ITRE Annual Activity Report

December 2015

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Message from the Director

ITRE continues to be a great investment by the state of North Carolina

To ITRE Staff and Friends,

It is with mixed emotions that I write this foreword for our 2015 Annual Activity Report. As many of you have known for a while, I plan to step down as ITRE Director in 2016 after a tenure in this position of nearly fifteen years. As the saying goes, time flies when you're having fun! Indeed, it has been a fun ride on this ITRE ship (no modal bias intended!). Next year, I look forward to returning back to my home department and resume my teaching, research, and service activities as an NC State faculty member.

ITRE has indeed made great strides towards becoming one of the elite transportation research and education centers in this country. A look back at where we were in 2001 vs. 2015 tells a compelling story. Back then our in-house annual expenditures were $4.28 million compared to $8.19 million this year—the highest in our history—and an increase of 91.3%. Back then, our in-house generated overhead dollars were estimated at $350,000 compared to $1,183,800 this year, an increase of over 250%. From a handful of students engaged in ITRE activities in 2001, this year we supported 85 graduate and undergraduate students on our projects. And the same trend is evident whether it pertains to the level and quality of our journal publications, our presentations at the TRB annual meetings, or our winning rate of nationally competitive research projects. And ITRE continues to be a great investment by the state of North Carolina, generating nearly $16.5 dollars for every dollar of state support. The highlight of our achievements in 2015 was the honor of hosting a campus visit and talk by the U.S. Secretary of Transportation the Honorable Anthony J. Foxx, on the future of transportation funding in the United States. We thus cemented our reputation as the place where critical national transportation issues are discussed and debated.

The list of individuals who have contributed to our continued success here at ITRE is too long to enumerate. Nevertheless, I would like to acknowledge a few key people. They include Associate Directors Robert Foyle and James Martin whose advice and guidance over those 15 years have been invaluable; Linda Lancaster, ITRE Director of Finance and the leader of the administrative staff, for her incredible dedication and work ethic and for being the glue that has kept this place working together as a unit; Jim Westmoreland, former Chair of the ITRE Advisory Council who stepped down earlier this year, for his and the Council's unwavering support and guidance; Bastian Schroeder, former Director of the Highway Systems Group (and PhD advisee !) who left ITRE for the private sector this October, for his amazing energy to advance our research agenda both nationally and in the state of North Carolina; and my former bosses Vice Chancellor(s) for Research Terri Lomax and Mladen Vouk. To them, your support and appreciation for what ITRE has accomplished has helped us make a difference.

And last but not least, I am fortunate to have been associated from day one with an incredibly dedicated staff at ITRE. The progress I cited earlier is all because of you, the reputation we built you get credit for, and as a result of your accomplishments, the future of this Institute will remain in good hands and will indeed thrive going forward.

Nagui Rouphail, PhD

Annual Activity Report - 2015
Institute for Transportation Research and Education (ITRE)
at NC State University Centennial Campus

This report summarizes ITRE's activities for the year 2015 and provides background information on the Institute's history, mission, goals, and objectives. It also provides an overview of ITRE's finances, personnel, and technical activities during the year. As in years past, the Institute has maintained and, in some instances, expanded its programmatic activities.

Center Description

The Institute for Transportation Research and Education (ITRE) is an Institutional Center of the University of North Carolina System. Chartered by the North Carolina General Assembly in 1978, ITRE continues to carry out research, training, technical support activities, and air transportation for a host of national, state, and local clients in order to address the nation's critical transportation issues. ITRE is committed to developing leadership in its study of transportation issues through fostering analytical thinking, integrating technology in education and research, serving as a catalyst for problem solving, and cultivating professionals and students dedicated to excellence in transportation.

ITRE is organized into six programmatic areas namely 1) Highway Systems, 2) Local Technical Assistance Program (LTAP), 3) Next Generation Air Transportation Program (NGAT), 4) Travel Behavior Modeling, 5) Geovisual Analytics and Decision Management Group (GADA), and 6) Public Transportation. A high-level organizational chart of our structure is depicted in ***Exhibit I***. As always, our programs are guided and monitored by the ITRE Advisory Council, whose membership is shown in ***Exhibit II***.

Summary of ITRE Goals

ITRE's strategic plan, developed in 2002, sets forth five major institute-wide goals:

- Increase national visibility
- Conduct and disseminate research that impacts the transportation community
- Sustain and enhance educational opportunities to improve the knowledge and skills of transportation professionals
- Strengthen the relationship with, and gain recognition within, the University System
- Provide superior technical assistance

These goals are being achieved through various objectives, such as increasing national exposure through conference presentations, published research, outreach efforts, and increased national project awards. Additionally, the Institute continues its training efforts on a national, regional, and state level, while promoting collaboration with faculty in the department of Civil, Construction, and Environmental Engineering at North Carolina State University and at other UNC System institutions.

This report highlights this year's activities and accomplishments in reaching these goals and objectives. More information about ITRE's programs and staff are available through ITRE's website:

http://www.itre.ncsu.edu

ITRE is housed in the Research IV Building on NC State's Centennial Campus

Exhibit I
ITRE High-Level Organization Flow Chart: Primary Program Groups

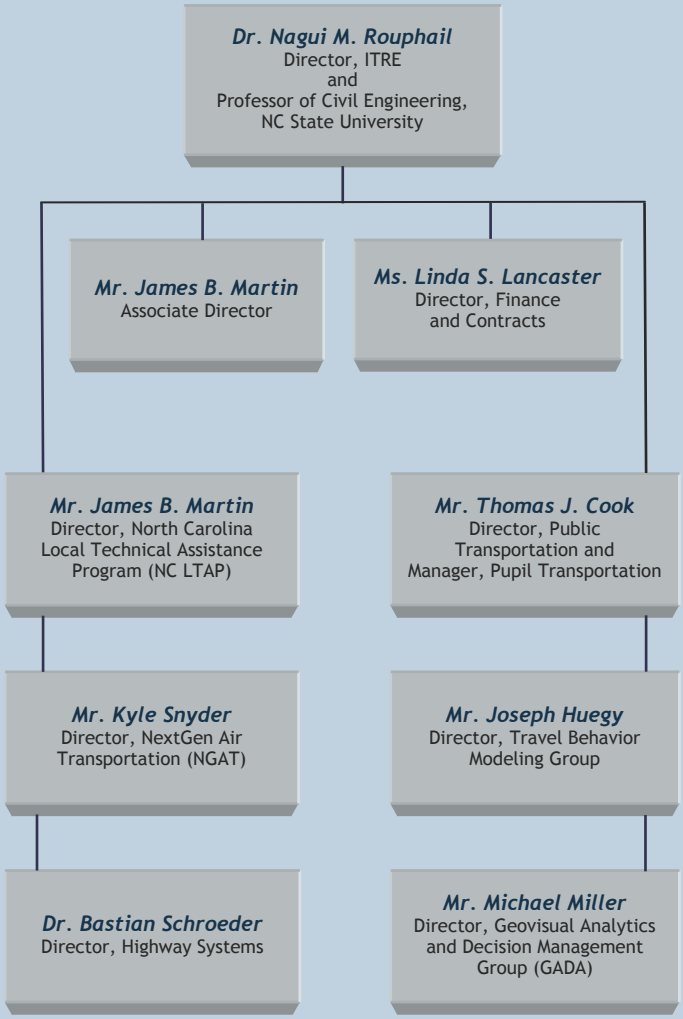
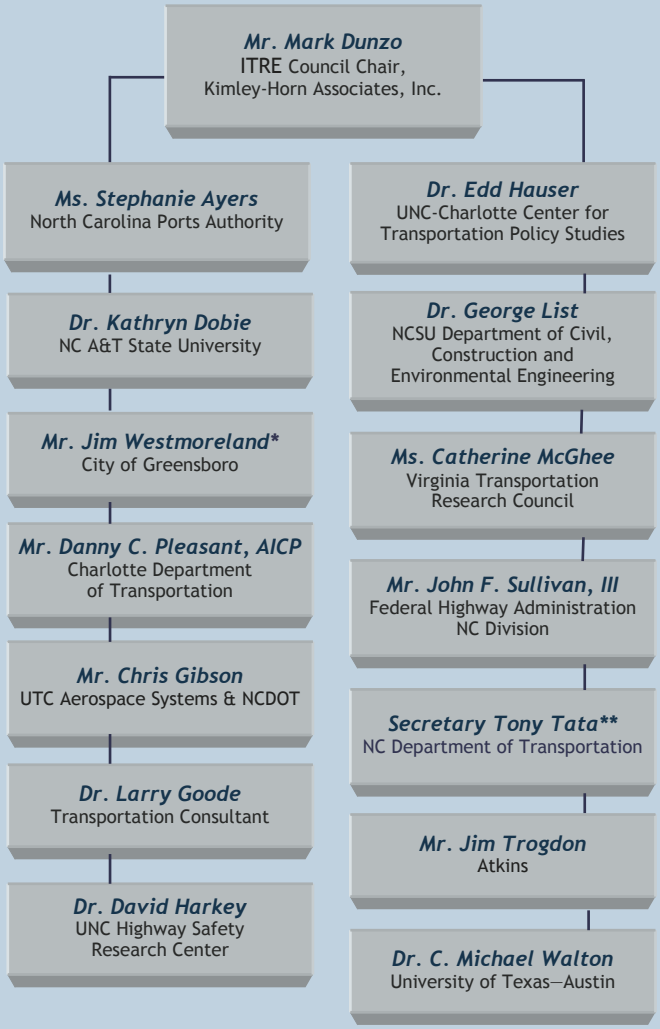


Exhibit II
2015 ITRE Advisory Council



*ITRE Council Chair through 6/30/2015
**Former member through 8/31/2015

In the next few pages, a synthesis is provided of each program area as indicated in Exhibit I above.

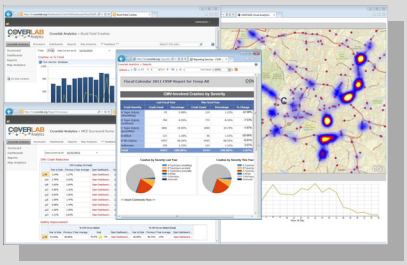
Geovisual Analytics and Decision Management Group (GADA)

Michael Miller, Director

The **Geovisual Analytics and Decision Management** Group (GADA) is composed of the **Operations Research and Education Laboratory** (OREd), the **Commercial Vehicle Enforcement Resource Lab** (COVERLAB) and **Vision Zero** programs joining their common specialties of GIS, geospatial analysis, and mathematical modeling to support operations management decisions and guide public policy. GADA continues to grow in 2015 in terms of number of active projects and national profile.

In addition to these three programs, GADA supports on-site **GIS training** at ITRE's GIS Lab. Through its partnership with eGIS Associates Inc., GADA provides quality GIS training opportunities with continued increases in enrollment and course offerings.

COVERLAB (coverlab.org) assists the North Carolina State Highway Patrol's Motor Carrier Enforcement (NCSHP MCE) section in developing, planning and improving their operational enforcement programs. COVERLAB staff provide operational planning support, decision management services, data analysis, research, and education for improving enforcement effectiveness.



COVERLAB staff, in partnership with the MCE, have developed an online data visualization decision management platform called **COVERLAB Analytics** to track, measure, and prioritize enforcement activities for improving operational effectiveness in reducing truck-involved fatal crashes as well as protecting federally funded road and bridge infrastructure from heavy truck damage.

Vision Zero is North Carolina's emerging program for reducing traffic fatalities – based on the idea that no loss of life is acceptable and everyone can help make this vision a reality. The goals of Vision Zero are to increase public awareness of traffic safety as a public health issue, change risky driver behaviors, and unite all safety stakeholders to build a unified vision towards the issue of traffic fatalities. A NC Vision Zero website is planned for development, with a tentative release in late 2016.

Vision Zero Analytics (VZA) is an online data visualization system for tracking and measuring traffic safety goals and identifying effective strategies to reduce traffic fatalities in North Carolina. With assistance from the North Carolina Governor's Highway Safety Program (NCGHSP), VZA provides the NCSHP, GHSP staff, and statewide safety stakeholders with common views of crash reduction goals for tracking and reporting progress. Troop supervisors can track their crash reduction performance goals, visualize data for in-depth analysis, and streamline reporting requirements with interactive reports. The first version of VZA was released in October 2014, and improvements are being developed for implementation in October 2016.

OREd provides school districts in North Carolina, South Carolina and Virginia with decision management tools based on ***Land Use-based membership forecasts, GIS analysis, and operations research techniques***. By integrating school and community planning data, OREd can assist school districts in developing data-driven and policy-based facility and assignment plans.

2015 marks the second year OREd has been involved with student assignment planning for the Wake County Public School System (WCPSS). WCPSS is the 16th largest school district in the nation-with over 156,000 enrolled-and it is still growing by several thousand students per year. To plan for this growth, WCPSS relies on mathematical modeling and decision science tools pioneered by OREd. By creating data-driven optimal scenarios for where to build new schools and how to draw attendance zones, OREd is able to help WCPSS meet the needs of the growing district with 13 new schools over the next three years.

In addition to WCPSS, OREd continues to work with many other school districts in North Carolina, South Carolina and Virginia to assist school leaders make the best decisions for the communities they serve. For more information on the services OREd provides visit *ored-outcomes.itre.ncsu.edu*.

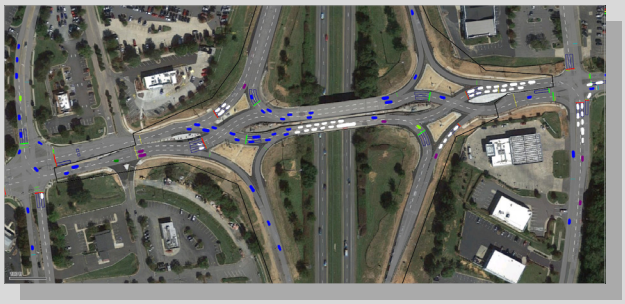
Highway Systems Group

Bastian Schroeder, Director

The **Highway Systems Group** was formed in the early 1980s to assist the North Carolina Department of Transportation (NCDOT) with pressing surface infrastructure challenges. Since that time, many research and development projects were conducted for maintenance and construction, while central office staff have helped NCDOT provide implementable solutions to pressing needs. Staff also regularly assist other municipal and state agencies such as the NC State Highway Patrol and NC Governor's Highway Safety Program. At the national level, staff are also engaged in projects funded by FHWA, FMCSA, ITE, NCHRP, NCFRP, and SHRP2 research programs, and the group is involved in teaching and professional development for the National Highway Institute (NHI).

The following list comprises eight key research focus areas of the Highway Systems group, which highlight the diverse expertise and involvement of our staff in local, state, and national level research.

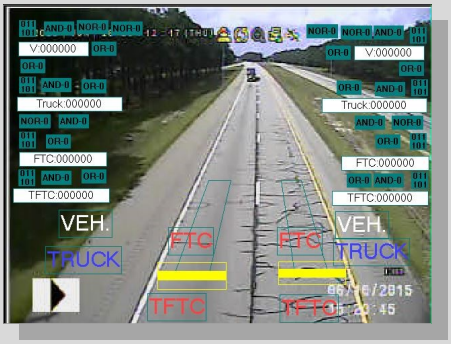
- Blind Pedestrian Access to Complex Intersections
- Unconventional Intersection Guidance and Analysis
- Identification and Evaluation of Roadway Assets
- Video-Based Detection and Assessment of Traffic Patterns
- Economic and Financial Assessment
- Freeway Performance Assessment, Modeling, and Monitoring
- Work Zone Evaluation
- Education and Training Courses and Workshops



Staff also provide job-specific training and education for transportation professionals at every level along with supplementary reference materials. For more information on these key themes, please visit our webpage at *www.itre.ncsu.edu/HWY*.

Major Accomplishments in 2015

- Two new positions have been filled within the group.
- Successful lead agency for new NCHRP research on Safety and Geometric Design Criteria for Diverging Diamond Interchange (DDI, NCHRP 15-58).
- Participation on various successful teams for national research projects, including FHWA projects "Innovations in Data Visualization Using the Research Data Exchange and the Weather Data Environment" and "Sketch Planning Methods to Support Planning and Operation."
- Lead authorship of the 2014 FHWA Informational Guide for the Diverging Diamond Interchange (DDI).
- Lead researchers for over fourteen research contracts for the NCDOT, with staff involvement in several other projects.
- Continued assistance to NCDOT in evaluation and monitoring of the I-40 "Fortify" work zone project.



- Publication of over a dozen peer-reviewed papers and conference proceedings.
- Participation in several national task order contracts for FHWA and NHI.
- Growth in training with delivery of customized courses outside of North Carolina.
- Full-semester instruction of two semester-long courses in Civil Engineering.
- Official staff membership in TRB committees on Highway Capacity and Quality of Service; Roundabouts; Pedestrians; Safety Data and Analysis; Operational Effects of Geometrics, Geometric Design; Work Zone; History; Access Management; and Traffic Law Enforcement.

Our Vision for the Future

- Increase course offerings and training in other states with increased online and web-based training focus.
- Continue to grow group with one to two additional full-time staff positions.
- Continue to diversify research portfolio across state and federal sponsors.
- Implement a high-fidelity traffic simulator to expand research capabilities at the state and national level.

NC Local Technical Assistance Program (NC LTAP)

James B. Martin, Director - Linda Collier, Assistant Director

The North Carolina Local Technical Assistance Program (NC LTAP) is one of 58 LTAP centers nationwide, funded by the Federal Highway Administration. The NC LTAP center was established at ITRE in 1986 and plays a leading role in helping state and local government agencies assess and apply new transportation technologies through training, technical materials, technical information services, and a quarterly newsletter. More than 80 training workshops are conducted annually for approximately 1,500 transportation personnel. Topics range from asphalt pavement maintenance to work zone traffic control.

The center also contributes to the professional development of the state's local transportation personnel through the Roads Scholar Program. This certificate program provides a curriculum of training to enable transportation workers to study road fundamentals, safety, drainage, snow and ice removal, and training management, among other topics. The courses help participants develop a sense of professionalism which advances their careers.

An Advanced Roads Scholar Program is also available for local agency staff, who seek to develop their technical and managerial skills further.

The Roads Scholar and Advanced Roads Scholar programs provide special training administered by North Carolina's Local Technical Assistance Program (NC LTAP) at ITRE, allowing local government agencies access to high quality training for their employees at a reasonable cost. The Roads Scholar Program consists of 14 different one- or two-day training sessions that are regularly offered each year. To become a Roads Scholar, 7 of the 14 training sessions must be completed.

The Master Roads Scholar Program consists of 10 training sessions offered through the NC Local Technical Assistance Program

How do I become a Master Roads Scholar?

To become a Master Roads Scholar, one must first become an Advanced Roads Scholar and then complete 6 of the 10 courses listed below and write a case study which focuses on a local transportation project.

Master Roads Scholar Courses:

- 7 Habits of Highly Effective People
- ADA Regulations and Requirements
- Asset Management
- Basic GIS
- Communicating with the Public and Media
- Ethics of Public Works
- Fundamentals of Government
- Leadership Skills
- Storm and Emergency Management
- Team Building

Photo credit: Mark Clifton

Master Roads Scholar Case Study

The Case Study should document a transportation project recently completed (within the last three years) in your local area or region of the state. You must submit a proposal describing your project for approval by NCLTAP prior to preparing the case study. The following outline can be used as a guide for the case study.

Introduction

- Describe the background of the project. Why is it needed? What is wrong with the current system or condition?
- Who is affected by the project, what are the challenges and what are the benefits of this project?

The Project

- Describe the magnitude of the project. This may include length, quantities, and costs.
- What steps were taken to complete the project?
- What challenges were encountered with the project? Do you consider this project a success and why?

Reflection

- What did you learn from this project?
- How can you use this knowledge in your career?

Upon completion of the Master Roads Scholar Program, participants receive the following:

- Certificate of Training
- Recognition at the APWA-NC Streets Division Annual Meeting
- Recognition in LTAP's Transportation Tracks newsletter
- Letter of Commendation, copied to supervisor and mayor
- Press release announcing achievement in local newspaper
- Master Roads Scholar shirt

NextGen Air Transportation Program (NGAT)

Kyle Snyder, Program Director

NGAT was originally started at ITRE in 2008 to provide a resource in the state focused on research and technology transfer as the FAA and the North Carolina aviation community began the transition to a "NextGen" air transportation environment. In 2012, NGAT was relaunched on a grant from NCDOT Division of Aviation with the primary objective of developing the Unmanned Aircraft Systems (UAS) Ecosystem in the state. While maintaining a broad NextGen scope for aviation research and development, the NGAT team has quickly developed a mature UAS program that is supporting development, integration, and adoption of the technologies in the state through collaboration with industry, academic researchers, and government agencies.

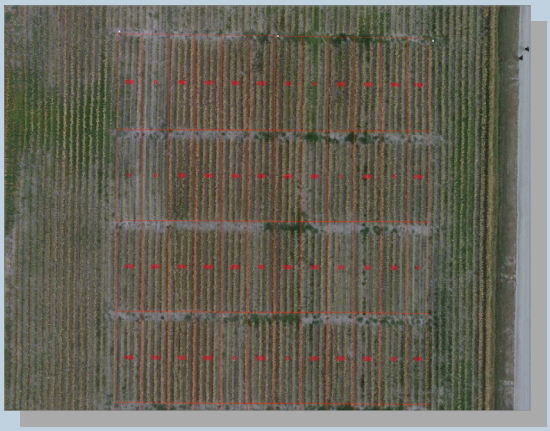
In 2014, the NextGen Air Transportation (NGAT) Program was approved as an NC State University Consortium. NGAT provides the aviation focus inside ITRE while it works with the external community through a membership model. NGAT's mission and charter are *to discover, evaluate, implement, and disseminate advanced air transportation technologies at the regional, national, and international level to improve the capacity, safety, and environment surrounding air transportation.*

NGAT 2015 Highlights

- Have now totaled more than 550 UAS flights, with over 125 hours of flight time.
- Attended AUVSI Unmanned Systems North America 2015.
- May 8, 2015 - FAA announced the ASSURE Team as the UAS Center of Excellence for research for the next 5 years. ASSURE Team is led by Mississippi State University while NC State University is the Core Team Member leading the Control and Communications (C2) research initiatives.
- Started the first ASSURE project, called UAS Surveillance Criticality Analysis, in November.
- Almost two dozen NGAT Consortium Members.
- Joint research project with NC State Soil Science Department.
- Guest lectures in UAS for Remote Sensing Class.
- Co-hosted Small UAS Airworthiness Workshop with ITRE and NCSU MAE Department.
- Supporting NCDOT Photogrammetry & Surveys with flight research to evaluate value of Small UAS for transportation surveying, traffic monitoring, and aerial photography.
- Continuing to build relationship with Raleigh-based Precision Hawk. Conducting joint research under NGAT Consortium, ASSURE, and FAA Pathfinder programs.
- Published “Evaluation and use of remotely piloted aircraft systems for operations and research” paper in the International Journal of Wildland Fire (T. Zajkowski, Co-Author).
- Continued support for NCDOT Division of Aviation UAS Program Office in developing UAS Management Best Practices, Outreach Plans, and Licensing/Permitting Program.

Precision Hawk launch at Lake Wheeler, Raleigh, NC.

Pictured above is a mosaic high-resolution image of the NCSU Lake Wheeler Farm flight test location from a NGAT UAS mission in early 2015.



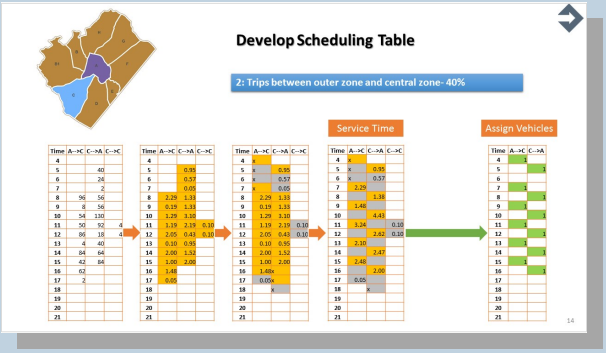
Imagery for joint research between NGAT and NCSU Department of Soil Science analyzing nitrogen content.

Public Transportation Group

Thomas Cook, Program Director

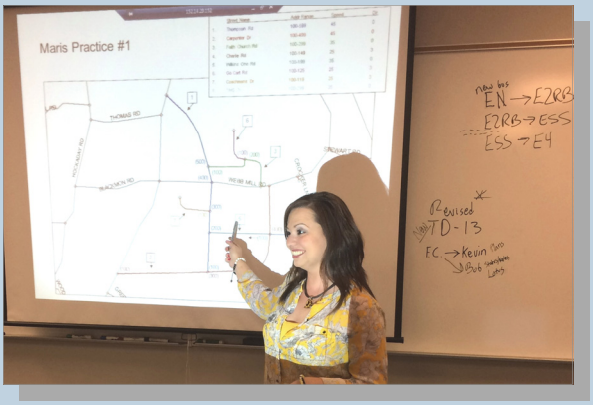
ITRE's Public Transportation Group conducts research, training, and technical assistance involving transit, bicycle and pedestrian, and pupil transportation.

- The **Transit Program** assists North Carolina transit systems, having contracts with the North Carolina Department of Transportation's Public Transportation Division (PTD) and with both transit systems and local governments. The program's primary focus is to provide technical assistance to the 18 urban and 82 rural public transportation systems as well as the state's intercity bus program. Transit Program staff provide online and on-site training as well as direct support to NCDOT/PTD for research, policy papers and recommendations, and policies and procedures manuals.
- **The Bicycle and Pedestrian Program** focuses on improving non-motorized transportation through planning assistance, training, and research. The staff have developed policies and procedures manuals, along with safety education materials and curricula, administered NCDOT grants initiatives (planning and SRTS grants), and offered training on planning, design, and accessibility. Currently, the staff are developing the Pedestrian and Bicycle Infrastructure Network–a geodatabase of all existing and planned non-motorized facilities within North Carolina. ITRE is also testing methods and will make recommendations to NCDOT to establish a non-motorized traffic monitoring program, which would be one of the first state programs of its kind. Recent research topics include rumble strips and bicycling, in addition to a before-and-after study determining the impacts of a pedestrian bridge that completed the American Tobacco Trail.
- **The Pupil Transportation Program** addresses school travel safety and operations activities. In addition to conducting school transportation research, the program also provides technical assistance to, and is responsible for, supporting the Transportation Information Management System (TIMS) for the North Carolina Department of Public Instruction (DPI). The TIMS staff provide support and consultation for a Geographic Information System (GIS) based on school bus routing and a scheduling software system used by nearly all public school districts in North Carolina. Technical assistance activities include website hosting and maintenance for several nationally-recognized organizations, including
    - National Association for State Directors of Pupil Transportation Services (*www.nasdpts.org*),
    - National Congresses on School Transportation (*www.nasdpts.org/ncstonline.index.html*),
    - Transportation Research Board School Transportation Subcommittee (*www.itre.ncsu.edu/anb10_6*),
    - Two state organizations: the North Carolina Bus Safety (*www.ncbussafety.org*) and the North Carolina Pupil Transportation Association (*www.ncbussafety.org/ncpta*).



The slide above shows some of the Public Transportation Group's efforts to assist the County of Lee Transit System to improve efficiency by implementing structured demand response service using service area zones with fixed service times.

Saw cutting to install bicycle loop detector on Spring Garden Street in Greensboro, NC as part of NCDOT's Non -Motorized Volume Data Program. Credit: Kristy Jackson



Lee Ann Beasley, Project Leader, shown teaching a Geocode (Map) Editing Class in ITRE's TIMS training lab.

Travel Behavior Modeling Group

Joe Huegy, Program Director

The Travel Behavior Modeling Group (TBM) performs research on travel behavior and travel demand forecasting topics.

Research work includes:

- The effect of various alternative development strategies on travel behavior in small communities and rural areas,
- Surveys of travel behavior of university students in North Carolina at six university campuses, and
- A regional land-use transportation decision support tool for Mississippi.

The Travel Behavior Modeling Group includes the Triangle Regional Model Service Bureau, which develops the travel forecasting models for the Triangle region of North Carolina. The Service Bureau is developing a new Version 6 of the Triangle Regional Model, which will add new commercial vehicle and university student models, along with an improved parking capacity and constraint model.

Current and former members of the Travel Behavior Modeling Group traveled to the 15th TRB National Planning Applications conference May 17-21, 2015 and made three presentations on their work on the Triangle Regional Model.

ITRE members Mei Ingram and Bing Mei, and former member Chao Wang presented their work on issues concerning Travel Behavior-Based Employment Categories, Interfacing the Regional Model with Statewide Model, and Modeling University Student Trips Separately from the General Population, respectively.

In addition, on May 18, Brian Morton with the Center for Urban and Regional Studies at UNC presented *Linking Rural Development and Transportation Using a Land Use-Transportation Decision Support Tool*, on which Joseph Huegy, TBM Program Director, was a co-author. This work analyzed the impacts of alternative land use strategies for a rural area in northeast Mississippi. Also on Wednesday afternoon, Joseph Huegy moderated a session on Data Collection and Management.

This conference provided an opportunity for team members to learn more about work carried out in other regions that might be useful to apply in the Triangle Regional Model. Readers interested in viewing the presentations can visit the following website: *www.trbappcon.org*.

Summary of ITRE's Finances

Exhibit III shows expenditures for the most recent Fiscal Year, July 1, 2014 through June 30, 2015. They are broken down by the funding source.

- Overall, about 6% of all FY2015 ITRE expenditures represent *State Appropriated Funds* related to administration, with additional operations support of 4% derived from *Indirect Cost Return*. The overall percentage of support from State Appropriations is unchanged since FY2012.
- *State of North Carolina* and *Federal Contracts* total 80% of all activity. Those figures have increased by about 3% compared to 77% for the FY 2014. State contracts increased by 4% while federal funding decreased by 1%.
- *Sales and Service* activity (10%) is derived mainly from registration fees for workshops and extension services. This includes the Operations Research and Education Lab (OREd) and our new overseas training program in Abu Dhabi, UAE.

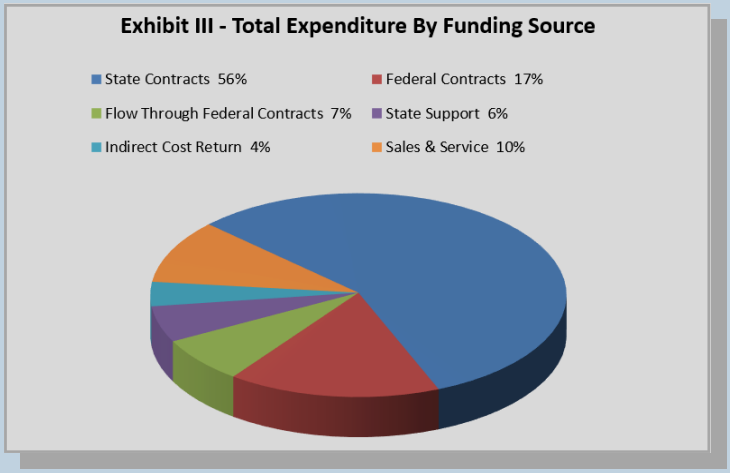


Exhibit IV shows how ITRE's FY2015 expenditures are expended in each program area. As has been the norm in the past few years, the Highway Systems program is ITRE's largest generator of expenditures, accounting for nearly 27% of all ITRE expenditures. This is a 1% increase over last year. We have combined Public and Pupil Transportation into one group and although their overall percentage decreased by 1%, several of the Highway Systems projects include staff from the Public/Pupil Transportation Group.

Highways is followed by Public Transportation with 13%, NGAT at 12%, and GADA with 10%. Other groups and administration contribute at various rates. The "Institute" expenditures include state appropriations, facilities and administrative receipts, professional development, and other accounts managed by the Institute as a whole.

The "CE Faculty" category represents sponsored research activity funded by the University of Maryland National Transportation Center which involves lead PI's from the Civil, Construction, and Environmental Engineering Department at NC State.

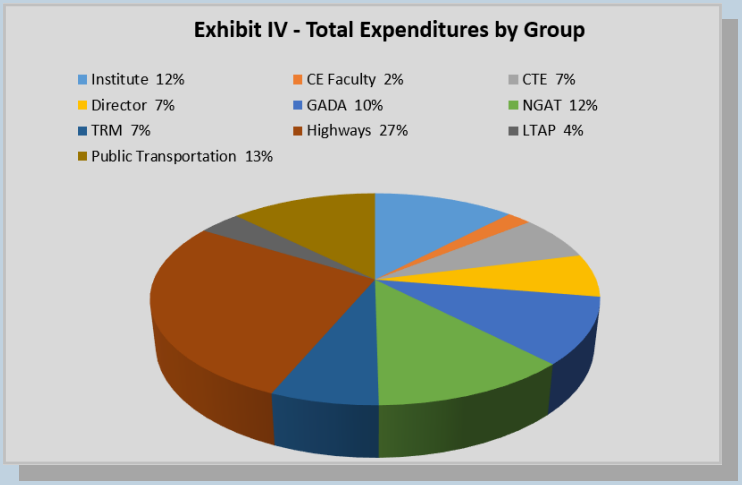


Exhibit V shows the distribution of expenditure sources by program area. This chart serves to highlight where each group expends its primary funds. Funds are categorized as State, Federal, and Other. This last category includes expenditures from contracts ITRE has with other states, not-for-profit organizations, the private sector, and course registrations. It highlights the fact that ITRE is still predominantly funded from state of North Carolina and local sources although there are some variations across program areas.

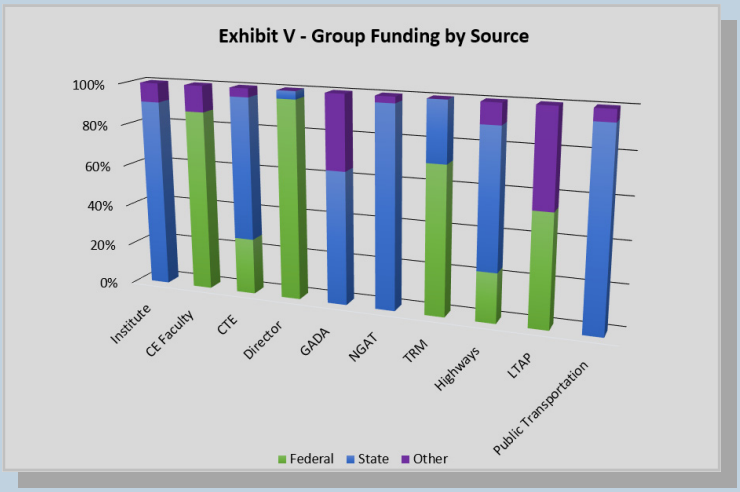


Exhibit VI tracks ITRE's total annual expenditures over the past five years. As can be seen, ITRE's total expenditures have increased in FY2015 compared to the previous cycle, by nearly $600,000 (or by about 7.84%, slightly exceeding $8M). In fact, the past three years represent the highest levels of expenditures by ITRE since 2008.

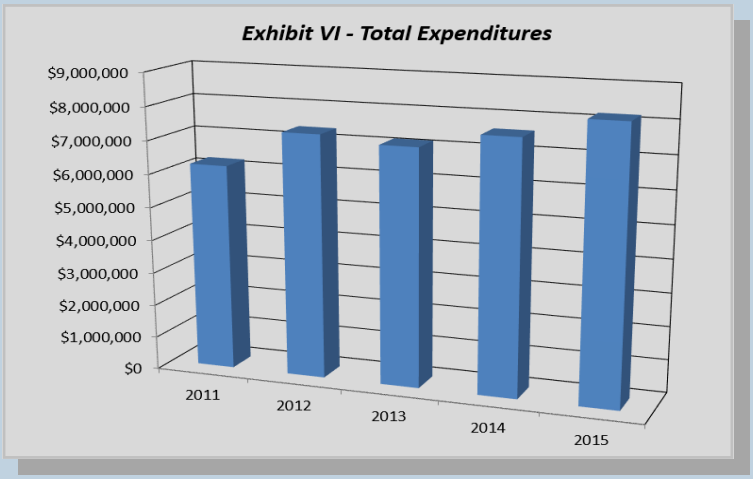


Exhibit VII summarizes ITRE's productivity trends over the past five years. The top line represents the ratio of total annual expenditures divided by ITRE's state appropriated funds. Total annual expenditures are utilized when calculating the ratio reflecting the value of our research activities. The ratio continues to be well above the indicated 4.0 minimum threshold cited in the UNC Office of the President Report (lower line). In 2013, the 2.7 value represents the average leverage ratio of all NC State University Centers and Institutes, as reported by the Office of the Vice Chancellor for Research, Innovation and Economic Development. ITRE again is showing it is a valuable and cost-effective asset to the state of North Carolina with 16.4 dollars generated for every dollar expended by the state.

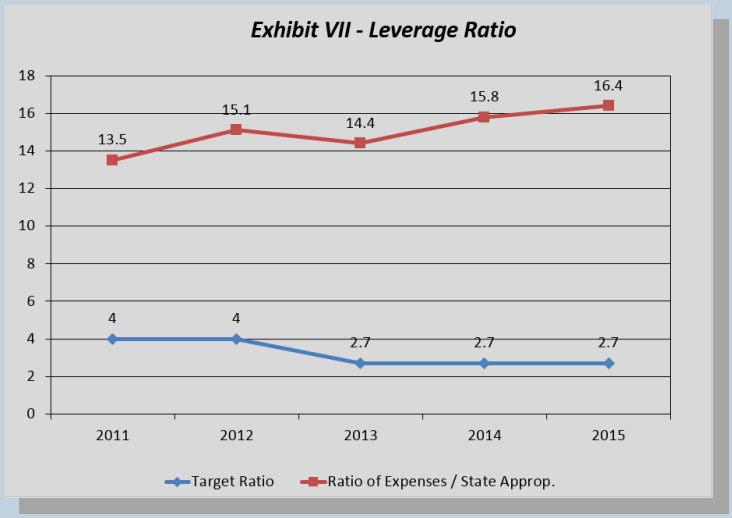
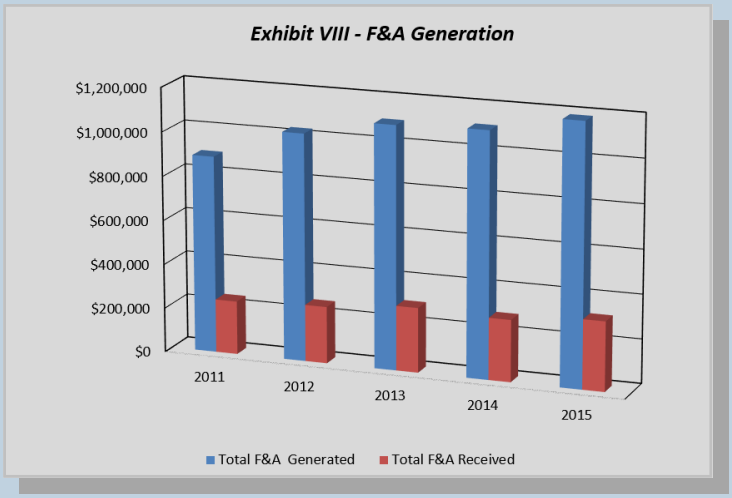


Exhibit VIII shows the trend in Facilities and Administrative (F&A) funds generated by our programs. In the last fiscal year we generated over $1,180,000 in F&A dollars from our local, state, and federal projects, an increase of 6.6% over the previous FY. This is the fourth year in a row that we broke the million dollar mark in overhead generation.

In past years, between 33-35% of the F&A funds were returned to operate the institute and provide incentives for improving ITRE's national visibility, but now about 26.6% is being returned due to a new allocation formula.



Summary of Project Activities

The following list summarizes ITRE's research and education projects at the national, state, and local levels for FY 14/15.

International and National Research and Development

International and national research efforts at ITRE continue to be quite significant in terms of magnitude and funding levels.

Accelerating Safety Activity Programs (ASAP), 2013-2014
Sponsor: Federally Funded through NCDOT (J. Martin)

Characterizing the Determinants of Vehicle Traffic Emissions Exposure: Measurement and Modeling of Land-Use, Traffic, Emissions, Transformation and Transport, 2014-2015
Sponsor: Health Effect Institute / EPA (N. Rouphail)

Development and Calibration of High Resolution Integrated Emissions and Mesoscopic Traffic Model for Korean Condition, 2015
Sponsor: Korea Institute of Civil Engineering and Building Technology (N. Rouphail)

Field Evaluation of Double Crossover Diamond Interchanges, 2010-2015
Sponsor: US Department of Transportation (N. Rouphail)

Framework for Mobile Source Emission Inventories, 2010-2015
Sponsor: US Environmental Protection Agency (N. Rouphail)

Guidelines for the Application of Crossing Solutions at Roundabouts, 2012-2015, NCHRP 3-78b
Sponsor: National Academy of Sciences (B. Schroeder)

Guidance for Traffic Signals at Diverging Diamond Interchanges and Adjacent Intersections (previous title: NCHRP 03-113), 2014-2016
Sponsor: National Academy of Science (C. Cunningham)

Local Technical Assistance Program, 2013-2015
Sponsor: Federally funded through NCDOT (J. Martin)

Southeastern Transportation Research Innovation, Development and Education (STRIDE), 2012-2015
Sponsor: University of Florida (D. Brill)

Triangle Regional Model Service Bureau at ITRE, 2013-2015
Sponsor: Federally funded through Triangle Transit (J. Huegy)

Triangle Regional Model Service Bureau at ITRE, Capital Area Metropolitan Planning Organization, 2013-2015
Sponsor: Federally funded through the City of Raleigh (J. Huegy)

Triangle Regional Model Service Bureau at ITRE, 2013-2015
Sponsor: Federally funded through the City of Durham, Chapel Hill, and Carrboro Metropolitan Planning Organization (J. Huegy)

On May 8, 2015 the FAA announced the selection of the ASSURE Alliance for the Unmanned Aircraft Systems (UAS) Center of Excellence for research funding for the next 5 years. ASSURE is the Alliance for System Safety of UAS through Research Excellence, and is led by the Mississippi State University with 21 total universities as part of the alliance and more than 100 industry partners, including local company Precision Hawk.

NC State University is a core member of ASSURE through NGAT's leadership in UAS integration in North Carolina. NextGen Air Transportation (NGAT) will lead the Control and Communications (C2) research activities for ASSURE collaborating with industry partners for matching funding to support well-defined research projects that meet FAA and ASSURE objectives. NGAT will reach across the NC State campus and other universities within the UNC System to access leading researchers and facilities to support C2 related research projects. The Center of Excellence is funded with $5M for FY2015. Initial projects have been awarded. Similar funding is anticipated for the next several years.

http://www.assureuas.org/

Daniel Findley, Senior Research Associate, presents information on aviation economic studies to the North Carolina Aviation Development Task Force Meeting.

The Trimble UX5 unmanned aircraft system was donated to the NGAT Consortium to support the ASSURE COE research. The NGAT team is using the UX5 in agriculture, surveying, and airspace integration research at FAA-approved flight locations across the state. Trimble is a founding member of the CGAT Consortium.

The ICOET conference, held in September, 2015 at the Raleigh Convention Center, was co-hosted by ITRE's Transportation and the Environment Program and the North Carolina Department of Transportation, with support from the US DOT Federal Highway Administration.

ICOET is the foremost multi-disciplinary, inter-agency supported conference addressing a broad range of ecological issues related to transportation systems. Experts in transportation development, related scientific study, policy issues, and administrative processes gather at ICOET to share the most current research information, quality applications, and the best practices that can enhance both the project development process and the ecological sustainability of transportation systems.

The ICOET program includes presentations for all transportation modes and incorporates various topics of interest for attendees – researchers, biologists, engineers, planners, project managers, administrators, and policy makers representing government, Tribal, academic, nongovernmental, and private industry organizations. More than 500 professionals from all 50 United States and over 20 other countries attend ICOET.

Triangle Regional Model Service Bureau at ITRE, NC Department of Transportation, 2013-2015
Sponsor: Federally funded through NCDOT (J. Huegy)

University of Maryland National University Transportation Center, 2013-2015
Sponsor: USDOT (N. Rouphail)

Other Projects Funded From Federal Sources

Accelerating Roundabout Implementation in the United States: Evaluation to Address Key Issues in Virginia Tech's Cost Proposal to Federal Highway Administration Task Order Proposal Request #34 Accelerating Roundabout Implementation in the United States, 2011-2015
Sponsor: Virginia Polytechnic Institute (B. Schroeder)

ACRP 11-05, 2014-2015
Sponsor: Cadmus Group / Transportation Research Board (J. Martin)

Dissemination of Airport Cooperative Research Program Research Results: Value and Utility Assessment, Scoping and Pilot-Testing (Previously Airport Cooperative Research Program 11-05, Task 2 - Value and Utility Assessment), 2011-2014
Sponsor: Cadmus /National Academy of Sciences (J. Martin)

EN1009 Context Sensitive Solutions - National Dialog 2 Support, 2011-2014
Sponsor: Project Performance Corporation/Federal Highways (J. Martin)

Environmental Justice Analyses When Considering Toll Implementation or Rate Changes, 2014-2016
Sponsor: Louis Berger Group, Inc./National Academies of Science (L. Lane)

Guidance for Alternative Intersections, 2013-2015
Sponsor: SAIC (B. Schroeder)

Impacts of Land Use Strategies on Travel Behavior in Small Communities and Rural Areas, 2011-2014
Sponsor: UNC-Chapel Hill/Transportation Research Board (J. Huegy)

NCHRP 03-115 Major Update to the 2010 Highway Capacity Manual, 2013-2015
Sponsor: Kittelson & Associates, Inc. (N. Rouphail)

Phase I AMS Testbed Selection, 2013-2015
Sponsor: Kittelson & Associates, Inc. (N. Rouphail)

Planning and Preliminary Engineering Applications Guide for the HCM (NCHRP-7-22), 2013-2015
Sponsor: Kittelson & Associates, Inc. (B. Schroeder)

Reliability Implementation - Strategic Highway Research Program 2: I-55, Task Orders 010 and 050, Issued under CS Professional Services Subcontract 08806, 2013-2014
Sponsor: Cambridge Systematics, Inc. (N. Rouphail)

Sketch Planning Methods to Support Planning Operations – Task Order 5002, 2014-2016
Sponsor: Kittelson & Associates, Inc. (B. Schroeder)

Task T-13001: Impacts Assessment of Dynamic Speed Harmonization with Queue Warning, 2013-2015
Sponsor: Kittelson & Associates, Inc. (N. Rouphail)

Transportation System Simulation Manual – Task Order 5001, 2014-2015
Sponsor: Kittelson & Associates, Inc. (G. List)

Work Zone Capacity Methods (NCHRP 03-107) for the Highway Capacity Manual, 2012-2015
Sponsor: Kittelson & Associates, Inc. (B. Schroeder)

The pedestrian and bike bridge over I-40 near the Streets at South Point Mall has made a world of difference to the users of the American Tobacco Trail. That's according to a before-and-after project by ITRE in the American Tobacco Trail Behavioral Impact Study, sponsored by NCDOT.

State of North Carolina and Local Research and Development

ITRE administered ongoing, statewide projects mostly in conjunction with the NC Department of Transportation (NCDOT) and local municipalities. See the pages that follow for additional project categories.

Americans with Disabilities Act Training, 2013-2015
Sponsor: NC Department of Transportation (D. Collins)

American Tobacco Trail Behavioral Impact Study, 2013-2014
Sponsor: NC Department of Transportation (T. Cook)

Assessment of Automated Sign Retro Reflectivity Measurement, 2014-2015
Sponsor: NC Department of Transportation (C. Cunningham)

Behavioral Effects of Completing a Critical Link in the American Tobacco Trail/East Coast Greenway, 2013-2014
Sponsor: Helen & William Mazer Foundation (T. Cook)

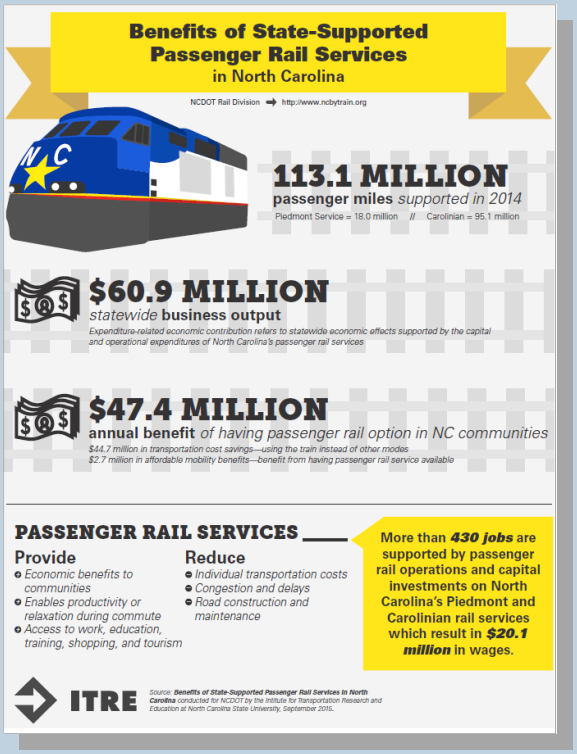
Bicycle and Pedestrian Data Collection, 2013-2017
Sponsor: NC Department of Transportation (S. O'Brien)

Bicycle and Pedestrian Geo-Spatial Data Update and Management, 2013-2014
Sponsor: NC Department of Transportation (S. O'Brien)

Defining North Carolina's Transportation Disadvantaged Populations, 2012-2014
Sponsor: NC Department of Transportation (L. Lane)

ITRE partnered with the NCSU Transportation Department and University Recreation to host a pit stop on NCSU campus for the National Bike to Work day in May.

ITRE Highways System Group employees Bastian Schroeder and Behzad Aghdashi presented at the NC Institute of Transportation Engineers (ITE) Section (NCSITE) Simulation and capacity Model Users Group (SIMCAP).



Railroads are an important part of the transportation system, enabling a cost-effective movement of goods and people to various destinations. Rail services can generally be broken into these two categories: freight service (movement of goods) and passenger service (movement of people). The North Carolina Rail Road's freight services move about 11.4 tons of freight annually, providing a statewide increase of economic activity estimated at $794 million in sales, including supply chain and household income effects. In addition to freight, North Carolina's passenger rail services have a substantial impact on North Carolina's economy. This study conducted by ITRE's Public Transportation Group (PTG) focuses on passenger services and the economic contribution they provide.

North Carolina's passenger rail system supported approximately 487,000 annual passengers who traveled over 113 million miles on the Piedmont and Carolinian services in 2014. These services benefit both passenger rail customers and the state's overall economy. In the absence of rail service, customers would be required to travel using other (often more-costly) modes or forego their intended trip altogether.

This study estimates the benefits North Carolina's Piedmont and Carolinian rail services provide to its users and to the state's economy. These benefits are detailed as transportation cost savings (benefits realized by traveling via passenger rail instead of by alternative modes), affordable mobility benefits (benefits derived from trips that would be foregone in the absence of rail service), and expenditure-related economic contribution (impacts to the state's economy resulting from expenditures related to rail operations and capital expenditures).

Delay and User Cost Estimation for Work Zones on Urban Arterials, 2012-2014
Sponsor: NC Department of Transportation (B. Schroeder)

Development of Web-Based Training Modules to Support NCDMV Driver Services, 2014-15
Sponsor: NC Department of Transportation (J. Martin)

Economic Contribution of Airports in North Carolina, 2015-2016
Sponsor: NC Department of Transportation (D. Findley)

Economic Contribution of the North Carolina Ports, 2014
Sponsor: NC State Ports Authority (D. Findley)

Economic Performance Measurements, 2013-2015
Sponsor: NC Department of Transportation (L. Lane)

Effects of Late Lane Merges on Travel Times, 2014-2016
Sponsor: NC Department of Transportation (C. Vaughan)

Evaluating the Economic Impact of Shared Use Paths in NC, 2015-2018
Sponsor: NC Department of Transportation (S. O'Brien)

Evaluating the Use of License Plate Agencies by NCDMV, 2014
Sponsor: NC Department of Transportation (J. Martin)

Evaluation of Life Cycle Impacts of Intersection Control Type Selection, 2013-2015
Sponsor: NC Department of Transportation (C. Cunningham)

Exploring Corridor Operations in the Vicinity of a Diverging Diamond Interchange (DDI), 2013-2015
Sponsor: NC Department of Transportation (B. Schroeder)

Facilitation of NC Department of Transportation Technical Assistance Program, 2013-2015
Sponsor: NC Department of Transportation (L. Lancaster)

High Speed Rail Technical Assistance, 2010-2015
Sponsor: NC Department of Transportation (J. Martin)

IMAP-Assessment of Benefits/Costs, Route Selection, and Prioritization, 2013-2015
Sponsor: NC Department of Transportation (N. Rouphail)

Interagency Coordination Protocol, 2014-2015
Sponsor: NC Department of Transportation (L. Lane)

Intercity Bus Routes, 2013-15
Sponsor: NC Department of Transportation (T. Cook)

Map Content Updates for NC State Highway Patrol Traditional Operational Enforcement Planning, 2014-15
Sponsor: NC State Highway Patrol (G. Ferrara)

Motor Carrier Safety Assistance Program Technical Support, 2013-2015
Sponsor: NC Department of Crime and Control and Public Safety (G. Ferrara)

NC Department of Transportation Maintenance Technical Assistance Program, 2013-2015
Sponsor: NC Department of Transportation (T. Baughman)

NextGen Air Transportation Center UAS Operations Project, 2014-2015
Sponsor: NC Department of Transportation (K. Snyder)

North Carolina Comprehensive Statewide Rail Plan, 2013-2015
Sponsor: AECOM, Inc. (G. List)

Pedestrian and Bicycle Infrastructure Network (PBIN) – Phase 3, 2015-2016
Sponsor: NC Department of Transportation (K. Jackson)

Performance Based Web Analytic Solution for NCSHP, 2013-2015
Sponsor: NC State Highway Patrol (G. Ferrara)

Planning-Level Extensions to NCDOT Freeway Analysis Tool, 2014-2015
Sponsor: NC Department of Transportation (B. Schroeder)

Professional Enhancement Program, 2013-2015
Sponsor: NC Department of Transportation (D. Findley)

Public Transportation Division Transit Operations Group/Urban Transit Technical Assistance Program, Technology Implementation and Research, 2013-2015
Sponsor: NC Department of Transportation (D. Collins/K. Monast)

Rail Intern Program, 2013-2015
Sponsor: NC Department of Transportation (T. Cook)

Reducing Aggressive Driving Behavior in the Vicinity of Trucks Using Real Time Feedback, 2013-2014
Sponsor: NC Governors Highway Safety Program (C. Cunningham)

Reduction in Railroad Right-of-Way Trespassing Incidents, 2014-2016
Sponsor: NC Department of Transportation (C. Cunningham)

Rumble Strip Gaps for High Speed Bicycles, 2014
Sponsor: NC Department of Transportation (S. O'Brien)

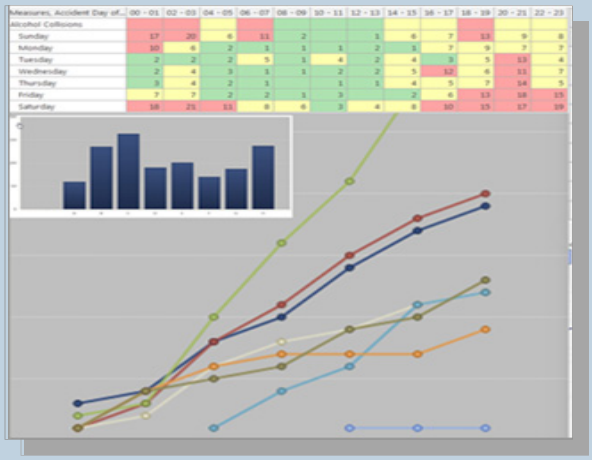
Skill Building Workshops, 2013-15
Sponsor: NC Department of Transportation (D. Collins)

Smartlink Baseline for Measurement of Benefits, 2012-2015
Sponsor: NC Department of Transportation (N. Rouphail)

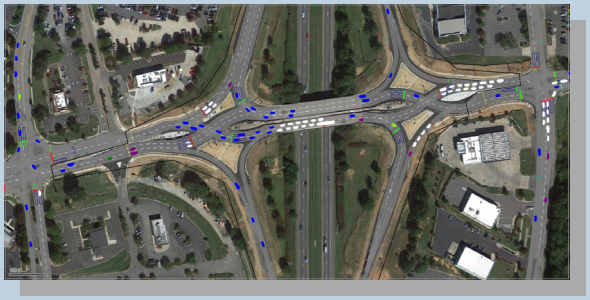
Dr. Nagui Rouphail, ITRE Director made his third visit to the Republic of Korea in October 2015. The visit included the delivery of three seminars at the Korea Transport Institute (KOTI), The Korean Institute for Civil Engineering and Construction Technology (KICT), and the Korea Research Institute for Human Settlements (KRIHS), as well as a presentation in a keynote session at the 73rd Annual Meeting of the Korea Transportation Society. Dr. Rouphail also reviewed the progress on a funded project on regional emissions estimation that is jointly carried by ITRE and KICT.

NCSU Alumni Reunion in Korea: left to right, Dr. Nagui Rouphail, ITRE Director, Dr. Jisun Lee (2009), Dr. Jung Myung Son (1980), Dr. Jae Joon Lee (2005), Dr. Hyejung Hu (2009), Dr. Sangkey Kim (2014), Dr. Chun Ho Yeom (2015), and not shown, Dr. Jong Dae Baek (2007).

Vision Zero, an initiative aimed at a long-term vision of ZERO fatalities on our roadways, includes a diverse set of safety stakeholders. ITRE staff are involved in facilitating a task force of stakeholders and sharing collision data in a useful and intuitive manner.



The Geovisual Analytics and Decision Management Group (GADA) presented Vision Zero Analytics to the ITRE Advisory Council on April 16th, 2015. Vision Zero Analytics (VZA) is an online data visualization system for tracking and measuring traffic safety goals, as well as identifying effective strategies for reducing traffic fatalities in North Carolina. VZA is an integral part of North Carolina's emerging crash reduction program called Vision Zero. Vision Zero is part of a national "Toward Zero Deaths" initiative aimed at reducing traffic fatalities on our nation's highways by increasing public awareness to change risky driving behaviors.



NCHRP 3-113: Guidance for Traffic Signals at Diverging Diamond Interchanges (DDI) and Adjacent Intersections focuses on developing a guidebook for designers, technicians, and planners. The research team has shaped a process for DDI implementation from initial design through final plans which walks readers through considerations unique to the DDI. Prior to publication, the process is being tested on DDIs currently in use in North Carolina, Kentucky, and Utah. The above image shows the current operations at the I-77 and Catawba Avenue DDI in Cornelius, NC.

Synthesis of Contemporary Guidance/ Recommendations for Pedestrian Signal Provisions at Marked Crosswalks, 2013-2015
Sponsor: NC Department of Transportation (B. Schroeder)

TDM Program, 2013-2015
Sponsor: NC Department of Transportation (D. Collins)

Teach Fundamental Engineering Principles Program, 2013-2015
Sponsor: NC Department of Transportation (C. Cunningham)

Technical Assistance to the NC Department of Public Instruction in the Implementation of the Transportation Information Management System (TIMS), 2013-2015
Sponsor: NC Department of Public Instruction (T. Cook)

Technical Support of NC State Highway Patrol Motor Carrier Enforcement Size and Weight Enforcement Program, 2013-2015
Sponsor: NC Department of Crime and Control and Public Safety (G. Ferrara)

Traffic Signal Inspection Course Presentation and Update, 2014-2015
Sponsor: NC Department of Transportation (C. Cunningham)

Trip Making Patterns of North Carolina's University Students, 2012-2014
Sponsor: NC Department of Transportation (J. Huegy)

Unmanned Aircraft Systems: A New Tool for DOT Inspections
Sponsor: NC Department of Transportation (K. Snyder)

Vision Zero, 2014-2015
Sponsor: NC Department of Transportation (D. Findley)

Work Zone Monitoring and Assessment for TIP I-5311/I-5338, 2016
Sponsor: NC Department of Transportation (B Schroeder)

Additional Project

Operations Research and Education Lab (OREd) Program
Sponsor: Various counties and school districts (M. Miller)

Staff Honors and Recognitions in 2015

State and National Committee and Panel Participation

TRB Committees

ABC40: Transportation Asset Management (C. Vaughan, friend)

ABE20: Transportation Economics (S. Bert, friend)

ABG20: Transportation Education and Training (D. Findley, friend)

ABG50: History Committee (D. Findley, member and communication coordinator)

ABJ35: Highway Traffic Monitoring (C. Vaughan, K. Jackson, friend))

ABJ40: Travel Survey Methods (J. Huegy, friend)

ADB30: Transportation Network Modeling (S. Tanvir, friend)

ADB40: Transportation Demand Forecasting (J. Huegy, friend)

ADB50: Transportation Planning Applications (J. Huegy, member)

ADC20: Transportation and Air Quality (S. Tanvir, friend)

ADC70: Transportation Energy (S. Tanvir, friend)

ADD10: Transportation and Economic Development (S. Bert, friend)

ADD40: Transportation and Sustainability (S. Tanvir, friend)

AFB10: Geometric Design (C. Vaughan, D. Findley, friends; S. Warchol, member)

AFB20: Roadside Safety Design (D. Findley, friend)

AFB30: Low-Volume Roads (D. Findley, friend)

AHB10: Maintenance and Operations Management (C. Cunningham, friend)

AHB20: Freeway Operations (S. Tanvir, friend)

AHB25: Traffic Signal Systems Committee (S. Warchol, C. Cunningham, friends)

AHB40: Highway Capacity and Quality of Service (B. Schroeder, member)

AHB50: Traffic Control Devices (T. Baughman, member)

AHB55: Work Zone Traffic Control (T. Baughman; chair, C. Vaughan, friend)

AHB65: Operational Effects of Geometrics (D. Findley, member; S. Warchol, C. Cunningham, friends)

AHB70: Access Management (C. Cunningham, member)

AHD50: Roadside Maintenance (T. Baughman, member)

ANB40: Traffic Law Enforcement (D. Findley, member)

ANF10: Pedestrian (S. O'Brien, K. Jackson, friends)

ANF20: Bicycle Transportation (S. O'Brien, member)

APO55: Rural Public and Intercity Bus Transportation (T. Cook, member)

APO60: Paratransit (K. Monast, member; T. Cook, friend)

APO85: Ferry (T. Cook, friend)

TRB Subcommittees and Task Forces

ABJ25T Task Force on the Traffic Monitoring Conferences (K. Jackson, friend)

ABJ35(3): Bicycle and Pedestrian Data Subcommittee (S. O'Brien, C. Vaughan, friend)

ABJ40(1): Household Travel Surveys (J. Huegy, member)

ABJ40(2): Freight Surveys (J. Huegy, member)

ABJ40(3): Stated Response Surveys (J. Huegy, member)

ABJ40(4): New Technologies (J. Huegy, member)

Joint ADD30 and ABD40: Integrated Transportation and Land Use Modeling (J. Huegy, member)

ADD50-01: Health and Transportation Joint Subcommittee (S. O'Brien, friend)

AHB40: Signalized Intersections (N. Rouphail, member)

AHB40: Freeway and Multi-lane Highways, (N. Rouphail, member, B. Aghdashi, member and secretary)

ANB10(6): School Transportation (S. O'Brien, friend)

ANF20(6): Joint Subcommittee on Pedestrian and Bicycle University Education (S. O'Brien, friend)

ANF10: Pedestrian Research (S. O'Brien, friend)

Panel Participation and Awards

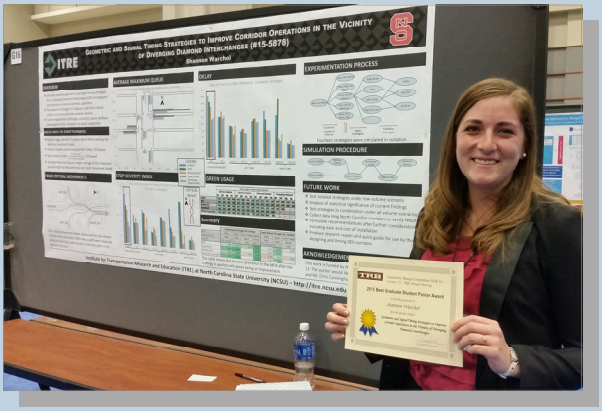
Outstanding Paper Award by Committee on Bicycle Transportation, ANF20, Rumble Strip Gaps for High-Speed Bicycles. Transportation Research Record: Journal of the Transportation Research Board. In press. (S. O'Brien, K. Jackson, D. Findley)

NCHRP 07-17: Pedestrian and Bicycle Transportation Along Existing Roads (S. O'Brien, panel member)

NCHRP 15-49: Geometric Design Guidelines for Managed Lanes (C. Cunningham, panel member)

The Best Paper Award by the Highway Capacity and Quality of Service Committee was again awarded to an ITRE member for the third year in a row. Chunho Yeom was awarded this honor this year for his research on lane utilization at two-lane arterials (DDIs). Left to right, Joe Hummer, Lilly Elefteriadou, (committee chair), co-authors Chunho Yeom, Bastian Schroeder, and Nagui Rouphail.

Katy Salamati was awarded the TRB Best Paper Award for the Roundabout Committee on her research and development of a simplified methodology for estimating emissions for roundabouts and signalized intersections. Co-authors include Bastian Schroeder, Chris Frey, and Nagui Rouphail.



Best Graduate Student Poster Award given at the 94th Annual Transportation Research Board (TRB) by the Geometric Design Division was presented to Shannon Warchol, with help from Bastian Schroeder and Chris Cunningham.

Special Awards - Other Organizations

2015 North American PTV Vision Traffic User's Group Meeting Best Abstract Award - *Dynamic Bandwidth Optimization for Improved DDI Signal Timing Using VISTRO and VISSIM* (Bastian Schroeder, Shannon Warchol)

2015 Dwight David Eisenhower Graduate Fellowship Award (Andy Wagner)

73rd Annual Korean Society of Transportation Conference Best Paper Award - *Application of Meso-scopic Model for Estimating Regional Emissions and Energy Consumption* (Kwanpyo Ko, Sangkey Kim, Nagui Rouphail, Shams Tanvir, Hyejung Hu, Choongheon Yang)

Don Blackburn 2015 Memorial Scholarship, North Carolina Section Institute for Transportation Engineers (NCSITE) (Shams Tanvir)

Helene M. Overly Graduate Scholarship, WTS NC Triangle Section (Shannon Warchol)

NCSU Award for Excellence in Outstanding Job Performance, ORIED Division (Mei Ingram)

Ramey Kemp Graduate Award 2015, Department of Civil, Construction, and Environmental Engineering, NC State University (Shams Tanvir)

Membership - Other Organizations

Air & Waste Management Association, Technical Committee, On and Off Road Mobile Source Emissions (S. Tanvir, secretary)

American Planning Association, Transportation Planning Division (J. Huegy, member)

Association of Pedestrian and Bicycle Professionals (S. O'Brien, K. Jackson, member)

Association for Unmanned Vehicle Systems International (AUVSI) (K. Snyder, member)

Community Transportation Association of America (T. Cook, member)

Federal Aviation Administration (FAA) UAS ASSURE Alliance Center Award of Excellence Team (COE), May 2015 (K. Snyder, member)

National Center on Strategic Transportation Policies, Investments and Decisions, University of Maryland (N. Rouphail, associate director)

National Committee on Uniform Traffic Control Devices (T. Baughman)

NCSITE Signal Systems User Group (C. Cunningham, chair)

NCSITE Simulation and Capacity Models Users Group (C. Cunningham, member)

NCSITE Traffic Analysis Tools Task Force (C. Cunningham, member)

NCSITE Traffic Engineering Council C. Cunningham, member)

NCSITE Transportation Planning Council (J. Huegy, member)

North Carolina Strategic Highway Safety Plan: Intersections Emphasis Area (S. O'Brien)

North Carolina Strategic Highway Safety Plan: Bicycle and Pedestrian Emphasis Area (S. O'Brien)

North Carolina Strategic Highway Safety Plan: Lane Departure Emphasis Area (D. Findley)

North Carolina Strategic Highway Safety Plan: Speed Emphasis Area (D. Findley)

North Carolina Strategic Highway Safety Plan: Data and Emerging Issues Emphasis Area (D. Findley)

RTCA SC-228 (K. Snyder, member)

UAS ASSURE Alliance Center of Excellence (K. Snyder, member)

Mei Ingram was the winner in the EPA category at NCSU's Office of Research, Innovation and Economic Development (ORIED) 2015 awards ceremony. Also pictured are Tom Cook and Nagui Rouphail.

Shams Tanvir, Ph.D student at ITRE, was awarded both the Ramey Kemp Graduate Award from the NCSU Department of Civil Engineering and the Don Blackburn Memorial Scholarship from the North Carolina Section Institute for Transportation Engineers (NCSITE)

ITRE nominees for the NC State University awards for Excellence. Left to right, Mladen A. Vouk, (Interim Vice Chancellor for Research), Kai Monast, Tom Cook, Nagui Rouphail, Chris Vaughan, Joe Huegy (for Mei Ingram), Walt Thomas, and Burke Foley.

ITRE staff visited the Bill Clinton Presidential Library in Little Rock, Arkansas during the TRB Highway Capacity Committee midyear meeting. From left to right, Lake Trask, Bastian Schroeder, Nagui Rouphail, Behzad Aghdashi, and Bo Yang.

Tom Cook retired from his position of Manager of Pupil Transportation and Director of Public Transportation. Nagui Rouphail presented Tom with a show of appreciation for his 20+ years of service to ITRE.

95th Annual Transportation Research Board Meeting Participation

Based on research conducted in 2015, ITRE staff will present and contribute to various meetings with the Transportation Research Board (TRB) at the Annual Meeting in January 2016. Many of these papers will also be considered for publication in upcoming issues of the *Transportation Research Record*.

A Framework for Defining Asset Features to Monitor and Assess Earth Retaining Structures, Cedrick Butler, William Rasdorf, **Daniel Findley**, Mohammed Gabr, **Steve Bert**

Behavioral Effects of Completing a Critical Link in the American Tobacco Trail, **Thomas Cook, Sarah Worth O'Brien, Kristy Jackson, Daniel Findley, Sarah Searcy**

Can Roundabout Corridor's Design Impact Optimal Crosswalk Location: A Multi-Objective Analysis, Paulo Fernandes, Katayoun Salamati, **Nagui Rouphail**, Margarida Coelho

DDI Signal Timing Fundamentals, Concepts, and Recommended Applications, **Chris Cunningham, Bastian Schroeder,** Stacie Phillips, Tom Urbanik, **Shannon Warchol**, Alison Tanaka

Development of a Transportation System Simulation Manual (TSSM) Framework: From Theory to Practice, **George List**, Medi Mashayekhi, Robert Bertini, Brandon Nevers

Estimating Route Travel Time Distributions From Segment Travel Times, **George List**, Henok Abdissa, Elizabeth Williams, LuYu, Billy **Williams**

Exploring Vehicle Pedestrian Crash Severity Factors Based on In-Car Black Box Recording Data, **Tai-Jin Song**, Jaehyun So, Jisun Lee, **Billy Williams**

Freeway Capacity: Theoretical Construct and Field Estimation Method, **Behzad Aghdashi, Nagui Rouphail, Kihyun Pyo, Bastian Schroeder**

Impact of Off-Ramp Geometric Treatments on Queue Spillback, **Shannon Warchol**, **Bastian Schroeder**, **Chris Cunningham**

Innovative Method for Remotely Fine Tuning Offsets Along a DDI Corridor, **SangKey Kim**, **Shannon Warchol**, **Bastian Schroeder**, **Chris Cunningham**

Integrating Dynamic Traffic Management Interventions into the HCM Freeway Facility Methodology, **Joseph Trask, Nagui Rouphail, Behzad Aghdashi**, Mohammed Hadi, Samaneh Khazraeian

Lane Utilization Model Development for Diverging Diamond Interchanges, **Chunho Yeom, Bastian Schroeder, Chris Cunningham**

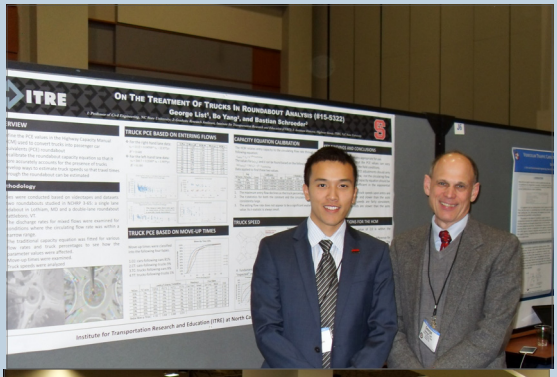
Modeling Freeway Work Zones with Mesoscopic Dynamic Traffic Simulators: Validation, Gaps, and Guidance, **Shams Tanvir, Nabaruna Karmakar, Nagui Rouphail**

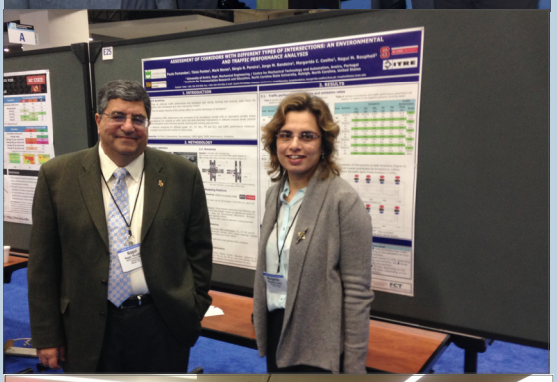
Positive Train Control: A Progress and Projection Analysis, Caroline Bojarski

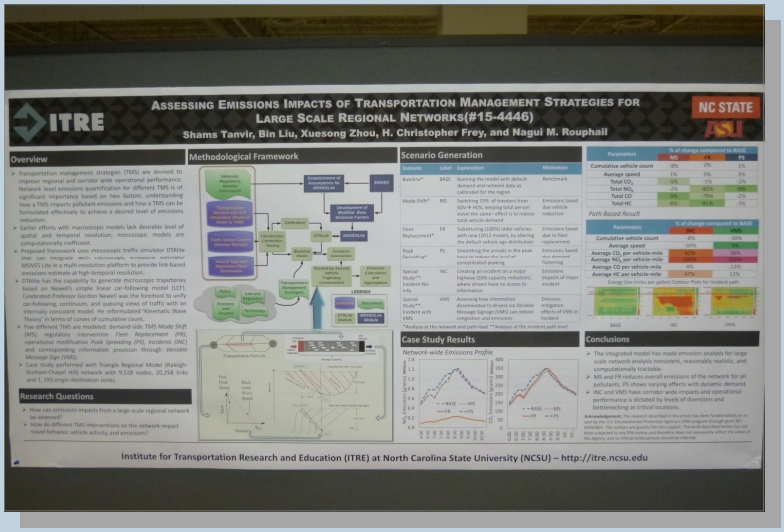
Relationship Between Network Parameters and Occurrence of Braess' Paradox, **George List**, Yi Chen

Simulation Guidance for Freeway Lane Closure Capacity Calibration at Diverging Diamond Interchanges, **Chunho Yeom, Nagui Rouphail,** William Rasdorf, **Bastian Schroeder**

Traffic Simulation Models Joint Subcommittee of AHB45, AHB40, AHB25, AHB20, ADB30, AHB55, ADC20, **George List,** presiding.







Conference and Workshop Attendance, Participation and Exhibits in 2015

Geovisual Analytics and Decision Management Group (GADA)

Commercial Vehicle Safety Alliance Workshop, Spring 2015 - (A. Belcher, B. Foley, attended)

Commercial Vehicle Safety Alliance Annual Meeting, *North Carolina's Motor Carrier Enforcement Resource Allocation Model,* Fall 2015 - (G. Ferrara, B. Foley, presented)

FMCSA Commercial Vehicle Information Systems Network (CVISN) Conference, *North Carolina's Motor Carrier Enforcement Resource Allocation Model,* May 2015 - (G. Ferrara, presented)

Governor's Highway Safety Program, Highway Safety Symposium - *Vision Zero Analytics*, August 2015 (G. Ferrara, B. Foley, presented)

NCSHP Motor Carrier Enforcement Conference and Workshop - *COVERLAB Analytics Training Workshop*, April 2015 (G. Ferrara, A. Belcher, B. Foley and M. Kuliani, hosted)

Traffic Records Forum, Fall 2015 - (G. Ferrara, B. Foley, M. Kuliani, attended)

Transportation Research Board Annual Meeting, January 2015 - (A. Belcher, attended)

Highway Systems

A Bridge to the Future - Making Logistics and Infrastructure a Competitive Advantage for NC. Transportation and Infrastructure Summit. *Diversifying Revenues to Improve Commerce and Economic Prosperity*. North Carolina Chamber, April 2015. Research Triangle Park, NC. (D. Findley, presented)

Board of Transportation, North Carolina Department of Transportation, *Economic Contribution of the North Carolina Ports,* January 2015, Raleigh, NC (D. Findley, presented)

Developing Freeway Demand Estimation Alternatives with Mixed Integer Linear Programming, INFORMS Annual Meeting, Philadelphia, PA, November 2015 (J. Trask, B. Aghdashi, J. Baugh, N. Rouphail, presented)

Dynamic Bandwidth Optimization for Improved DDI Signal Timing Using VISTRO and VISSIM. North American PTV Vision Traffic User's Group Meeting. Portland, OR. October 2015 (B. Schroeder, S. Warchol, presented)

Executive Committee for Highway Safety, *Moving Forward with Vision Zero*, January 2015, Raleigh, NC (D. Findley, presented)

Highway Safety is a Real Risk, and YOU are the Most Important Highway Safety Device!, Students Against Destructive Decisions Leadership Conference, RTP, NC, November 2015, (D. Findley, keynote speaker)

Highway Safety Symposium, *Vision Zero*, August 2015, Concord, NC (D. Findley, presented)

Human Factors and Transportation Engineering, PSY340: Ergonomics. NC State University, February 2015, Raleigh, NC (D. Findley, presented)

North Carolina Capital Area Metropolitan Planning Organization Conference - *Economic Benefits of Public Transit*, May 2015 (S. Bert, presented)

North Carolina Airports Association (NCAA) Division 1,2 and 3 Meetings - *Economic Contribution of North Carolina's Airports*, August and September 2015 (S. Bert, presented)

North Carolina Impaired Driving Assessment, Date and Evaluation Programming, National Highway Traffic Safety Administration, April 2015, Raleigh, NC (D. Findley, presented)

Optimization of Active Traffic Management Strategies Using Mixed Integer Linear Programming, INFORMS Annual Meeting, Philadelphia, PA, November 2015 (J. Trask, B. Aghdashi, J. Baugh, N. Rouphail, presented)

Research Seminar: Human Factors in Transportation, Carolina Chapter of the Human Factors and Ergonomics Society, March 2015, NC State University, Raleigh, NC (D. Findley, presented)

Regional Law Enforcement Liaisons Meeting, *Vision Zero*, April 2015, Raleigh, NC, (D. Findley, presented)

Right of Way Fatality and Trespass Prevention Workshop, Federal Railroad Administration, August 2015, Charlotte, NC (C. Cunningham, presented)

The Fusion of all Things Urban Streets, Signal Systems Users Group, August 2015, Charlotte, NC (C. Cunningham, attended)

Transcend 2015, International Conference on Mobility and Transport for Elderly and Disabled People, Lisbon, Portugal, July 2015, (T. Baughman, presented)

Unique Signal Timing Coordination Considerations, Signal Systems Users Group, Raleigh, NC, May 2015 (C. Cunningham, attended)

Using "Dynamic Bandwidth Assessment Tool" for Optimizing Intersection Offsets. North Carolina Section of the Institute for Transportation Engineers Signal Systems User's Group Meeting. Greensboro, NC, May 2015 (S. Warchol, presented)

ITRE Director

Adaptation of Mesoscopic Model for Estimating Regional Emissions and Energy Consumption, 73rd Annual Korean Transportation Society Conference, October 2015, Sejung, Republic of Korea, *Conference Best Paper Award* (presented by H.Hu, N. Rouphail co-author)

Adaptive Ramp Metering Modeling in the Highway Capacity Manual (HCM) Environment, 2015 UTC Conference for the Southeastern Region, Birmingham, AL. March 2015, (S. Khazraeian (FIU), B. Aghdashi (NCSU), M. Hadi (FIU), N. Rouphail (NCSU), Y. Xiao (FIU), presented)

An Interactive Traffic Management Platform Using HCM Concepts, I3 Florida's Transportation Showcase, Orlando, FL, May 2015 (N. Rouphail, presented)

Grow America Tour, US Secretary of Transportation the Honorable Anthony Foxx, NC State University Centennial Campus, February 2015, (N. Rouphail, presented)

Operations and Management Session, 2015 UTC Conference for the Southeastern Region, Birmingham, AL, March 2015, (N. Rouphail, moderator)

*Dynamic Traffic Control Interventions for Enhanced Mobility and Economic Comp*etitiveness, 2015 UTC Conference for the Southeastern Region, Birmingham, AL, March 2015 (L. Trask, B. Aghdashi, N. Rouphail, S. Khazraeian (FIU), M. Hadi, presented)

Freeway Facility Core and Reliability Methodology, AHB40 Highway Capacity and Quality of Service Committee Midyear Meeting, Little Rock, AR, June 2015 (N. Rouphail, presented)

HCM 2010 Major Update, Uninterrupted Flow and Stochastic Capacity, Presentation at the Korean Transportation Institute (KOTI), Sejung, Republic of Korea, October 2015 (N. Rouphail, presented)

High Resolution In-Vehicle Sensing: Description and Applications, Korea Institute for Civil Engineering and Building Technology (KICT), Seoul, Republic of Korea, October 2015 (N. Rouphail, presented)

Royal Melbourne Institute of Technology, Melbourne, Australia, March 2015 (J. Guzman, N. Rouphail, Invited PhD Dissertation External Examiner)

Travel Time Reliability: Integrating Mobility and Safety Considerations, Special Session, 73rd Annual Korean Transportation Society Conference, Sejung, Republic of Korea, October 2015. (N. Rouphail, presented)

UTC Regional Meeting and Conference for the Southeastern Region, Birmingham, AL, March 2015 (N. Rouphail, attended)

NC Local Technical Assistance Program (NC LTAP)

APWA State Conference, Hickory, NC, June 2015 (B. Woods. L. Collier, J. Martin, attended)

APWA NC Combined Equipment Services and Streets Conference, Greenville, NC, September 2015, (B. Woods, L. Collier, J. Martin, attended)

LTAP Southeast Regional Meeting, Savannah, GA, March 2105 (B. Woods, L. Collier, J. Martin, attended)

NextGen Air Transportation (NGAT) Program

ACE Camp, Charlotte, NC, June 2015 (T. Zajkowski, presented)

ASSURE/Trimble Connected Farm Demonstration Denver, CO August 2015 (J. Gorman, attended)

AUVSI Unmanned Systems Conference, Atlanta, GA, May 2015 (NGAT Team, presented/moderated)

Duke Marine Science Workshop, Beaufort, NC, June 2015 (T. Zajkowski, presented)

Dare County Stem Day, Manteo, NC, April 2015 (K. Snyder, presented)

Dept. of Justice, National Institute of Justice UAS Expert Convening Forum, Washington, DC, August 2015 (K. Snyder, attended on behalf of NC CIO)

FAA COE ASSURE Kickoff, Washington, DC, June 2015 (K. Snyder, attended)

Florida Unmanned Systems Business Expo, Orlando, FL, February 2015 (T. Zajkowski, presented)

ICOET Conference, Raleigh, NC, September 2015 (T. Zajkowski, presented)

Knowledge Well Partnership & Annual Event, Raleigh, NC, December 2015 (K. Snyder, presented)

IEEE 2015 Robo Research Seminar, Charlotte NC, March 2015, (K. Snyder, presented)

MITRE Workshop, Raleigh, NC, October 2015 (NGAT Team, hosted)

NASA UAS Traffic Management (UTM) Conference, San Francisco, CA, July 2015 (K. Snyder, attended)

National Security & Social Implications Remotely Piloted Airborne Vehicles/Related Technologies Workshop Washington, DC, March 2015 (J. Gorman, moderated)

NC Agriculture Aviation Association (NAAA) Chapter Mtg., Atlantic Beach, NC, February 2015 (K. Snyder, presented)

NC Aerospace Suppliers Conference, Concord, NC, August 2015 (K. Snyder, moderated)

New Mexico State University TAAC Conference, Santa Fe, NM, December 2015 (K. Snyder, T. Zajkowski, attended)

NGAT/Brooks Pierce NC UAS Program Update Briefing & Community Reception, General Aviation Terminal Raleigh Durham International Airport, Raleigh, NC, April 2015 (K. Snyder, hosted)

NGAT/Trimble Navigation Ltd. UX5 First Flight in NC Demo, Raleigh, NC, January 2015 (K. Snyder, hosted)

Southern Ag Leaders Conference, Myrtle Beach, SC, January 2015 (K. Snyder, presented)

State Fair UAS Demonstration, Raleigh, NC, October 2015 (NGAT Team, hosted)

UAS Commercialization Conference, Washington, DC, June 2015 (K. Snyder, speaker)

Public Transportation

Association of Pedestrian and Bicycle Professionals Professional Development Seminar, St. Louis, MO, September 2015 (S. O'Brien, K. Jackson, presented)

Bridging the Gap: Economic, Health, and Transportation Impacts from Completing a Critical Link in a 22-mile Rail Trail, Triangle Bicycle and Pedestrian Workshop, Durham, NC; April 2015. Georgia Trails Summit, Athens, GA; June 2015. Carolina Tarwheels Meeting, September 2015. (K. Jackson, presented)

Designing for Pedestrian Safety NHI Course, Columbus, OH, September 2015 (S. O'Brien instructed)

Establishing North Carolina's Non-Motorized Volume Data Program, Association of Pedestrian and Bicycle Professionals, Professional Development Seminar, September 2015 (S. O'Brien, K. Jackson, presented)

Maintaining and Contributing to North Carolina's Non-Motorized Volume Data Program Workshop, Raleigh, NC and Charlotte NC, June/July 2015 (S. O'Brien, C. Cunningham, K. Jackson co-instructed)

NC Bike Summit, Charlotte, NC, October 2015 (S. O'Brien, presented)

NCDOT Pedestrian Crossing Assessments Workshops, March 2015, Hickory, NC; April 2015, Wilmington, NC; April 2015, Raleigh NC. (S. O'Brien, B. Schroeder, co-instructed)

North Carolina Bicycle Summit, Greensboro, NC, October 2015 (K. Jackson, attended)

Pupil Transportation

NCDOT/Public Transportation Division Community Transportation Conference, October 2015, Raleigh, NC, (K. Monast, presented)

NC Public Transportation Association Annual Conference, Concord, NC, June 2015 (K. Monast, J. Scott, presented)

NC Pupil Transportation Association Transposium, Asheville, NC, June 2015 (M. Perez, L. Beasley, presented)

Travel Behavior Modeling Group

2015 TRB Transportation Planning Application 15th Conference (J. Huegy, B. Mei, M. Ingram, attended; C. Wang, presented)

Better trip distribution starts from developing travel behavior based employment categories, 15th TRM National Transportation Planning Application Conference, May 2015 (M. Ingram, presented)

Interfacing the Regional Model with Statewide Model to Improve Regional Commercial Vehicle Travel Forecasting, 15th TRM National Transportation Planning Application Conference, May 2015 (B. Mei, presented)

Land Use Forecasting Models for Small Areas in NC, NCAMPO Annual Meeting April 2015 (J. Huegy, co-presenter)

Linking Rural Development and Transportation Using a Land Use-Transportation Decision Support Tool, 15th TRM National Transportation Planning Application Conference, May 2015 (J. Huegy, co-presenter)

Modeling University Student Trips Separately from the General Population in a Regional Travel Demand Model, 15th TRM National Transportation Planning Application Conference, May 2015 (C. Wang, presented)

North Carolina Model User Group Spring and Fall meetings (J. Huegy, B. Mei, M. Ingram, attended)

Refereed Journal Papers

Aghdashi, S., N. Rouphail, A. Hajbabaie and B., Schroeder (2015), *Generic Speed Flow Models for Basic Freeway Segments on General Purpose and Managed Lanes*, In Press, Transportation Research Record, Journal of Transportation Research Board.

Aghdashi, S., A. Hajbabaie, J. Trask, B. Schroeder and N. Rouphail (2015), *Freeway Reliability Scenario Generation: A hybrid Approach*, In Press, Transportation Research Record, Journal of Transportation Research Board.

Cunningham, C.M., Findley, D.J., Hovey, K., Foley, P.B., Smith, J., Fowler, T.J., Chang, J., and J.E. Hummer (2015), *Improved Asset Management and Inventory Development Through Sample Analysis and Vendor-Client Communication.* Journal of Infrastructure Systems.

Fernandes, P., T. Fontes, M. Neves, S.R. Periera, J. Bandeira, M. Coelho and N. Rouphail (2015), *Assessment of Corridors with Different Types of Intersections: An Environmental and Traffic Performance Analysis*, In Press, *Transportation Research Record, Journal of Transportation Research Board.*

Fernandes, P., K. Salamati, N. Rouphail and M. Coelho (2015), *Identification of Emission Hotspots in Roundabouts Corridors*, In Transportation Research, Part D- Transport and the Environment Volume 37, June 2015, pp. 48-64.

Fernandes, P., T. Fontes, S.R. Peireira, N. Rouphail and M. Coelho (2015), *Multi-Criteria Assessment of Crosswalk Location in Urban Roundabout Corridors*, In Transportation Research Record No. 2517, Journal of Transportation Research Board, pp. 37-47.

Hajbabaie, A., N. Rouphail, B. Schroeder and R. Dowling (2015), *A Planning Level Methodology for Freeway Facilities*, In Press, Transportation Research Record, Journal of Transportation Research Board.

Holzem, A., Hummer, J.E., Cunningham, C.M., O'Brien, S., Schroeder, B., and K. Salamati (2015). *Pedestrian and Bicyclist Accommodations on Superstreets.* In Press, Transportation Research Record, Journal of Transportation Research Board.

Hunter, E., K. Salamati, L. Elefteriadou, V. Sisiopiku, N, Rouphail, B. Phillips, B. Schroeder (2015), *Driver Yielding at Unsignalized Midblock Crossings*, In Press, Transportation Research Board, Journal of Transportation Research Board.

Jackson, K., Elizabeth Stolz, and Christopher Cunningham (2014). *Non-motorized Site Selection Methods for Continuous and Short-Duration Volume Counting*, In Press, Transportation Research Record, Journal of Transportation Research Board.

List, G., B. Yang and N. Rouphail (2015), *On the Treatment of Trucks for Freeway Capacity Analysis*, In Press, *Transportation Research Record, Journal of Transportation Research Board.*

Mandipalli, S., V. Sisiopiku, B. Schroeder, L. Elefteriadou, K. Salamati and N. Rouphail (2015), *A Probit-Based Pedestrian Gap Acceptance Model for Midblock Crossing Locations*, In Press, *Transportation Research Record, Journal of Transportation Research Board.*

Mansfield, T., Rodriquez, D., Huegy, J., MacDonald-Gibson, J., The *Effects of Urban Form on Ambient Air Pollution and Public Health Risk: A Case Study in Raleigh, NC, Risk Analysis 35(5),* Dec. 2014.

O'Brien, S.W., K.N. Jackson, E. Vosburgh, and D.J. Findley. *Rumble Strip Gaps for High-Speed Bicycles,*(2015) In Press, Transportation Research Record: Journal of the Transportation Research Board.

Salamati, K., N. Rouphail, H.C. Frey, Bin Liu and B. Schroeder (2015), *Simplified Macroscopic Planning Level Methodology to Compare the Emissions at Roundabouts and Signalized Intersections*, In Transportation Research Record No. 2517, Journal of Transportation Research Board, pp. 48-60 (2015 Best paper award by the TRB Roundabout Committee).

Taylor, J., X. Zhou, N. Rouphail and R. Porter (2015), *Method for Investigating Intra-Driver Heterogeneity using Vehicle Trajectory Data: A Dynamic Time Warping Approach*, in Transportation Research, Part B, Methodological, Volume 73(3), pp. 59-80.

Vaughan, C., C. Jagadish, S. Bharadwaj, C. Cunningham, B. Schroeder, J. Hummer, D. Findley, N. Rouphail, (2015) *Long-Term Monitoring of Wrong-Way Maneuvers at Diverging Diamond Interchanges*, In Press, Transportation Research Record, Journal of the Transportation Research Board.

Yeom, C., A. Hajbabaie, B. Schroeder, C. Vaughan, X. Yuan and N. Rouphail (2015), *Innovative Work Zone Capacity Models from Nationwide Field and Archival Sources*, In Transportation Research Record No. 2485, Journal of Transportation Research Board, pp. 51-60.

Yeom, C., Hummer, J.E., Schroeder, B.J., Cunningham, C.M., Vaughan, C., and N. Rouphail (2015). *Empirical Before-After Comparison of the Operational Performance of Diverging and Conventional Interchanges*. Journal of Transportation of the Institute of Transportation Engineers. Volume 7, Issue 1.

Zhou, X., S. Tanvir, L. Hao, B.Liu, N. Rouphail and H. C.Frey (2015), *Integrating a Simplified Emission Estimation Model and Mesoscopic Dynamic Traffic Simulator to Emission Impacts of Traffic Management Strategies*, Transportation Research Part D: Transport and Environment, Volume 37, June 2015, pp. 123-136.

Other Publications and Reports

Cunningham, C.M. and B.J. Schroeder (2015). *Diverging Diamond Interchange Information Guide*. Federal Highway Administration. Part of Full Report documenting Alternative Intersection and Interchange Guidelines.

Findley, D.J., Schroeder, B.J., Cunningham, C.M., Brown, T.H. *Highway Engineering: Planning, Design, and Operations*. 1st Edition. Butterworth-Heinemann. Elsevier, 2015.

Huegy, J., Wang, C., Mei, B., Findley, D., Searcy, S., Bhadury, J., (2015), *Trip Making Patterns of NC's University Students*, Final Report. North Carolina Department of Transportation.

Hummer, J.E., Cunningham, C.M., Srinivasan, R., Rao, S., and S. Warchol (2015). *TECHBRIEF – Field Evaluation of Diverging Diamond Interchanges* (Safety). Federal Highway Administration. FHWA DTFH6-10-C-00030.

Hummer, J.E., Cunningham, C.M., Srinivasan, R., Rao, S., and S.Warchol (2015). *Safety Evaluation of Seven of the Earliest Double Crossover Interchanges Installed in the US*. Federal Highway Administration. FHWA DTFH6-10-C-00030.

Jackson, K., *North Carolina Terminology for Active Travel. North Carolina Department of Transportation Report*. October 2015.

Monast, K., Cook. T., Findley, D., Bert, S. and Small, J.D. *Benefits of Transit in North Carolina* North Carolina Department of Transportation. February 2015.

Schroeder, B., O'Brien, S., and Findley, D. (2015). *North Carolina Pedestrian Crossing Guidance*. North Carolina Department of Transportation, Final research report, FHWA/NC 2014-2015.

Tanvir, S., Nagui Rouphail, and Bastian Schroeder. *Network Level Impacts of Major Freeway Reconstruction Project on Vehicular Emissions, 108th Annual Conference of Air & Waste Management Association,* June, 2015, Raleigh NC.

Williams, B.M., Craft,D.W., Wagner,J.A., Rouphail,N.M., List,G.F., Dylan R. Horne, D.R., and Narron, B.L., *Smartlink – Baseline for Measurement of Benefits*, Final report, NCDOT RP-2013-08, September, 2015.

Student and Scholar Activities

Support for Scholars and Students

ITRE research and technical assistance projects continue to engage and support a large number of students from various disciplines at both the undergraduate and graduate levels. The tables on the next page summarize our level of student support. This year is yet another banner year where we had a significant increase in graduate and undergraduate student participation in ITRE research. In 2015, we had one the highest number of research-supported graduate (42) and the highest number of undergraduate (44) students in our history. Twenty of our graduate students were supported as Graduate Research Assistants (GRA) on projects. Much of the graduate student support continues to derive from federal research dollars from agencies, such as the National and Regional Transportation Centers, the National Cooperative Highway Research Program (NCHRP), the Strategic Highway Research Program (SHRP-2), the Federal Highway Administration, and the Environmental Protection Agency. We also provided meaningful research experiences for our undergraduate students, primarily in the areas of highway systems, rail operations, and a variety of other fields.

Post-Doctoral Fellows

Dr. Sangkey Kim completed his PhD at NC State University in December 2014 on the topic of "Dynamic Bandwidth Optimization for Coordinated Arterials". Kim joined ITRE as a post-doctoral fellow in January 2015, where he is engaged in several funded research projects in the area of signalization, work zone, and data visualization.

Visiting Scholars and Students

Dr. Hyejung Hu from the Korea Institute for Civil Engineering and Building Construction (KICT) visited ITRE in January 2015 for the kickoff meeting of a sponsored research project by KICT on regional emission estimation. Dr. Hu received her doctoral degree in Civil Engineering at NC State University and worked as a post-doctoral candidate at ITRE.

Dr. Goncalo Goncalves and *Mr. Nuno Perreira* from the Technical University of Lisbon (TUL) and ITDS, respectively, visited ITRE in March 2015 to continue the collaboration on the Intelligence to Drive (i2D) system, jointly supported by ITRE and TUL. Further testing of a Vehicle-Infrastructure-Vehicle (VIV) prototype took place during the visit.

Dr. Junggon Sung is Senior Research Fellow at the Korea Institute of Civil Engineering and Building Technology (KICT). KICT is a government sponsored research institute in Goyang, South Korea. His research interests are highway safety and highway management systems. Dr. Sung received his doctoral degree in Transportation Engineering at the University of Wisconsin in Madison, and he completed a sabbatical visit to ITRE in June 2015.

PhD student, *Paulo Fernandes*, from the University of Aveiro, Portugal and the co-advisee of Dr. Coelho and Dr. Rouphail visited ITRE in May and June 2015 continuing his research collaboration on roundabout corridor operations and their impact on safety, efficiency, and vehicle emissions.

PhD student, *Martin Hartmann*, from Karlsruhe Institute of Technology (KIT) in Germany is spending a research sabbatical at ITRE during the Fall Semester 2015. Martin's work focuses on the development of a macroscopic traffic flow model for freeway facility evaluation based on the German Highway Capacity Manual.

Student Presentations

Application of Meso-scopic Model for Estimating Regional Emissions and Energy Consumption, 73rd Annual Korean Society of Transportation Conference, October 2015 (K. Ko, S. Kim, N. Rouphail, S. Tanvir, H. Hu, C. Yang, presented)

Bluetooth Probe Data on Freeways, NCSITE Annual Meeting, Raleigh, NC, November 2015 (J. Wagner, presented)

Inaugural Intelligent Transportation Society Conference, Fall 2015 (Z. Manfredi, attended)

Introduction to i2D: Intelligence to Drive, 2015 NCSITE Annual Meeting, Raleigh, NC, November 2015 (S. Tanvir, presented)

Network Level Impacts of Major Freeway Reconstruction Project on Vehicular Emission, A&WMA 108th Annual Conference, Raleigh, NC, June 2015 (S. Tanvir, N. Rouphail, B. Schroeder, presented)

Regional Transportation Alliance Conference, Spring 2015 (Z. Manfredi, attended)

2015 Supported Graduate Students	
Ishtiak Ahmed Juwon Baek Helena Bell Yi Chen Joy Davis Darshan Divakaran Tristan Dyer Jonah Freedman Alfred Garshong Gholam Habibi Adrienne Heller Dylan Horne Elizabeth Hunter Nabaruna Karmakar Sangkey Kim Kihyun Ko Kwanpyo Ko Shu Liu Yijun Ma Mehdi Mashayekhi Ashley Newby	William Palmer Lindsay Patterson Briana Phillips Gowtham Ramesh Shoaib Samandar Parth Satra Sarah Searcy J. Douglas Small Tai Jin Song Anna Stokes Kambiz Tabrizi Shams Tanvir Joseph Trask Andy Wagner Shannon Warchol Charles West Elizabeth Williams Xingyu Xuan Bo Yang Rui Yang Chunho Yeom

2015 Supported Under-graduate Students	
Evan Arnold John Bauman Amanda Bennett Caroline Bojarski Riyad Brothers Chris Carnes Katherine Cassidy Jacob Clayton Daniel Coble Amelia Coley Matthew Conrad Michael Corwin Roderick Cox Brandon Edwards Edward Foyle Charles Getz Zhu Gong Regan Hale Steven Hill Kyle Hovey Hamilton James Stacey Jennings	Noah Johnson Ashley Landguth Maddie Lawson Alyssa Little Caleb Lowman Zachary Manfredi Rodniqua Minor Tim Nye Ian Pike Teresa Pincus Margaret Ray Andrew Robinson Scott Sallade Cory Steiss Adam Stewart Dawson Stott Michael Strickland Meredith Stull Wah Tran Viktoria Van Cantfort Erik Vosburgh Matthew Wright

Academic Year	Graduate Students	Under-graduate Students	High School Interns	Total
2005-06	15	17		32
2006-07	14	11		25
2007-08	14	10		24
2008-09	9	4		13
2009-10	16	12		28
2010-11	20	18		38
2011-12	31	13	2	46
2012-13	36	14	2	52
2013-14	43	40	1	84
2014-15	42	44	0	86
Totals	**240**	**183**	**5**	**428**

Exhibit IX

Summary of Continuing Education Activities

More than 7,100 transportation professionals – from flaggers to professional engineers – received the benefit of ITRE's education activities during 2015. This represents an increase of almost 400 participants over last year. The newest figure includes participants from our newly minted overseas training program at the Municipality of Abu Dhabi (ADM) in the United Arab Emirates. This program began in May of this year and is expected to extend well into 2016.

This exhibit lists training areas, workshops, and summary statistics, including a separate listing of ITRE's Distance Learning Programs.

Program	Seminars/Webinars in 2015	Attendees
ITRE	*Grow America Bus Tour*, US Secretary of Transportation Anthony Foxx, February, 2015	150
	ICOET 2015 International Conference on Ecology and Transportation, Raleigh, NC (September)	467
	National Transportation Center Webinars, co-organized with University of Maryland: "Technology and Innovation in Transport: A UK Perspective" (May); "Applications of Vehicle Probe Data for Performance Measurement" (July); "Improving Freight Transportation Reliability" (November)	357
	Transportation Founders Fund (TFF), April 2015	85
LTAP	**Every Day Counts FHWA webinars:** *Road Diets*, April, 2015 *Data-Driven Safety Analysis*, June 2015 *National Usage of GRS IBS* *Stakeholders Partnering for Success*, December 2015	 12 7 5 10
	ITRE and LTAP Totals	**1,093**

United States Department of Transportation Secretary Anthony Foxx visited the NC State Centennial Campus on February 19 as part of his Grow America Bus Tour of the southeast region. The event, organized by ITRE, attracted more than 150 people to hear Secretary Foxx speak on the long-term surface transportation reauthorization bill he is proposing to Congress. The "Grow America Act" bill, said Foxx, would create "stability and certainty" in transportation infrastructure funding streams moving forward.

Secretary Foxx first spoke of problems with the present transportation system, which included a lack of care in infrastructure maintenance, lack of investment in capacity that is sorely needed, and the inability to capture new innovations that could be of help. Foxx stressed the need for more creativity among our nation's civil engineers, including those present in the room, stating that future innovations were necessary to improve the system's performance.

https://www.youtube.com/watch?v=MVXLnwBSpGU&feature=youtu.be

Program	Training/Workshops in 2015	Instruction Hours per Session	Sessions Offered	Total Hours	Attendees
Highways	Distance Learning				
	FEP Spring Program for NCDOT employees	3	44	132	161
	FEP Fall Program for NCDOT Employees	3	42	126	170
	Fundamentals of Engineering (FE) Tues/Fri review course	3	40	120	60
	Professional Engineering Review Course ONLINE	3	22	66	120
	Classroom Training				
	Professional Enhancement Courses				
	PE Friday/Saturday	14	8	112	45
	PE Wednesday Night Summer Review Course	3	22	66	35
	Highway Engineering Concepts (HEC) Statesville	7	18	126	28
	DOT Maintenance Courses				
	Drainage	7	13	91	176
	Guardrail	7	3	21	45
	Flagger Training	4	21	84	299
	Flagger Instructor Training	12	7	84	60
	Work Zone Safety—Basic	7	26	182	496
	Work Zone Safety—Intermediate	7	22	154	472
	Work Zone Safety-Advanced				
	Work Zone Safety Supervisor	21	18	378	367
	SOFTWARE TRAINING Workshops				
	Traffic Signal Fundamentals	16	1	16	28
	Traffic Signal Inspection	8	5	40	256
	Intro to Site Development and Highway Access	8	3	24	155
	VISSIM (Introduction, Advanced I & II)	16	1	16	11
ITRE	**Classroom Training**				
	Abu Dhabi Municipality Training Program	20	7	140	148
	Highways and ITRE Totals	**169**	**323**	**1,978**	**3,132**

Program	Training/Workshops in 2015	Instruction Hours Per Session	Sessions Offered	Total Hours	Attendees
LTAP	Asphalt Pavement Maintenance	8	5	40	93
	Asphalt Roller Operator Safety Training	8	1	8	9
	Backhoe Operator Safety Training	8	1	8	18
	Basic Work Zone Safety Training	8	12	96	191
	Chain Saw Safety	4	2	8	62
	Concrete: What? When? and How?	8	1	8	13
	Confined Space Entry and Lockout/Tagout	8	4	32	73
	Construction Mathematics	8	1	8	8
	Designing Pedestrian Facilities for Accessibility	8	1	8	15
	Excavation Safety	8	1	8	17
	Flagger Training	4	11	44	118
	Flagging Instructor RECERTIFICATION	6	3	18	21
	Flagging Instructor Training	12	1	12	20
	Guardrail Design/Installation and Maintenance	6	1	6	18
	How to Keep Yourself and Your Agency Out of Court	1	8	8	15
	Intermediate Work Zone Safety Training	7	9	63	155
	Leadership Training	6	1	6	12
	Maintenance and Repair of Utility Cuts	4	7	28	149
	Motorgrader Operator Safety	8	1	8	9
	OSHA 10-Hr Safety Training	10	3	30	76
	Plan Reading	4	2	8	17
	Road Safety 365	8	2	16	46
	Roadway Drainage Maintenance	8	2	16	33
	Snow and Ice Control	7	3	21	67
	Soils Fundamentals	8	4	32	71
	Trenching 'Competent Person	8	7	56	82
	Work Zone RECERTIFICATION	7	4	28	71
	Work Zone Traffic Control Supervisor	20	6	120	120
	Writing Skills for Transportation Professionals	8	2	16	23
	FHWA – Every Day Counts	2	2	4	12
	APWA-NC Construction Inspection for Public Works Projects	17	1	17	28
	APWA-NC Advanced Construction Inspection Workshop	12	1	12	15
	LTAP Totals	**249**	**106**	**793**	**1,677**

Program	Training/Workshops in 2015	Instruction Hours per Session	Sessions Offered	Total Hours	Attendees
Public Transportation	**Distance Learning: Webinars**				
	Using Your Data	1	1	1	12
	Policies and Practices	1	1	1	14
	Basics of Scheduling	1	1	1	16
	Basics of Dispatching	1	1	1	16
	Service Delivery Methods	1	1	1	14
	Understanding Billing	1	1	1	12
	AssetWorks Refresher Training	4	11	44	82
	Skillbuilding Workshops	12	2	24	16
	TrIP_Maker Demonstrations	4	8	32	18
	NC Operating Statistics- Community Transportation	1	4	4	97
	Establishing NC's Non-motorized Volume Data Program	1	1	1	39
	Maintaining and Contributing to MC's Non-motorized Volume Data Program	65	2	13	29
	Pedestrian Crossing Assessments	6	3	18	102
	Basics of the Pedestrian and Bicycle Infrastructure Network	1	1	1	49
	Fully Allocated Cost Model	1	4	4	68
	Classroom Training				
	Skillbuilding Workshops	8	2	16	16
	Transportation Leadership Development	8	6	48	26
	AssetWorks Refresher Training	9	2	18	51
	Technology User Groups	8	1	8	19
	Best Practices in ADA Paratransit	8	1	8	52
	ADA 101	8	1	8	54
	Public Transportation Totals	**150**	**55**	**253**	**802**

ITRE's Highway Operations and Safety section completed its first international work zone safety training in Abu Dhabi in the United Arab Emirates. The training addressed work zone concepts, worker and road user safety, risk assessment, pedestrian considerations, flagging operations and procedures, and inspection and maintenance of traffic control devices using the Abu Dhabi Work Zone Traffic Management Manual. The courses, taught by Tim Baughman, were not only lecture-based, but included group exercises as well as several plan-sheet applications for setting up work zones typical of Abu Dhabi streets, freeways, and roundabouts.

Program	Training/Workshops 2015	Instruction Hours Per Session	Sessions Offered	Total Hours	Attendees
OREd	ArcGIS Basics & Intro to ArcGIS I/II	30	2	60	28
	ArcGIS Server Development: Intro, Intermediate, Advanced	24	1	24	5
	Python: Basic, Intermediate, Advanced	24	2	48	27
	ModelBuilder: Basic, Intermediate	12	1	12	7
	ArcGIS Online & Web Apps	12	2	24	12
	OREd Totals	**102**	**8**	**168**	**79**
Pupil Transportation	Distance Learning Training				
	Blackboard- TDTIMS	2	1	2	68
	Classroom Training:				
	TIMS Open Lab	12	6	72	9
	TIMS New User	12	5	60	34
	TIMS Geographic Certification I	12	2	24	16
	TIMS Geographic Certification II	12	2	24	8
	TIMS Elplot & Geboundplan	12	1	12	8
	TIMS Run Optimzation	6	1	6	8
	TIMS Customized Training (ESQL)	6	2	12	8
	Onsite Training (misc)	8	4	32	6
	NCPTA Transposium Training				
	Attendees at all TIMS Classes at conference, representing 41 Counties in North Carolina	-	-	-	221
	Pupil Transportation Totals	**82**	**24**	**244**	**386**
	GRAND TOTAL	**752**	**516**	**3,436**	**7,169**

ITRE Staff Participation in Community Service

In April, ITRE staff helped Habitat for Humanity build a house.

In September, we helped at the Food Bank of Raleigh

With the assistance of another team, ITRE sorted 2,600 lbs of sweet potatoes into family-size bundles that will feed over 2,000 people!

In 2015, four ITRE staff members donated a combined 62 units of platelets (15.5 gallons) through Rex Blood Services. Platelets are used during cancer treatments, organ transplants, and open heart surgery, as well as by accident victims.

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