the stresses induced in various elements of the box girder by both known truck loads and ambient traffic. These test results will then be used to calibrate a global finite element (FE) model of the bridge. As a result of the work, DelDOT will be better able to develop an effective management strategy for the Newport Viaduct.

Year Initiated: 2009

Budget: \$175,142

Principal Investigator: Michael Chajes, Department of Civil and Environmental Engineering

Project Manager: Jiten Soneji, Bridge Design

In-Service Monitoring for Improved Maintenance and Management of DelDOT Bridges

The goal of this project is to continue enhancement of DelDOT's bridge management efforts through the collection and utilization of in-service strain response data for bridges. This is a continuation of earlier projects which initiated the effort to collect in-service data on a series of bridges in Delaware.

Year Initiated: 2009

Budget: \$49,862

Principal Investigator: Harry "Tripp" Shenton, Department of Civil and Environmental Engineering

Project Manager: Jiten Soneji, Bridge Design

Using Electrical Density Gauges for Field Compaction Control

This project will allow DelDOT to assess the accuracy and repeatability of the Electrical Density Gauge (EDG) for quality control of soil compaction. It will also allow DelDOT to make a smooth transition towards adoption of the EDG as the primary quality control tool for soil compaction, should this outcome be desired by DelDOT upon completion of this research.

Year Initiated: 2009

Budget: \$100,000 (multiple years)

Principal Investigator: Christopher Meehan, Department of Civil and Environmental Engineering

Project Manager: James Pappas, Division of Materials and Research



Research Projects Cont.

Cross-Frame Forces in Skewed Steel I-Girder Bridges

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.

Year Initiated: 2010

Budget: \$91,264 (multiple years)

Principal Investigator: Jennifer McConnell, Department of Civil and Environmental Engineering

Project Manager: Jiten Soneji, Division of Bridge Design

Development of Specifications for the Use of Continuous Compaction Control Systems

The objective of this research project is to develop specifications that can be used to guide the application of Continuous Compaction Control technology to DelDOT field construction projects.

Year Initiated: 2010

Budget: \$50,000

Principal Investigator: Christopher Meehan, Department of Civil and Environmental Engineering

Project Manager: James Pappas, Division of Materials and Research

Design, Construction and Monitoring of a Geosynthetic Reinforced Soil (GRS) Integrated Bridge System (IBS) in the State of Delaware

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.

Year Initiated: 2011

Budget: \$145,179 (multiple projects)

Principal Investigator: Christopher Meehan, Department of Civil and Environmental Engineering

Project Manager: James Pappas, Division of Materials and Research

Non-Destructive Testing Methods to Evaluate the Integrity of Concrete Bridge Decks

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.

Year Initiated: 2011

Budget: \$62,260

Principal Investigators: Thomas Schumacher and Dennis Mertz, Department of Civil and Environmental Engineering

Project Manager: James Pappas, Division of Materials and Research



Baseline Monitoring and Testing of the Indian River Inlet Bridge (IRIB)

This project is phase 2 of the long-term structural health monitoring (SHM) system on the Indian River Inlet Bridge. These funds will be used to conduct various baseline tests, studies and analyses to characterize the baseline performance of the bridge as a permanent record for the future. DelDOT 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 the significant resource.

Year Initiated: 2012

Budget: \$446,458 (multiple years)

Principal Investigator: Harry "Tripp" Shenton and Michael Chajes, Department of Civil and Environmental Engineering

Project Manager: Barry Benton, Bridge Management

Capacity of Reinforced Concrete Moment Frame Culverts

The Delaware Department of Transportation maintains a large number of short-span bridges, so-called reinforced concrete moment frame culverts, which were built before the 1950's. Many of these structures do not pass current load ratings despite their superior in-service performance. This research project will assess the latest bridge analysis procedures and conduct full-scale laboratory experiments to develop a new evaluation methodology specifically for this type of structure.

Year Initiated: 2012

Budget: \$72,984

Principal Investigator: Thomas Schumacher, Department of Civil and Environmental Engineering

Project Manager: Ping Jiang, Bridge Design

Research Projects Cont.

Verification of Design of a Novel Mechanically Stabilized Earth Wall at the Christiana Interchange

A novel type of mechanically stabilized earth wall will soon be constructed at the Christiana interchange. It is a critical structure serving as access to the bridges comprising the interchange. This wall will be instrumented to ensure that it meets the design assumptions. Interpretation of the measured results, during and after construction, requires a thorough understanding of the design. The principal investigator (PI) will reduce the measured data and interpret the results and will be available on call to help DelDOT resolve potential issues during the construction.

Year Initiated: 2012

Budget: \$36,432

Principal Investigator: Dov Leshchinsky, Department of Civil and Environmental Engineering

Project Manager: Barry Benton, Bridge Design



Traffic and ITS

2007-2012 GPS Travel Time and Delay Data Collection and Analysis

This longitudinal study uses the state-of-the-art equipment in receiving satellite position information for collecting real-time statewide traffic data. The data is then analyzed and displayed by Geographic Information Systems software.

Year Initiated: 2001

Budget: \$695,034 (multiple years)

Principal Investigator: Ardeshtir Faghri, Department of Civil and Environmental Engineering

Project Manager: Mark Eastburn, Division of Planning

A Meta-Analysis of Studies, Projects and Practices on Planning for a Sustainable Environment with Special Emphasis on the States of Vermont and Delaware

The main objectives of this study are to: 1) research the extent of the sprawl dilemma in Delaware, 2) review integrated policies aims at achieving a possible balance among land-use, transportation and environment, 3) understand benchmark processes used for integrate environmental decision making, 4) develop a framework for integrated environmental policy making that can be adopted in Delaware

Year Initiated: 2007

Budget: \$37,500 (multiple years)

Principal Investigators: Young-Doo Wang, Center for Energy and Environmental Policy and Chandra Aleong, Delaware State University

Project Manager: Ralph Reeb, Division of Planning

An Examination and Presentation of Travel in Sussex County

Sussex County needs to be the focus of a comprehensive compilation and presentation of available travel and demographic data including origins and destinations, projections and their impacts, trip purpose, employment, seasonal variation, and trip generation. Available population projections also need to be examined in terms of future impact to areas in Sussex County. The Delaware Transportation Monitoring System, the National Travel Survey, and the Census 2000 CTPP are among practically untapped data sources. These together with Travel Demand Forecasting outputs, traffic studies, and traffic counts could provide a vital resource for planning and understanding for the public. Methods for dissemination of travel demand and traffic count information need to be developed.

Year Initiated: 2007

Budget: \$45,889

Principal Investigator: David Racca, Center for Applied Demography and Research

Project Manager: Michael DuRoss, Division of Planning

2008 – 2012 ITS Lab Baseline Service

The objectives of this project are to establish the Intelligent Transportation Systems Laboratory as a state-of-the-art facility with three focus areas – service to the Delaware Department of Transportation (DelDOT); training for DelDOT and classroom instruction support; research facility for university faculty and students.

Year Initiated: 2008

Budget: \$163,887 (multiple years)

Principal Investigator: Earl "Rusty" Lee, Department of Civil and Environmental Engineering

Project Manager: Gene Donaldson, Transportation Management Center

Research Projects Cont.

Use of Roundabouts as Alternatives to All-Way-Stop Controls

The objective of this project is to determine how successfully roundabouts will perform in Delaware. This will be determined by carrying out field observations (and software analysis) of the existing roundabouts to make assessments on geometric design parameters, driver/bicyclist behavior in and approaching roundabouts, and pedestrian issues.

Year Initiated: 2008

Budget: \$19,982

Principal Investigator: Ardeshir Faghri and Stephen Mensah, Department of Civil and Environmental Engineering

Project Manager: Daniel LaCombe, Division of Planning

2009 – 2012 Delaware Signal Timing Enhancement Partnership (DSTEP)

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

Year Initiated: 2009

Budget: \$201,639 (multiple years)

Principal Investigator: Earl Lee, Department of Civil and Environmental Engineering

Project Manager: Gene Donaldson, Transportation Management Center

Enhanced Pedestrian Crossings

This research will focus on two issues: 1) experimenting with alternatives to MUTCD standards for crossing signals and 2) determining best practices for installing accessible pedestrian signals.

Year Initiated: 2009

Budget: \$47,213

Principal Investigator: Earl Lee, Department of Civil and Environmental Engineering

Project Manager: Mark Luszcz, Transportation Management Center



2010-2012 Travel Demand Modeling Support

Support for this project will assist DelDOT with the development, maintenance, application and evaluation of a travel demand forecasting model. The model supports planning studies for Delaware's MPOs and various DelDOT sections on an as-needed basis.

Year Initiated: 2010

Budget: \$145,245 (multiple years)

Principal Investigator: Rusty Lee, Department of Civil and Environmental Engineering

Project Manager: Michael DuRoss, Division of Planning

Effective Countermeasures for Crash Reduction at Unsignalized Intersections for Two-Lane Undivided Roadways

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

Year Initiated: 2011

Budget: \$42,632

Principal Investigator: Ardeshir Faghri, Department of Civil and Environmental Engineering

Project Manager: Adam Weiser, Transportation Management Center

Pavement Markings and Signing to Support Senate Bill 120

Senate Bill 120, recently signed by the Governor into law, allows bicyclists to both use the shoulder, as well as travel straight through an intersection from a lane otherwise designated as a right-turn only lane. This research will investigate signing and striping options for intersections. The Delaware Manual on Uniform Traffic Control Devices specifies five basic requirements for a traffic control device—Fulfill a need; command attention; convey a clear, simple meaning; command respect from road users; and give adequate time for proper response. This research will work under these five basic principles in developing new markings to meet the requirements of Senate Bill 120.

Year Initiated: 2012

Budget: \$58,312

Principal Investigator: Earl Lee, Department of Civil and Environmental Engineering

Project Manager: Mark Luszcz, Transportation Management Center

Research Projects Cont.

Transit

A Feasibility Study of Bus Rapid Transit (BRT) in Delaware

Project will determine the feasibility of deployment of Bus Rapid Transit in the state of Delaware through a comparative review of selected localities that have successfully deployed BRT and an assessment of the necessary attributes to support BRT in Delaware.

Year Initiated: 2007

Budget: \$72,577

Principal Investigator: Bernard Dworsky, Institute for Public Administration

Project Manager: Catherine Smith, Delaware Transit Corporation

Optimizing Accessible Taxi Service to Augment Traditional Public Transit Services in Delaware

Is taxi service an option for the disabled or people who do not drive? Is taxi service cheaper than paratransit? This project will explore a possible expansion of accessible taxi-based transportation initiatives, to augment traditional public transit services, particularly in Kent and Sussex Counties, and expand mobility options for Delawareans at the most efficient cost.

Year Initiated: 2008

Budget: \$58,000

Principal Investigator: Douglas Tuttle, Institute of Public Administration

Project Manager: Catherine Smith, Delaware Transit Corporation



Improving Access to Taxi Service – Delaware’s “Missing” Transit Mode

This research project will build upon a recent IPA report that was intended to identify ways to optimize accessible taxi service to augment traditional public transit service in Delaware. Instead, that report documented the complete absence of accessible vehicles within Delaware’s current taxi fleet, as well as certain organizational and procedural barriers that must be overcome in order to make taxis a more attractive transit option in the First State. The focus of this new project will be on the identification and prioritization of fiscally viable alternatives that can remove those barriers and transform taxi service from Delaware’s “missing” transit mode into a truly affordable, available, and accessible transportation alternative.

Year Initiated: 2012

Budget: \$53,643

Principal Investigator: Douglas Tuttle, Institute of Public Administration

Project Manager: Catherine Smith, Delaware Transit Corporation

University Transportation Center

Department of Transportation Tier II UTC

Focusing on highway, transit, and freight corridors, the UDUTC addresses problems of national importance as well as those that are specific to Delaware but have the potential for results that are transferable to other parts of the country. Advanced research focuses on the use of data to better understand and improve the resiliency of transportation corridors to both short- and long-term pressures and the development of tools to support the integrated management of corridors.

Year Initiated: 2005

Budget: \$2,221,600

Principal Investigator: Sue McNeil, Department of Civil and Environmental Engineering

Project Manager: Amy Stearns, Research and Innovative Technology Association (RITA), Federal Department of Transportation

Department of Transportation Tier I Rutgers University UTC Consortium

As part of the consortium led by the Center of Advanced Infrastructure and Transportation (CAIT) at Rutgers University, the University of Delaware’s primary area of research will be the State of Good Report (SGR) with Safety and Economic Competitiveness as secondary areas. These three have been identified as USDOT strategic interrelated areas and will impact the overall transportation system’s performance.

Year Initiated: 2012

Budget: \$300,000

Principal Investigator: Sue McNeil, Department of Civil and Environmental Engineering

Project Manager: Dawn Tucker-Thomas, Research and Innovative Technology Association (RITA), Federal Department of Transportation

Research Projects Cont.

Fuel Cell Bus

This project is a research effort to develop, build, and deploy a fleet of fuel cell powered hybrid transit vehicles, and a hydrogen refueling station on the UD campus and within the State of Delaware. Fuel cell technology offers the potential to reduce our reliance on foreign oil supplies and to decrease the effects of harmful emissions on our environment. The project will focus on developing fuel cell powered technology demonstration vehicles, establishing a refueling infrastructure, and conducting reliability, safety, and durability studies.

Year Initiated: 2005

Budget: \$10,248,508 (multiple years)

Principal Investigator: Ajay Prasad, Department of Mechanical Engineering

Project Manager: Sean Ricketson, Federal Transit Administration

Implementation Status: Three fuel cell buses in operation on campus, on-going project

Fuel Cell Bus Program

Background

Hydrogen-powered fuel cells are highly efficient and produce zero emissions at their point of use. For these reasons, fuel cells have the potential to alleviate major concerns facing the nation today such as dependence on foreign petroleum, emission of greenhouse gases, and urban air quality. In particular, fuel cells are well suited for automotive use, especially in urban transit vehicles. The urban driving schedule of transit vehicles is perfectly matched to the fuel cell-hybrid drive train, and the centralized aspect of refueling and maintenance greatly simplifies the hydrogen infrastructure issue. Despite their promise, fuel cells today face significant challenges for commercialization, including cost and durability, which translate to research opportunities.

UD Center for Fuel Cell Research Mission

Since the initial fuel cell bus grant by the Federal Transit Administration to the Delaware Center for Transportation and the Department of Mechanical Engineering in 2005, the program is now in its fifth phase with over \$10 million in grant funding. A center was established in December 2008, dedicated to all aspects of fuel cell research. The mission of the UD Center for Fuel Cell Research (CFCR) is as follows:

- To promote basic and applied research to improve fundamental understanding of fuel cells, and address critical barriers to commercialization
- To provide students with the opportunity to participate in fuel cell research and demonstration projects
- To support companies engaged in the development of fuel cells, as well as hydrogen production, storage and distribution
- To create an opportunity for national and international recognition and a platform for economic growth in Delaware

Background for the CFCR:

- Sustainability has risen to the forefront at the national and state levels, and on the UD campus. The CFCR builds on this favorable climate for sustainable energy technologies in general, and fuel cells in particular.
- About 25 faculty in the College of Engineering and the College of Arts and Sciences are engaged in fuel cell research. They have established laboratories for fundamental and applied fuel cell research, attracted a large group of student and post-doctoral researchers, become a visible presence at fuel cell conferences, and published in the top journals in the field.
- Our efforts have been strongly supported by our congressional delegations.
- The State of Delaware is home to major fuel cell/hydrogen infrastructure corporations including DuPont, WL Gore, Bloom Energy, Air Liquide, Air Products and Ion Power.

CFCR Industrial Sponsors:



Research Projects



The first bus (Phase 1) of this fleet has been in operation since April 2007, and transports students daily from the Laird Campus to their classes and back. The bus refuels at the hydrogen refueling station installed by Air Liquide at their Delaware Research and Technology Center in Newark. The second bus (Phase 2), which is an improved version of the Phase 1 bus with a dual fuel cell stack, has been in operation since November 2009. A

larger, 40-foot Phase 3 bus is in its final stage of fabrication and will be delivered in early 2014. It will employ a triple fuel cell stack and advanced Lithium-Titanate batteries for hybrid operation. Finally, a Phase 4 vehicle, employing a quadruple stack and larger hydrogen storage capacity will be added to the fleet in 2014. A new fuel cell bus parking and maintenance facility has been developed at UD's STAR campus. For now the buses will continue to refuel at Air Liquide. Plans to locate a new hydrogen refueling station at the STAR campus are being evaluated. Sponsors of UD Fuel Cell Bus Program include the Federal Transit Administration, and Delaware Department of Natural Resources and Environmental Control.



Bus #	Size	Stack	Batteries	H2 Storage	Operation
1	22-ft	20 kW	Ni-Cad	12.8 kg	2007
2	22-ft	40 kW	Ni-Cad	12.8 kg	2009
3	40-ft	60 kW	Li-Ti	19.2 kg	2014*
4	40-ft	80 kW	Li-Ti	25.6 kg	2014*

*Expected Delivery

H₂ Refueling station at Air Liquide

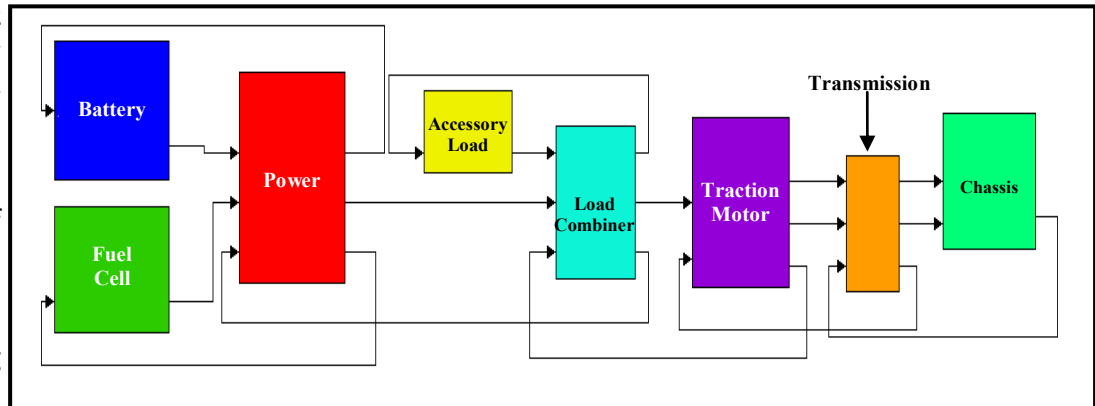


One of the major innovations of the UD Fuel Cell Bus Program is a simulation tool developed in Matlab/Simulink. Within this software tool, every sub-system on the bus including the fuel cell, batteries, chassis, traction motor, power combiner, balance-of-plant, and accessories has its own dedicated model. The sub-systems are packaged together to create a "virtual bus" which is then driven on the same drive cycle as the physical bus using position and speed data acquired by an on-board GPS unit. The key outputs of the virtual bus, such as hydrogen consumption, system efficiency, and battery state-of-charge, are compared with physical data acquired by on-board sensors on the actual bus. Our

software tool gives predictions that are within 5% of experimental observations. We can now use this validated software as a reliable design tool. Such simulation tools are a cost-effective way to model the design and performance optimization of power systems before committing to hardware implementation. Design features that can be thoroughly tested in software include the chassis size and weight, degree of hybridization, battery chemistry, fuel cell and balance-of-plant components, hydrogen storage, and power management strategies.

Research Projects Cont.

Another important innovation is our Real-Time Data Acquisition and Presentation system. The system uses a variety of on-board sensors to collect data from many different sources, including vehicle computer state, high voltage power flow, vehicle



[Matlab/Simulink simulation tool for fuel cell hybrid buses](#)

position, speed, and acceleration, fuel cell system state, and individual cell voltages in the fuel cell stack. A system has been developed to record all of these data and to automatically transmit them via a cellular link to a server in the lab. Programs working in the background continuously analyze the incoming data to provide information to multiple user communities: they provide detailed data to researchers who wish to analyze the buses' performance, it sends immediate warnings of vehicle faults to the staff responsible for maintenance, and it compiles an operational history of the bus with important information about each run, which is available for public web access.

Anyone with internet access can observe in real-time where the buses are on their respective routes, how much power the fuel cell is producing, the rate of hydrogen consumption, the battery state-of-charge, the system efficiency, etc.

There are only about 5 fuel cell buses in daily operation across the nation. Hence a significant portion of the nation's fuel cell bus efforts resides at the University of Delaware. The UD Fuel Cell Bus Program can be proud of its accomplishments over the past few years. The program has made important strides in developing reliable and affordable fuel cell systems for urban transit, involving undergraduate and graduate students in fuel cell research and development projects, demonstrating this technology to transit agencies, and conducting education and outreach to the wider public community about the benefits of fuel cells for urban transit.



From left: Professors Ardeshir Faghri, Suresh Advani and Ajay Prasad in front of UD's first Hydrogen Fuel Cell Bus

PUBLICATIONS

DCT Publications are the final technical reports which have been reviewed by the project manager. Many of them are the Masters or Doctoral Theses for the graduate student working on the project. Full publications can be viewed on our website www.ce.udel.edu/dct/publications. Listed are the titles of DCT published reports from 2007-2012.



<u>ENVIRONMENTAL</u>				
Report Title	Report Number	Author(s)	Department	Publication Date
Long-Term Performance Monitoring of a Recycled Embankment in Wilmington, Delaware	232	Victor Kaliakin, Christopher Meehan, Nii Atttoh-Okine, Paul Imhoff	Department of Civil and Environmental Engineering	December 2012
Impacts of Bird Droppings and Deicing Salts on the Highway Structures: Monitoring, Diagnosis, Prevention	221	Chin Pao Huang & Gregory Lavenburg	Department of Civil and Environmental Engineering	April 2011

<u>PAVEMENT AND MATERIALS</u>				
Report Title	Report Number	Author(s)	Department	Publication Date
RAP Methodology: Previous Experimental Results and Creep Behavior with Geocell Reinforcement	233	Nii Atttoh-Okine	Department of Civil and Environmental Engineering	December 2012
Risk Analysis of a Scrap Tire Embankment	216	Nii Atttoh-Okine & Olufikayo Oluwaseun Aderlinlewo	Department of Civil and Environmental Engineering	September 2011
Delaware Hot Mix Asphalt Pavement Noise Study	218	Nii Atttoh-Okine	Department of Civil and Environmental Engineering	June 2007
Thin Overlay Maintenance Treatment Application in Delaware Communities	217	Nii Atttoh-Okine & Hong Joon Park	Department of Civil and Environmental Engineering	June 2007

<u>PLANNING</u>				
Report Title	Report Number	Author(s)	Department	Publication Date
Advancing Asset Management at DelDOT	230	Sue McNeil & Qiang Li	Department of Civil and Environmental Engineering	November 2012
Infrastructure Security and Emergency Preparedness: Selecting Asset Protection Strategies	228	Sekine Rahimian & Sue McNeil	Department of Civil and Environmental Engineering	June 2012

Publications Cont.

PLANNING (CONTINUED)				
Report Title	Report Number	Author(s)	Department	Publication Date
Safe Routes to School Mode-Share Analysis	219	William DeCoursey & Edward O'Donnell	Institute for Public Administration	July 2011
Development and Evaluation of a Residential Allocation Model Using Time Series Tax Parcel Data in GIS	209	David Racca	Institute for Public Administration	June 2011
Transit-Oriented Development (TOD): Identification of Optimal Characteristics in Delaware	206	Edward O'Donnell & Theodore Patterson	Center for Applied Demography & Survey Research	June 2010
Integrating Transportation/Transit Planning in the Overall Planning Process	202	Edward O'Donnell & Theodore Patterson	Institute for Public Administration	June 2009
Asset Management as a Strategic Decision-Making Tool in DelDOT	189	Sue McNeil	Department of Civil and Environmental Engineering	June 2008
Delaware's Elderly Driver	184	Bernard Dworsky & Julia O'Hanlon	Institute for Public Administration	June 2007
Succession Planning, Phase II	182	Douglas F. Tuttle	Institute for Public Administration	June 2007

SOILS, BRIDGES AND STRUCTURES				
Report Title	Report Number	Author(s)	Department	Publication Date
Testing and Analysis of the Route 141 Newport Viaduct: Fatigue Evaluation	227	Harry W. Shenton, III, Michael Chajes, Daniel Kucz, James Quigley & Jose Soto Fuentes	Department of Civil and Environmental Engineering	June 2012
Testing and Operation of Delaware's First Permanently Instrumented "Smart" Bridge	225	Harry W. Shenton, III & Douglas Nathaniel Charles	Department of Civil and Environmental Engineering	January 2012
In-Service Monitoring for Improved Maintenance and Management of DelDOT's Bridges	223	Harry W. Shenton, III & Kevin S. Connor	Department of Civil and Environmental Engineering	January 2012
Effective Width of Concrete Slab Bridges in Delaware	208	Harry W. Shenton, III & Brian P. Jones	Department of Civil and Environmental Engineering	January 2012
Using Electrical Density Gauges for Field Compaction Control	220	Christopher L. Meehan & Jason S. Hertz	Department of Civil and Environmental Engineering	December 2011
Establishment of a Geotechnical Information Database	207	Christopher Meehan	Department of Civil and Environmental Engineering	July 2010
An Investigation of Continuous Compaction Control Systems	204	Christopher Meehan & Faraz Sadeghi Tehrani	Department of Civil and Environmental Engineering	July 2009

Publications Cont.

SOILS, BRIDGES AND STRUCTURES (CONTINUED)

Report Title	Report Number	Author(s)	Department	Publication Date
An Investigation of Continuous Compaction Control Systems	204	Christopher Meehan & Faraz Sadeghi Tehrani	Department of Civil and Environmental Engineering	July 2009
Case History: Strain and Force Distribution in HDPE Reinforced Wall	203	Christopher Meehan, Dov Leshchinsky & Baris Imamoglu	Department of Civil and Environmental Engineering	June 2009
Scour Monitoring of the Indian River Inlet Bridge: Pilot Study	200	Jennifer Righman, Jack Puleo, Jamie MacMahan & Michael Chajes	Department of Civil and Environmental Engineering	January 2009
Instrumented Geogrid Reinforced Mechanically Stabilized Earth Wall Undergoing Large Settlement	197	Dov Leshchinsky, Christopher Meehan & S.A. Berkheimer	Department of Civil and Environmental Engineering	May 2007
Load Rating of Bridges without Plans	195	Harry W. Shenton, III, Michael J. Chajes, & J. Huang	Department of Civil and Environmental Engineering	November 2007
Development of Delaware's First "Smart Bridge"	194	Nicole Reader, Michael J. Chajes & Harry W. Shenton, III	Department of Civil and Environmental Engineering	October 2007
Load Rating Using an In-Service Monitoring System	190	Harry W. Shenton, III, Michael J. Chajes & B.O. Brooks	Department of Civil and Environmental Engineering	September 2007
Moment Redistribution & Service II Limit State	185	Jennifer Righman McConnell & Michael Zettlemoyer	Department of Civil and Environmental Engineering	August 2007

TRANSIT

Report Title	Report Number	Author(s)	Department	Publication Date
Optimizing Accessible Taxi Service to Augment Traditional Public Transit Services in Delaware	222	Douglas Tuttle & Kristen Eaton	Institute for Public Administration	January 2012
Applications of Carsharing in Small Cities in the United States: A Framework for Implementation and Analysis	205	Adam Catherine & Ardeshir Faghri	Department of Civil and Environmental Engineering	Spring 2007
Feasibility of Bus Rapid Transit Within the Mid-Atlantic Region	234	Bernard Dworsky, Marcia Scott, William DeCoursey, Todd Franzen	Institute for Public Administration	June 2009

TRAFFIC & ITS

Report Title	Report Number	Author(s)	Department	Publication Date
New Castle County Transportation Operations Management Plan (TOMP) 2010	235	Earl Lee, Holly Rybinski, David Racca, Chuoran Wang & Dan Brown	Department of Civil and Environmental Engineering	March 2010

Publications Cont.

TRAFFIC AND ITS (CONTINUED)				
Report Title	Report Number	Author(s)	Department	Publication Date
Application of Global Positioning System (GPS) to Travel Time and Delay Measurements	231	Ardeshir Faghri & Mingxin Li	Department of Civil and Environmental Engineering	Summer 2012
Study and Calculation of Travel Time Reliability Measures	229	David Racca & Daniel T. Brown	Center for Applied Demography & Survey Research	November 2012
Safety at Rural Non-Signalized Intersections in Delaware	226	Ardeshir Faghri & Rebecca Frey	Department of Civil and Environmental Engineering	September 2012
Application of Global Positioning System (GPS) to Travel Time and Delay Measurements: Fall 2009 and Summer 2010	224	Ardeshir Faghri, Robert Suarez & Morteza Tabatabaie Shourijeh	Department of Civil and Environmental Engineering	April 2012
The Delaware Signal Timing Enhancement Partnership (DSTEP) Corridor 2, SR 72, Newark	215	Earl Lee, Mindy Laybourne & Trevor Booz	Department of Civil and Environmental Engineering	September 2011
The Delaware Signal Timing Enhancement Partnership (DSTEP) Corridor 1, Cleveland Avenue, Newark	214	Earl Lee, Laura Black & Trevor Booz	Department of Civil and Environmental Engineering	September 2011
MUTCD Experimentation with Countdown Pedestrian Signals and Change Intervals	211	Earl Lee, Mark Luszcz & Rudy Bedeley	Department of Civil and Environmental Engineering	October 2011
Application of Global Positioning System (GPS) to Travel Time and Delay Measurements	210	Ardeshir Faghri, Robert Suarez, Morteza Tabatabaie Shourijeh	Department of Civil and Environmental Engineering	September 2010
Application of Global Positioning System (GPS) to Travel Time and Delay Measurements	201	Ardeshir Faghri	Department of Civil and Environmental Engineering	August 2010
Use of Roundabouts as Alternatives to All-Way Stop Controls	199	Stephen Mensah and Sepideh Eshragh	Department of Civil and Environmental Engineering	August 2010
Fall 2008 WILMAPCO New Castle Co. DE, & Cecil Co., MD - Travel Time, Speed and Delay Data Collection Presentation	198	Ardeshir Faghri	Department of Civil and Environmental Engineering	Fall 2008
Application of Global Positioning System (GPS) to Travel Time and Delay Measurements	192	Ardeshir Faghri	Department of Civil and Environmental Engineering	October 2008

PRINCIPAL INVESTIGATOR & PROJECT MANAGER MEETINGS



Project Manager Mark Glaze and Principal Investigator Young Doo Wang, discuss the progress of their project, Estimating Vehicle-Miles-Traveled by Vehicle Class for the State of Delaware.

The Principal Investigator (PI) and Project manager (PM) meetings are held once a year. The meeting is typically held in the fall where the PIs and PMs have the opportunity to give an overview of the newly funded projects for the coming academic year. Each PI is to give a report on his/her project followed by a discussion with all participants. Afterwards, each Principal Investigator has the opportunity to meet with his/her Project Manager to discuss their current research project. The objectives of the meeting are: 1) to disseminate overview information about the DCT projects, including administrative information; 2) to hear brief overviews by the researchers on their planned research; 3) to encourage dialogue between the PIs and PMs so that the PIs can better understand how their research may ultimately be used by DelDOT; and 4) to facilitate the future exchange of information between the PI and PM. Graduate students who are working on projects are encouraged to attend.

The following PI/PM Meetings were held each year at the University of Delaware.

October 1, 2007
December 17, 2008
October 2, 2009
October 22, 2010
January 11, 2012
October 29, 2012



DCT Director, Arde Faghri heads the round-table discussion for the 2010 PI/PM Meeting

TRANSPORTATION RESEARCH SHOWCASE



DCT Director, Ardeshr Faghri and DelDOT Transportation Secretary, Shailen Bhatt at the 2012 Research Showcase

In the Spring, DCT researchers, graduate students and staff travel to Dover to sponsor an annual "Transportation Research Showcase". Each Principal Investigator and graduate student(s) hosts a poster session for his/her current status on their project(s). The major categories featured in this showcase are: Environmental, Pavement and Materials, Planning, Structures and Bridges, Traffic and ITS, and Transit, along with the projects sponsored by UTC. Visitors to this showcase include personnel from DelDOT, FHWA, Delaware Legislature, University of Delaware, and private industry. The showcase gives attendees the opportunity to speak with the Principal Investigator on a one-to-one basis about their ongoing project.

Research Showcase cont.**Research Showcases 2007-2012**

April 30, 2007, Paradee Center, Dover, DE

May 6, 2008, Paradee Center, Dover, DE

May 4, 2009, Paradee Center, Dover, DE

May 5, 2010, DeIDOT Administrative Bldg., Dover, DE

May 9, 2011, DeIDOT Administrative Bldg., Dover, DE

May 9, 2012, Paradee Center, Dover, DE



DISTINGUISHED GUEST SPEAKER SERIES

Several times a year, the Delaware Center for Transportation will invite guest speakers to the University to present talks on important transportation-related issues. Many of these lectures are co-sponsored with the University of Delaware's University Transportation Center (UTC) For co-sponsored talks with UTC, refer to the UTC section of this report on pages 44-46.

The following were DCT Distinguished Guest Speakers:

April 16, 2010—Doug Hill, Principal with Town Point Development

"Transit Oriented Design, Realities and Possibilities in Rural Mixed Use Design"

Mr. Hill discussed the realistic challenges and exciting possibilities of creating a mixed use development in a rural environment that embraces many elements of transit oriented design, low impact design, LEED design, and New Urbanism.



April 9, 2010—James M. Mwape, E-ZPass Interagency Group

"Electronic Toll Collection (TC) and how it increasingly saves time, money and environmental impacts"

There are an estimated 28 million ETC transponders in use in the US alone, and there are a number of recognized brand names for these systems across the country. While we in the northeast recognize E-ZPass, Florida has the SunPass, and Texas has TxTag. US Department of Transportation's push by interoperability in the tolling industry creates new challenges and opportunities and Mr. Mwape will speak of the difficulty in finding ETC knowledgeable graduates and describe potential career opportunities.



March 19, 2010—Tom Vanderbilt, New York Times Best Selling Author

"Objects in Mirror Are Closer Than They Appear"

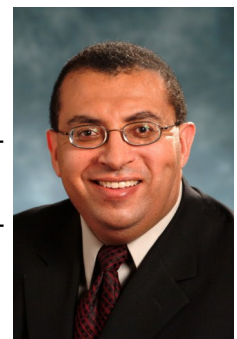
Mr. Vanderbilt is the best selling author of TRAFFIC—WHY WE DRIVE THE WAY WE DO (and what it says about us). Tom's research led him around the world and exposed him to hundreds of transportation experts of all persuasions. In TRAFFIC, he explores the conventional wisdom of traffic design, the counter-intuitive, and everything in between.



May 4, 2007—Dr. Khaled Hamad, Texas Transportation Institute

"Applications of Archived ITS Data at TransGuide"

Transportation management centers (TMCs) generate and archive enormous amounts of transportation data. Archived intelligent transportation system (ITS) data applications today tend to focus on ITS data as a resource for transportation planning, mainly for the generation of aggregated system performance measures such as corridor travel times, speeds, and delays. As ITS data applications increase, interest is also growing in using archived ITS data to help optimize TMC operations. One area of considerable interest is incident management. This presentation focused on freeway ITS features and data. It described a prototype geographically reference framework for ITS data and summarized spatial and temporal patterns in distribution of incidents along instrumented freeways in San Antonio, Texas. This analysis could be useful to help optimize freeway incident management practices.



DELAWARE T²/LTAP CENTER

About the T²/LTAP Center



Under the direction of Earl “Rusty” Lee, the T² Center (Technology Transfer)/LTAP (Local Technical Assistance Program) at the DCT is associated with 58 other centers throughout the United States and Puerto Rico. Primarily funded by the Federal Highway Administration and the state departments of transportation, most centers serve multiple transportation agencies. The Delaware Center was established in 1988 at DelDOT and relocated in 2002 to the University of Delaware.

The Center works with DelDOT, FHWA, regional transportation planning agencies, and city and town public works departments. The Center’s main objective is to provide training and assistance in the areas of highway safety, infrastructure management and workforce development. Additionally, the center distributes a quarterly newsletter (TRAVEL-LOG) via email to more than 600 federal, state, and local transportation specialists; elected officials; consultants; and others. The center staff includes Mr. Matheu Carter, P.E., who is the Center’s circuit rider engineer. He is available to make on-site visits to Delaware’s towns and cities to offer technical assistance on a variety of issues such as pavement repairs, asset management, and compliance with federal and state mandates. The Center is also assisted by Sandra Wolfe whose responsibilities include scheduling and handling the logistics of the training workshops, classes and seminars.

Program Vision and Operational Standard

The core business of the LTAP/T² Center is to conduct one on one assistance, training and technology transfer in the form of workshops, seminars, and conferences. Our principal customers in this regard are local transportation agencies, DelDOT, and the FHWA. Other customers include the WILMAPCO and Dover-Kent MPO’s, the Delaware River and Bay Authority, consultants, and the facilities staff of the University of Delaware.

The Center’s operational standard is to provide the training that our customers want. These are some of the steps the Center takes to assure that standard is met:

1. Regularly meet with representatives of DelDOT to create a prioritized list of workshops, seminars, etc. Some DelDOT divisions go through a formal procedure to establish their technology transfer priorities, while others adopt less formal techniques.
2. Local governments usually transmit their training and technology transfer priorities during our circuit rider’s on-site visits. Additional requests are generated by telephone calls, emails, and conversations at meetings.
3. National Highway Institute (NHI) and Federal Highway Administration (FHWA) contact us regarding new workshop opportunities. After discussions with our customers we schedule those that look most promising.
4. We review newsletters of other T² Centers, journals, periodicals, the LTAP forums, etc. in search of innovative technology transfer topics we may bring to Delaware.

When selecting the annual program of events, the Center must be cognizant of the strategic plans and other documents that DelDOT, FHWA, and other agencies produce. Our intention is always to structure our offerings to be in line with where our customers want to be in the future.

The program must always be demand-responsive. That is, a training system must exist that is meeting the current needs of the client and yet adaptable to their future needs. The Center must remain flexible and work with our customer base at DelDOT and local governments and agencies to seek out the training

Delaware T²/LTAP Center Cont.

needs. A long-range vision training program offers little in the way of flexibility and cannot readily adapt to new requirements. The Center must be ready to train clients on these new requirements while also helping them develop their workforce.

Delaware T²/LTAP Center Work Program

The Delaware LTAP/T² Center provides transportation training seminars and workshops to local and state personnel as part of its mission. Many of these are free to members of public agencies. Course descriptions and registration forms are listed on the T² Center website (www.ce.udel.edu/dct/t2/t2.htm) and all public agencies and private sector professionals are encouraged to take advantage of these offerings. Often, courses sponsored here are developed by the Federal Highway Administration and presented across the country, but courses focusing on specific issues in Delaware are also developed and presented. We want to make sure our offerings are relevant to the needs of Delaware's public agencies.

2007 Training

<u>Worker/Work Zone Safety</u>	<u># Sessions</u>
Work Zone Design and Safety	2
<u>Highway Safety</u>	<u># Sessions</u>
Pedestrian Facility Design	1
Safety Conscious Planning	1
<u>Infrastructure Management</u>	<u># Sessions</u>
Advancing Transportation Systems	1
Annual DelDOT Maintenance and Operations Workshop	1
Annual DelDOT Pavement and Materials Workshop	1
Asphalt Pavement Recycling Technology	1
Geosynthetic Applications for Stormwater Runoff	1
Integrating Transportation and Land Use Planning: How the Connections Really Work	1
Pavement Distress Identification	1
Pedestrian Facility Design (NHI)	1
Right-of-Way Appraisers' Course	1
Subsurface Investigations (NHI)	1
Urban Drainage Design	1
<u>Workforce Development</u>	<u># Sessions</u>
Asset Management	1
Geotechnical Software Training	2
Geosynthetics for Local Governments Workshop	1
Must We Keep Meeting Like This?	1
NEPA: Project Development and Transportation Decision Making	1

Delaware T²/LTAP Center Cont.

2008 Training

Highway Safety	# Sessions
Emergency Evacuation Planning	1
Freight Planning and Environmental Considerations - FHWA	1
Safety Circuit Rider Program	2
Infrastructure Management	# Sessions
Annual DelDOT Winter Training	1
Annual DelDOT Pavement and Materials Workshop	1
Chip Seal Pavements	1
Concrete Pavement Workshop	1
Context Sensitive Design	1
Culvert Design	1
Drainage Management System for Local Governments Using PWS DrainsMS	1
Economic Evaluation of Highway Projects	1
Fracture Critical Inspection Techniques for Steel Bridges (NHI)	1
HEC-RAS River Analysis Systems	1
Highways for Life Workshop	1
Pavement Management Systems for Local Governments Using PWS RSMS	1
Pavement Preservation	1
Tire Pavement Noise	1
Urban Drainage Design	1
Workforce Development	# Sessions
Honing Your Presentation Skills	1



Delaware T²/LTAP Center Cont.



2009 Training

<u>Worker/Work Zone Safety</u>	# Sessions
OSHA 10-Hr. Training	2
<u>Highway Safety</u>	# Sessions
Guardrail Installation Training (NHI)	1
Work Zone Training	1
<u>Infrastructure Management</u>	# Sessions
Annual DelDOT Winter Training	1
Annual DelDOT Pavements and Materials Workshop	1
APWA Click, Listen and Learn: Retroreflectivity Seminar	1
Context Sensitive Design	1
Highway/Utility Issues (NHI)	1
Highways in the Coastal Environment (NHI)	1
Historic Bridges	2
Inspection and Maintenance of Ancillary Highways (NHI)	1
LTAP Clearinghouse Webinar: Retroreflectivity	1
Pavement Marking Workshop	1
Pre-Cast Concrete Slab Demo	1
<u>Workforce Development</u>	# Sessions
Tort Liability/Risk Management	1

Delaware T²/LTAP Center Cont.

2010 Training

<u>Highway Safety</u>	# Sessions
APWA Click, Listen and Learn: Retroreflectivity Seminar	1
Sign Retroreflectivity – Basics	2
Sign Retroreflectivity – Inspectors	2
Streets, Sidewalks and the Americans with Disability Act Training	3
<u>Infrastructure Management</u>	# Sessions
Annual DelDOT Pavements and Materials Workshop	1
Annual DelDOT Maintenance and Operations Workshop	1
Cementitious Materials for Concrete	1
Chemical Admixtures for Concrete	1
Concrete Pavement Preservation Workshop	1
Construction Field and Materials Training	1
How NEPA Affects DelDOT	1
<u>Workforce Development</u>	# Sessions
Access Management, Location and Design (NHI)	1
Better Communications	1

2011 Training

<u>Worker/Work Zone Safety</u>	# Sessions
ATSSA Flagger Safety Training	2
OSHA 10-Hr. Safety Training	1
<u>Highway Safety</u>	# Sessions
Delaware MUTCD Changes (various sections)	6
MUTC for Locals: Intro, Part 1, Part 2, Part 3, Part 6	3
Roadside Safety System Design Mentor and Guardrail Designer Training	1
<u>Infrastructure Management</u>	# Sessions
Annual DelDOT Maintenance and Operations Workshop	1
Annual DelDOT Pavements and Materials Workshop	1
Bridge Inspection for Non-Destructive Evaluation (NHI)	1
Bridge Maintenance Training (NHI)	1
Warm Mix Asphalt Field Day Demo	1
Water Quality Management of Highway Runoff (NHI)	1
Winter Maintenance: Snow and Ice Removal	1

DELAWARE T²/LTAP CENTER**2012 Training**

<u>Worker/Work Zone Safety</u>	
ATSSA Flagger Safety Training	3
Avoiding Runovers and Backovers in Work Zones	2
OSHA 10-Hr. Safety Training	2
MUTCD for Locals – Part 6	2
<u>Highway Safety</u>	
Delaware MUTCD for Locals: Intro, Part 1, Part 3	2
Delaware MUTCD for Locals: Part 2	2
Highway Safety Manual Training (NHI) <ul style="list-style-type: none"> • HSM Lite • Practitioners 	2
Roadside Safety Design (NHI)	3
Snow Plow Simulator Training	28
Systemic Approach to Safety Management	1
Winter Maintenance: Snow and Ice Control	6
<u>Infrastructure Management</u>	
Annual DelDOT Winter Workshop	1
Annual DelDOT Materials and Research Training	1
Introduction to Delaware's Integrated Transportation Management System	1
Modern Roundabouts: A Safer and More Efficient Design	2
Highway Noise Abatement	2
Stream Diversions for Bridge Construction	1
Urban Drainage Design (NHI)	3
<u>Workforce Development</u>	
50 Ways to Lose Your Federal Funding	2
Managing NEPA	2
NHI Webinar: FHWA's Consultant Service Procurement Requirements and Updated Q&A Guidance	1
UTC/CAIT Webinar: Traveling Lecture Series, Intersection Safety	1
UTC/CAIT Webinar: Traveling Lecture Series, NDE of Bridge Decks	1
UTC/CAIT Webinar: Traveling Lecture Series, State of Good Repair	1
UTC/CAIT Webinar: Traveling Lecture Series, What Lack of Infrastructure Investment Will Cost Our Nation	1

Delaware T²/LTAP Center cont.

Municipal Engineering Circuit Rider

While the 58 Local Technical Assistance Programs (LTAP) or Technology Transfer (T²) Centers across the country share many similarities and a common purpose to assist local governments with transportation challenges, not all Centers have Circuit Riders. The Delaware T² Center established a Circuit Rider in 1992 as a contracted, part time consultant and it developed as a popular program for many Delaware municipalities.

Based on this success, the program was upgraded to a full time staff position in 2008. Since that time, Matheu J. Carter, P.E. has been the Municipal Engineering Circuit Rider. In this capacity, Matt's primary role is to reach out to local governments and help them with their transportation-related challenges.

While the Delaware Department of Transportation (DelDOT) maintains in excess of 90% of the public roads, Delaware's fifty seven municipalities maintain their local streets and have responsibility for signage, sidewalks, and drainage even for many of the DelDOT maintained roadways within their towns. DelDOT took control of county roads in 1935 and so there are no county road systems in Delaware.

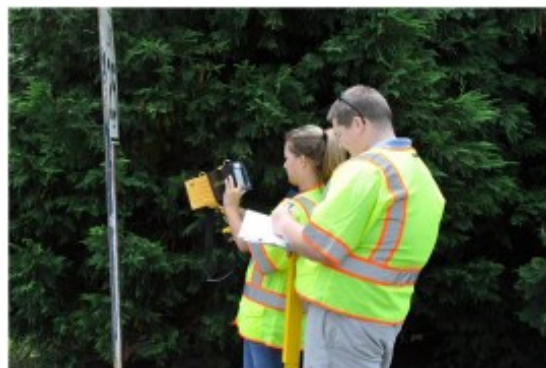
While three municipalities maintain no local streets, the remaining towns maintain as little as 0.13 miles (686 feet) to nearly 147 miles. Not surprisingly, those with the greatest mileage of locally maintained streets include Wilmington, Dover, Newark, Middletown, Milford, Seaford, Smyrna, Georgetown, and Ocean View. These and others have substantial public works departments, some with their own engineering staff. As the municipalities' mileage responsibilities drop off, so too do their public works assets and many of the smaller towns have a skeleton crew of maintenance personnel or streets maintenance is part of the general maintenance staff of the town. Some contract out all maintenance on an as-needed basis.

The State of Delaware assists towns with street maintenance through the Municipal Street Aid

Fund, which currently allocates \$5 million (FY 2013) to municipalities on the basis of street mileage and population. In addition, the Community Transportation Fund (CTF) allocates variable amounts each year (\$16.75 million, FY 2013) through state Legislators, typically used for projects such as repaving, drainage problems, and curbs and sidewalk upgrades. Some municipalities look to the Delaware T² Center for technical support in connection with this assistance.

In on-site visits, the Municipal Engineering Circuit Rider provides advice and training in one-on-one meetings with Street Supervisors, Town Clerks, Town Managers, Council Members, Mayors, and others. Often, initial visits on a topic will require some research that may rely on the Center's relationships with experts in DelDOT and our LTAP colleagues across the country. Sometimes, Matt will collect field data to support analyses and recommendations, and technical memoranda may be developed to further support local personnel. During other times, Matt develops and presents training workshops on a variety of transportation topics.

Matt is a Professional engineer, registered in Delaware, Maryland, Pennsylvania, New Jersey, New York, and Georgia. His 25(+) year career has led him through heavy construction to design consulting to public works, a diverse experience he now uses to help local governments sort through the confusion and sidestep some of the obstacles as they attempt to maintain and improve their transportation network.



Delaware T²/LTAP Center cont.

In recent years, the Circuit Rider has assisted a number of municipalities through our training workshops and one-on-one assistance. Some examples include:

- Speed limit studies – collect spot speed data and make recommendations for posted speed limits.
- Pedestrian safety studies – evaluate pedestrian safety issues and make recommendations for improvements.
- Sidewalk curb ramp upgrade projects – assist with contracting issues in connection with CTF funding.
- Pavement upgrades – provide contract assistance and training to improve quality of local pavement projects.
- Asset management – directly and indirectly collect asset inventory (signs, pavement condition, sidewalks, etc.) to begin asset management programs.
- Drainage improvements – investigate drainage problems and recommend alternative solutions.

At times, the Circuit Rider has been able to add engineering interns to expand the resources of the program. Also, the Delaware T² Center has been able to employ interns directly, but more often, a municipality will hire an intern with the Center's assistance and Matt provides engineering oversight and training as a free service. For example, interns have proven to be excellent "force multipliers" in our effort to develop asset inventories and conduct speed limit studies for municipalities.

Looking forward, the Delaware T² Center hopes to continue to expand the services of the Municipal Engineering Circuit Rider Program to as many local Delaware governments as may need them. Some of the general goals for the program going forward include:

- Conduct year round outreach to local governments and agencies to ensure they are aware of the Circuit Rider resources and a reminder to call on us as needs arise.
- Expand the development and delivery of training workshops across Delaware to help local personnel help themselves and enhance highway safety.
- Encourage and support more proactive approaches to asset management, including the expanded use of pavement preservation technologies.
- Support efforts to enhance accessibility for the physically disabled through training and project assistance.
- Expand technology transfer outreach to include demonstrations (like the 2011 Warm Mix Field Day), short video films, technical briefs, and training workshops.
- Encourage innovative approaches to highway and worker safety through technology transfer initiatives and training workshops.



ITS LAB

Richard E. Hangen Intelligent Transportation Systems (ITS) Laboratory

The University of Delaware's ITS Lab has been in operation since 1997 and has been used for a variety of research projects and coursework. The Delaware Department of Transportation (DelDOT) has partnered with the University to create a functional lab facility that can serve DelDOT's needs as well as provide a hands-on learning experience for University students.

The ITS lab has a robust software suite supported by funding from DelDOT, the University's College of Engineering, the Department of Civil and Environmental Engineering and private – public partnerships. PTV America donated 15 licenses of the Visum/Vissim suite to support the transportation curriculum and research. Bentley Systems provides all College of Engineering students and faculty with free licenses to all of their software packages and free access to their online training resources. Citilabs has provided the lab with the entire CUBE suite – Voyager, Land, Cargo and Avenue. Additionally, the lab maintains other useful software such as ESRI's ARCGIS, HCS, Synchro, AutoTurn, etc.

This facility hosts meetings and seminars. Software vendors such as PTV and Citilabs are able to hold classes on new products. Recently the lab hosted a quarterly meeting of Simulation and Capacity Analysis User Group (SIMCAP) for the Institute of Transportation Engineers. Current plans for the lab include adding equipment for video-teleconferencing. The lab supports meetings with research sponsors, guest speakers and is able to host training, such as that offered by the T² program.

The lab is a showcase facility for the college and the department and is a key part of the student recruitment process. The lab enhances

the existing transportation curriculum by improving the quality of lab assignments and research. Students can use the current or archived data in support of assignments or research in a variety of ways including planning models, signal timing, corridor coordination plans, redesign of intersections, roundabout evaluation, as well as statistical analysis of traffic data.



UNIVERSITY TRANSPORTATION CENTER (UTC)

University Transportation Center Resiliency of Transportation Corridors



The University of Delaware was designated a Tier II University Transportation Center in the August 2005 Transportation Reau-

thorization - Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU). Strategically located astride major national transportation corridors, Delaware is a critical part of the national transportation network in terms of both freight and passenger transportation. Specifically, the I-95 corridor, the Northeast Rail corridor, and the Port of Wilmington are facilities of national significance. This strategic location also serves as a rich source of examples for classes, as well as for

applied research problems that are consistent with the interests and the expertise of our faculty in transportation and land use planning, infrastructure, environmental quality and freight transportation. For these reasons, the University of Delaware University Transportation Center (UDUTC) selected as our theme resiliency of transportation corridors.

The Center draws on our strategic location in a region with all transportation modes that support economic development and improved quality of life, and on corridors that are of national significance as a testbed for our work. Our region is representative of many others with significant issues related to congestion, safety, aging infrastructure, and the competing demands of transporting individual travelers and freight while protecting the environment.

The UDUTC Research Concentrates on Four Areas:

- **Planning**—Understanding and anticipating the relationships among transportation, land use, and economic development in corridors is essential to resiliency. We need to develop planning approaches that are based on understanding the dynamics of transportation systems and corridors in terms of a model of resiliency. In short, the concept of resiliency makes special demands on the conventional planning processes, and we must recognize and accommodate this. Also, the long history of transportation systems in the BOSTFOLK corridor offers an opportunity to study the historic resiliency of systems with long functional/engineering lives as a basis for understanding and modeling contemporary and future behavior and resiliency.
- **Ecology and the Environment**—Corridors not only transport people and goods but also facilitate the spread of invasive species, concentrate air quality issues, and impose external pressures on the environment. Also, corridors not only break up ecological zones and habitats but create their own linear ecological environments, which are poorly understood. Linking planning, design, operating, and maintenance strategies to enhance the ecological and environmental quality of transportation corridors is a challenging problem.
- **Infrastructure Renewal**—Planning for and executing infrastructure renewal projects and strategies are key to the proper functioning of transportation corridors. Asset management strategies, innovative repair and replacement techniques, and new materials and contracting practices require additional research to be effective for corridor applications.
- **Operations and Management**—Intelligent Transportation Systems (ITS) have had a significant impact on the operation and management of our transportation systems, particularly corridors. However, in the areas of congestion mitigation and management and emergency preparedness and response, corridors play a unique role as critical links and bottlenecks to mobility and accessibility. Research on how to better leverage our knowledge of the corridor is key to preparedness and response to unanticipated events.

OUTREACH AND TECHNOLOGY TRANSFER

The outreach and technology transfer functions of the UDUTC are carried out through a newsletter, participation in the annual DCT research showcase, brown-bag lunches and workshops, research briefs, and web-based presentations. In addition, the UDUTC supports guest speakers, field trips for students and career opportunities.

UTC Cont.**Transportation Research Projects**

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	TOTAL
1. Number of transportation research projects selected for funding	6	4	5	7	5	3	30
2. Total budget costs for the projects reported in number one above.	\$235,294	\$231,583	\$223,830	\$597,764	\$244,272	\$116,934	

Project descriptions may be found on the UTC webpage: http://www.ce.udel.edu/UTC/Current_Research.html.

GRADUATE EDUCATION PROGRAM

The graduate education programs include students from the College of Agriculture, College of Arts and Science, College of Earth, Ocean and Environment, and College of Engineering. All students are engaged in an interdisciplinary element in both coursework and research. In addition, UDUTC students are required to enroll in Urban Transportation Systems, which covers the key elements of transportation systems analysis, policy, and economics.

UD-UTC graduate students have participated in a variety of conferences and meetings including the Transportation Research Board Annual Meeting and the Annual Inter-university Symposium on Infrastructure Management. UD-UTC graduate students are also the recipients of

numerous awards including Eisenhower Fellowships, WTS scholarships, IRF Scholars, ENO Transportation Leadership Conference Fellows, and ITE scholarships. Each year we have awarded a Student of the Year Award.

Student of the Year Awards

Mindy Laybourne
2012



Laura Black
2011

Geoff Edwards
2010



Charles Mitchell
2009

Michelle Oswald
2008



UTC, cont.

The program has also funded graduate student fellowships.

UD-UTC Graduate Fellowship Recipients

2012-2013

- Eileen Collins - MA Student, School of Public Policy & Administration
- Tucker Smith - MS Student, Department of Civil and Environmental Engineering

2011-2012

- Erik Archibald - MS Student, Disaster Science and Management, School of Public Policy & Administration
- Matthew Becker - MS Student, Department of Civil and Environmental Engineering
- Elisa Kropat - MS Student, Department of Civil and Environmental Engineering (partial fellowship)
- Mindy Laybourne - MS Student, Department of Civil and Environmental Engineering (partial fellowship)
- Lauren Lobo - MS Student, Department of Civil and Environmental Engineering
- Arthur Wicks - MPA Student, Institute for Public Administration, School of Public Policy & Administration

2010-2011

- Todd O'Boyle - PhD Student, Institute for Public Administration
- Peter Seymour - MCE Student, Department of Civil and Environmental Engineering

2009-2010

- Geoff Edwards - PhD Student, Institute for Public Administration
- Charles W. Mitchell III - MCE Student, Department of Civil and Environmental Engineering
- Trevor Booz - MCE Student, Department of Civil and Environmental Engineering

2008-2009

- Houston Brown - MCE Student, Department of Civil and Environmental Engineering
- Todd Franzen - MPA Student, Institute for Public Administration
- Michelle Oswald - MCE Student, Department of Civil and Environmental Engineering

Undergraduate education programs have focused on research opportunities for undergraduates. Many of the students participating in undergraduate research have gone on to graduate school or to work for transportation related companies.

As part of the outreach of the UDUTC, distinguished guest lecturers are invited to campus. With partial support from the Delaware Center for Transportation, the following speakers gave talks between 2007 and 2012:



“Towards ubiquitous Dynamic Minimum ETA Route Guidance and Experiences with DARPA Autonomous Vehicle Challenges” – 10/04/07, Alain L. Kornhauser, Princeton University

“The Role of Computing in Urban Travel Forecasting: How Transportation Planning Practice Shaped Software and Software Impacted Transportation Planning Practice” – 3/21/08, David Boyce, Northwestern University



“The Logistical Debacle Post-Katrina: Synthesis and Recommendations” – 04/18/08, José Holguín-Veras, Professor, Rensselaer Polytechnic Institute

UTC Cont.

"Globalization and Infrastructure Needs" – 10/31/08, Michael Gallis, Michael Gallis Associates

"Transportation Mega Projects in New York; Behind the Scenes" – 12/04/08, Robert (Buz) Paaswel, University Transportation Research Center, City College of New York



"Optimizing Facility Use Restrictions for the Movement of Hazardous Materials" – 10/23/09, Linda Nozick, School of Civil and Environmental Engineering, Cornell University



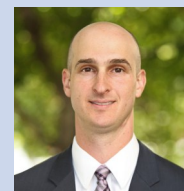
"Motorcoach Transportation and Accident Analysis" – 10/30/09, Robert Kadlec, Kadlec Engineering



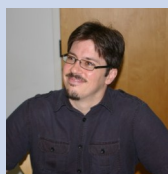
"Planning, Scale, & the Mobilityshed" – 3/18/10, Richard Layman, DC-based Planner, Blogger and Transit activist



"Delaware's Relationship with Transportation Flows and Infrastructure in the Northeast Corridor Region" – 3/25/10, Adie Tomer, Brookings Institute Researcher, specializing in aviation and airport issues



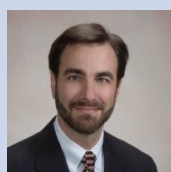
"Logistics underpins America's ability to deploy forces all over the world, on short notice-and, by extension, America's power in the world" – 4/22/10, David Axe, Journalist specializing in military-related transportation and robotics



"Mobility and Transportation: Providing Access to the World" – 10/13/10, Lester A. Hoel, L.A. Distinguished Professor of Engineering Emeritus, University of Virginia



"Pavement Management and Infrastructure Asset Management: From the Trenches" – 10/22/10, Charles Larson, Practice Leader, IMPE, Stantec



UTC Cont.

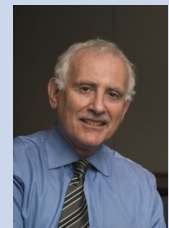
"Taxes or Tolls: What's the Future of Infrastructure?" – 11/01/10, Richard Little, AICP, Keston Institute for Public Finance and Infrastructure Policy, University of Southern California

"Planning for Mobility: Engineering for Tomorrow" – 2/28/11, Dr. Mimi Shellers, Director, Center for Mobilities Research and Policy, Drexel University



"Asset Management on Amtrak in the Northeast Corridor" – 3/15/11, Willem Ebersöhn, Program Director, Engineering Systems, Amtrak Engineering

"Economic Costs of Freight Transportation Supply Chain Disruptions" – 2/21/12, Ira Hirschman, Ph.D., Parsons Brinkerhoff



"The Future of Surface Transportation in the U.S.: What Will the Congress Do to Meet the Needs" – 4/11/12, Jack Basso, Director of Program Finance and Management, AASHTO

"New Methods for Inspection and Evaluation of Steel Gusset Plate Connections" – 11/05/12, Dr. Christopher Higgins, Oregon State University



DCT and UTC together, sponsor a series of a brown bag lunch discussions. These informal lunch meetings are held at the University of Delaware. Invited to attend these meetings are DelDOT employees and University of Delaware faculty, staff and students.

UTC

CAIT at UD—New UTC AWARD

In January, 2012 the Center for Advanced Infrastructure and Transportation (CAIT) at Rutgers University was awarded a multi-million dollar grant from the US Department of Transportation's Research and Innovative Technology Administration under the University Transportation Center (UTC) program, Tier I. The University of Delaware was one among the consortium members that worked with Rutgers to submit the successful proposal and will be continuing the research, education/workforce development, and technology transfer begun with the Tier II award. State of Good Repair (SGR) is the consortium's primary area of research.

The other research university partners include Columbia University, New Jersey Institute of Technology, Princeton University, University of Texas at El Paso, University of Virginia, Utah State University, and Virginia Polytechnic Institute.

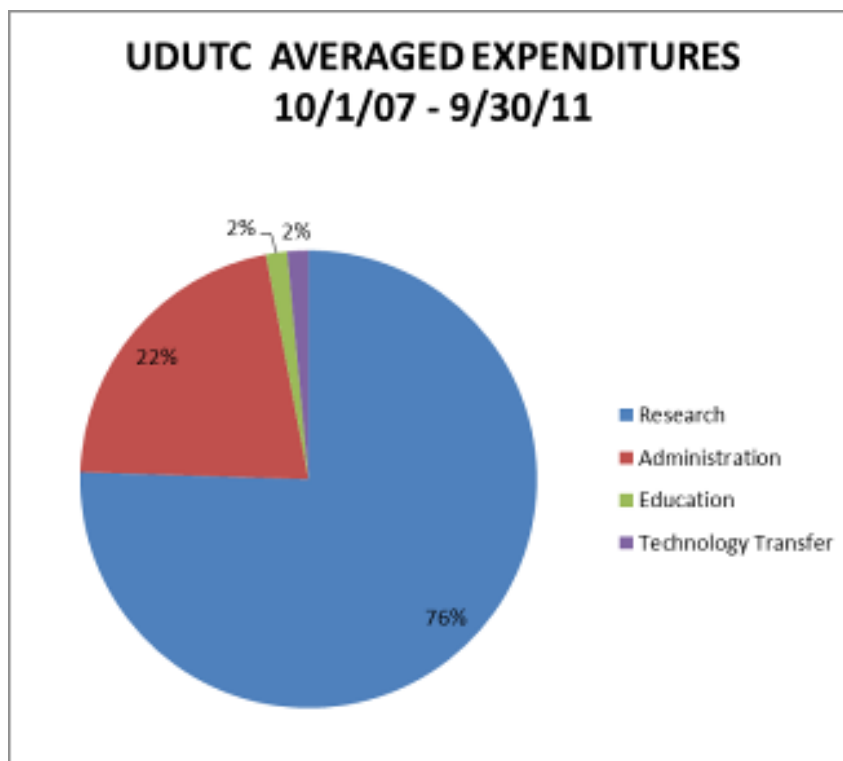
Like our UD-UTC, CAIT at UD supports research. Four projects were awarded for the 2012-2013 academic year and Diane Wurst, an MCE student in structures was awarded a UTC fellowship. Collaborative research projects with CAIT

at UD faculty and faculty at Rutgers, Princeton, University of Utah and New Jersey Institute of Technology are under negotiation.

CAIT also supports interactive webinars on SGR, and CAIT at UD has hosted a number of these events both on campus and at DelDOT.

Webinars in 2012:

- April 20, 2012—State of Good Repair
- July 25, 2012—Intersection Safety
- Sept. 17, 2012—NDE of Bridge Deck
- Oct 30, 2012— Failure to Act



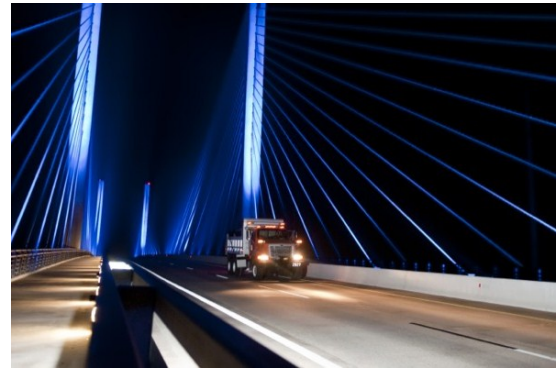
CENTER FOR INNOVATIVE BRIDGE ENGINEERING

The Center for Innovative Bridge Engineering was established at the University of Delaware in 2000 to be a local, regional, and national resource in bridge engineering. The Center's activities comprise three components: research, education, and technology transfer. Housed within the Department of Civil and Environmental Engineering, the Center is well-positioned to address such national needs as repair, retrofit, and rehabilitation of deteriorated infrastructure; understanding long-term bridge performance; bridge security; design for improved service life of bridges; and education and training of bridge engineers for the workforce.

Researchers

The Center comprises faculty at the University of Delaware who have a strong interest in bridge engineering and related issues. Interested faculty from other institutions are also invited to become members of the Center. Participants over the past five years have included the following:

Dennis R. Mertz (Director)—bridge design, fatigue and fracture
 Michael J. Chajes—bridge testing, evaluation, and rehabilitation
 Harry W. (Tripp) Shenton III—long-term health monitoring
 Jennifer E. Righman—high-performance materials and plastic behavior
 John W. Gillespie Jr.—application of advanced composite materials
 Robert G. Hunsperger—corrosion monitoring using time domain reflectometry
 Jack Puleo—bridge scour
 Nii Attah Okine—bridge management systems
 Daniel K. Cha—biosensors for corrosion monitoring of bridge cables
 Dov Leshchinsky—bridge substructures
 Sue McNeil—infrastructure asset management
 Thomas Schumacher—non-destructive testing (NDT) and structural health monitoring (SHM) of civil infrastructure
 Richard P. Wool—use of bio-based materials for infrastructure applications



Projects

Areas of research focus within the Bridge Center include Design and Analysis, Bridge Evaluation and Advanced Sensors, Geotechnical Engineering, Advanced Materials, and Planning and Management. The research is often multidisciplinary. For example, ongoing work on the development of sensors for void and corrosion detection involves researchers from the Department of Electrical and Computer Engineering as well as the Department of Civil and Envi-



ronmental Engineering. A listing of structural projects funded between 2007 and 2012 can be found on page 28.

Among those listed projects was one sponsored by the Delaware Department of Transportation related to the structural health monitoring of the new Indian River Inlet Bridge located over the Indian River Inlet in Rehoboth Beach. Heavy construction of the cable-stayed bridge began in 2009 with the official opening in May, 2012. The project's goal was to install a long-term structural health monitoring (SHM) system on the bridge during its construction. By installing the SHM system, DelDOT 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.

Center for Innovative Bridge Engineering

Phase II of the project consists of operating and maintaining the SHM system and conducting various baseline test, studies, and analyses to characterize the performance of the bridge as a permanent record for the future.

Technology Transfer

In 2010, Dr. Thomas Schumacher launched the Inspection, Monitoring and Maintenance of Civil Infrastructure (IMMCI) Research Group in the Department of Civil and Environmental Engineering. The group is devoted to research to support a sustainable civil infrastructure for the benefit of society and the environment. To that end the group is involved with bridge projects funded by the Federal Highway Administration, the Delaware Department of Transportation and the federal Department of Transportation through the Center for Advanced Infrastructure and Transportation at Rutgers University. The research group has also organized seminars and brought renowned experts in the area of non-destructive testing and structural health monitoring in civil engineering to UD. Following is a list of visitors to campus. A number of these lectures were co-sponsored by the Delaware Center for Transportation and the University Transportation Center grant.

Dr. Christopher Higgins, Oregon State University
New Methods for Inspection and Evaluation of Steel Gusset Plate Connections
November 5, 2012

Dr. John S. Popovics, University of Illinois at Urbana-Champaign
Air-Coupled Impact-Echo Scanning for Bridge Deck NDE
September 17, 2012

Dr. Georg K. Kocur, Massachusetts Institute of Technology
Time Reverse Modeling of Acoustic Emissions in Reinforced Concrete Members
June 5, 2012

Dr. Christian U. Grosse, Technical University Munich, Germany
Non-destructive Testing and Continuous Monitoring Techniques as Modern Tools for the Assessment and Life Time Prognosis of Civil Engineering Structures
May 24, 2012

Dr. Kaz Tabrizi, Advanced Infrastructure Design
Assessment of the Aging Infrastructure
(part of CIEG667: NDT for Civil Engineers)
May 8, 2012

Dr. Branko Glišić, Princeton University
Long-gauge and Distributed Fiber Optic Sensors, Principles, Advantages, Applications
April 16, 2012

Dr. Ralf W. Arndt, Rutgers University
Non-destructive Testing in Cultural Heritage
September 22, 2011

Center for Innovative Bridge Engineering

Graduate Students

The Bridge Center provides a strong academic program for graduate students in bridge engineering. The Center's graduates have a strong background in bridge engineering and are well positioned to become leaders in the field. Members of the current group of students completing degrees have been offered jobs with well-known companies in San Francisco, Boston, Denver, Philadelphia, New York and Wilmington.

The following students have earned graduate degrees through the Bridge Center during the past five years or are currently working on advanced degrees:

- | | |
|---------------------|-----------------------|
| • Kelly Ambrose | • Jun Huang |
| • Andrew Bechtel | • Brian Jones |
| • Briana Brookes | • Diane Kucz |
| • Houston Brown | • Kervin Michaud |
| • Geoffrey Burrell | • Robert Natale |
| • Michael Cann | • James Quigley |
| • Patrick Carson | • Michael Rakowski |
| • Douglas Charles | • Nicole Reader |
| • Renee Cimo | • Justin Ross |
| • Kevin Connor | • Dustin Schopen |
| • Benjamin Cross | • Matthew Segerman |
| • Andrew Dunn | • Jose Soto Fuentes |
| • Ryan Gagnier | • Hong Su |
| • Matthew Hayes | • Brian Thomas |
| • Dennis Helmsetter | • Jason Winterling |
| • Betsy Hicks | • Michael Zettlemoyer |



* * * * *

INSTITUTE FOR PUBLIC ADMINISTRATION



As a public service and research center within the School of Public Policy & Administration (SPPA) at the University of Delaware, the Institute for Public Administration (IPA) addresses the policy, planning, and management needs of its partners through the integration of applied research, professional development, and the education of tomorrow's leaders.

Transportation-related project funding enables IPA to conduct applied research, collaborate with partners that support innovative transportation research, convene transportation professionals and policy-makers in workshop/forum/training settings, build consensus, and educate/train graduate students regarding transportation policy issues.

Jerome Lewis, IPA Director

Dr. Lewis is the Director of the Institute for Public Administration and holds a faculty appointment as an Associate Professor with the School of Public Policy & Administration. He specializes in state and local government management, policy analysis, planning and civics education. He provided leadership in establishing the Institute for Public Administration, the Delaware Association for Public Administration, the University of Delaware Masters Program in Public Administration, and the Delaware Legislative Fellows Program.



Transportation Policy Work of IPA

Transportation research has reached a new crossroads. It no longer focuses strictly on transportation planning, civil engineering, and design of infrastructure strictly for use by cars. Because transportation impacts the social, environmental, economic, energy, and health sustainability of our nation, transportation research has evolved to incorporate a multidisciplinary approach. Smart Growth, Complete Streets, and Complete Communities are among the contemporary planning strategies that consider the need for multi-modal transportation options, pedestrian- and bicycle-friendly design, safe access to public transit, and compact land-use patterns to combat sprawl.

The foundation of IPA's work related to transportation is public policy research and analysis. IPA supports DCT's multidisciplinary research education and technical assistance initiatives by conducting applied research on transportation policy issues, participating in its workshops and distinguished lecture series, and contributing to DCT's online *TranSearch* magazine. In cooperation with partnering transportation and planning agencies, IPA draws upon faculty, professional staff, and SPPA graduate Public Administration Fellows to conduct research on issues such as the resiliency of transportation systems, integrating land-use planning with transportation, facilitating more efficient freight and passenger movement along the Northeast Corridor, improving performance through technology and advanced systems management, enhancing multi-modal transit options, and planning for complete and healthy communities.

Transportation policy forums and workshops seek to focus attention on linkages between land use and transportation policy, current and emerging transportation policy issues, methods to facilitate discussion, and the dissemination of preliminary research results. Forums feature top industry leaders, academic leaders, and policymakers as speakers and session panelists. These forums are designed to foster innovative thinking, networks, dialogue, and action on transportation policy and planning issues.

Results of research are disseminated both in a hard copy and electronic (online) format through white papers, research reports, SPPA's *Connect* and DCT's *TranSearch* magazines, podcasts, and posters at the annual DCT Research Showcase in Dover, Delaware.

Each year, through a systematic methodology, DCT identifies, prioritizes, and funds multidisciplinary transportation research projects. The following IPA projects have been selected for DCT funding in the last five years.

INSTITUTE FOR PUBLIC ADMINISTRATION, Cont.

Overview of IPA Transportation Research Projects Supported by DCT

2012

Researching Opportunities to Improve Taxi Service, the “Missing Transit Mode” in Delaware (Phase 2), Accessible and responsive taxi service is the “missing mode” of transportation in Delaware. This project will conduct a review of other jurisdictions’ initiatives to provide improved taxi accessibility and availability in order to identify a rational path forward for the First State. Rules requiring some reasonable level of fleet modernity should be explored for possible application for several reasons. Also proposed for exploration are alternatives to the current “medallion” approach to taxi licensing, such as possible new franchising models for Delaware. The end goal is to identify policy options that will enhance the overall quality of taxi service such that it is no longer Delaware’s “missing” transit mode.

- Douglas Tuttle (PI) and Bernard Dworsky

2011

NPDES and Nonpoint Source Pollution Education, The goal of this project was to: 1) Research past stormwater education initiatives undertaken by DelDOT for NPDES compliance; 2) Conduct a literature review of stormwater education campaigns state-wide, regionally and nationally; 3) Host a workshop to obtain feedback from NPDES co-permits and to identify applicable tools for stormwater education; and 4) Compile a report identifying key elements and methods to achieve the NPDES’s stormwater education requirements.

- Martha Corrozi Narvaez (PI) and Andrew Homsey



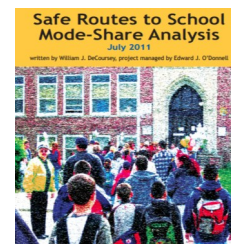
2010

TOD: Identification of Optimal Characteristics in Delaware, The objective of this project was to create a preliminary framework for evaluating the potential of transit-oriented development (TOD) sites in Delaware and apply that framework to selected locations throughout the state. This paper provides public officials and Delawareans with a roadmap for TOD implementation and success in the 21st century.

- Edward O'Donnell (PI) and Ted Patterson

Delaware Safe Routes to School – Mode Share Analysis, The purpose of this project was to provide mode-share data for a sampling of elementary school students for the Delaware Safe Routes to School (SRTS) Program. Baseline data was developed for the SRTS program to determine the current status of walking/biking to school, program benchmarks, and priority areas of focus.

- William DeCoursey (PI)



Delaware Transportation Management Operations Plan and Performance Assessment – NCC, As part of a collaborative effort, IPA and the Delaware Center for Transportation (DCT) conducted research on the current state of the Transportation Operations Plan and Performance Assessment (TOMPS) system in New Castle County, Delaware. A policy forum was held with participation from stakeholders to gauge the awareness of intelligent transportation management systems (ITMS and TOMPs). A white paper provided outcomes of research and the policy forum explained the relevance of ITMS and TOMPs.

- Edward O'Donnell (PI), William DeCoursey, Gene Donaldson (DelDOT), Dan Blevins (WILMAPCO)



IPA Cont.

2009

Feasibility of Bus Rapid Transit within the Mid-Atlantic Region,

The deployment of bus rapid transit (BRT) is one alternative to meeting anticipated transportation demands increasing volumes of traffic, traffic congestion, and changing demographics. IPA conducted a study to assess the feasibility of a regional BRT system as a viable, high-speed transportation mode that operates on an interstate, intrastate, and inter-jurisdictional basis. A policy forum was also conducted to solicit input from regional stakeholders

- Bernard Dworsky (PI), Marcia Scott, William DeCoursey, Edward O'Donnell



Optimizing Accessible Taxi Service to Augment Traditional Public Transit Services in Delaware,

A projected rise in Delaware's aging and baby-boomer population will impact the need to offer more mobility options and accessible transportation for residents. This study looks at the need for possible expansion of accessible taxi-based transportation initiatives, to augment traditional public transit services and expand mobility options for Delawareans at the most efficient cost.

- Douglas Tuttle (PI)

Optimizing Accessible Taxi Service
to Augment Traditional Public Transit
Services in Delaware



Senior Driver – Public Information and Education Campaign, This is a follow-up project to the Delaware Senior Drive Safety Project. IPA collaborated with the Roadway Safety Foundation to develop and carry out a 'Senior Safety and Mobility' campaign. The public information and education campaign spread the word on importance senior driver safety in Delaware, educated seniors and their families, and provided information to help the motoring public understand and appropriately address safe-driving issues.

- Bernard Dworsky (PI) and Julia O'Hanlon

Integrating Transportation/Transit in the Overall Planning Process, The scope of work of this project included a review of current transportation/land use integration practices in Delaware to identify planning integration deficiencies. In addition, current practices were compared with best practices via literature search, recommendations were developed to address planning integration deficiencies, and a briefing workshop was conducted.

- Edward O'Donnell (PI) and Ted Patterson

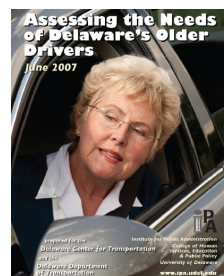
2007

Assessing the Needs of Delaware's Older Drivers, The study examined demographic trends and statistics related to older drivers; highlighted case studies of recently adopted road-design policies and practices in other states; and summarized issues and recommendations on intersection design for older pedestrians and drivers, signage and traffic-signal design, and assessment, education, and outreach strategies. Priorities and recommendations were made for the state of Delaware.

- Bernard Dworsky (PI) and Julia O'Hanlon

Senior-Safety Licensing and Testing, This project compiled provisions in place among the 50 states regarding the testing and licensing of older drivers, and recommendations for provisions that Delaware might consider for initial and renewal of older drivers.

- Bernard Dworsky (PI)



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