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Perhaps the best word to describe ITRE these days is partnership. The Institute participates in many partnerships—some with universities, some with public agencies, some with private firms. Each partnership is designed to achieve the ITRE goal of addressing the critical transportation problems facing North Carolina and the nation. And each partnership is marked by that most precious of commodities: cooperation.

One partnership has produced the new Center for Transportation and the Environment. Funded both by the North Carolina Department of Transportation and the U.S. Department of Transportation, CTE is operated by ITRE and the Department of Civil Engineering at NCSU. CTE is now in operation and has funded its first round of research projects. From its funding to its administration to its policy-setting, CTE is a true partnership among the two DOTs and the University.

Likewise, the new Transportation Materials Research Center is a partnership that includes the two DOTs, the University, and private companies in the aggregates industry of North Carolina. This Center is also now in its first year of operation. ITRE provides funding for the Center and participates in the operation and policy-setting for the Center.

We also are pleased to continue our long-standing partnership with NCDOT in both ongoing and new activities, and we are especially pleased that NCDOT continues to rely on ITRE for training and research. As noted earlier, NCDOT is an active partner in funding and operating CTE and TMRC. And NCDOT has asked the Institute to carry out many smaller projects. We are grateful for this cooperative relationship with NCDOT.

There are other partnerships as well. The Southeastern Transportation Center is a cooperative partnership among several universities in the Southeast. Of particular importance is the relationship between ITRE and North Carolina A&T State University in operating STC. The NC Energy Division and the NC Department of Public Instruction continue to cooperate with ITRE in operating the Transportation Information Management System that optimizes school bus routes throughout the state. The Federal Transit Administration, NCDOT, and the City of Winston-Salem are cooperating in a four-way partnership with ITRE in testing the use of new vehicle control and communications technology in public transportation.

ITRE is also working in a partnership with the National Academy of Public Administration to carry out a National Cooperative Highway Research Program project. This project is examining the capabilities of state departments of transportation to adapt to the changing pressures that they now face.

There are many more partnerships. Each one is important to ITRE as we address transportation problems that are increasingly complex and pressing. We value each partnership...and each partner.
**Executive Summary**

Established in 1978 by order of the N.C. General Assembly, the Institute for Transportation Research and Education (ITRE) is recognized by state and local government agencies as a leading resource in transportation research and technical assistance. As a unit of North Carolina State University, ITRE provides research assistance and project administration for the 16-campus UNC system and Duke University, as well as for state government agencies.

ITRE assists local and state government agencies in meeting a wide range of transportation challenges. This effort is coordinated through ITRE’s program areas: Highways, Local Governments, Pupil Transportation, Geographic Information Systems, and Public Transportation.

**Funding Sources for ITRE Programs (1992-94)**

**Total Budget for ITRE Programs (in Millions of Dollars)**

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Associate Director for Programs

James B. Martin, P.E.
Associate Director for Programs

Robert L. Martin, P.E., A.I.C.P.
Associate Director for Finance
The Institute for Transportation Research and Education is a constituent organization of the University of North Carolina system. Schools with transportation programs that comprise ITRE include the following: North Carolina A&T State University, North Carolina Central University, North Carolina State University, University of North Carolina-Chapel Hill, University of North Carolina-Charlotte, and Duke University. ITRE is administered by North Carolina State University and reports to the Office of the Vice Chancellor for Research, Outreach, and Extension.

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**Pupil Transportation Program**
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Southeastern Transportation Center

As the Region IV USDOT university transportation center, STC is committed to its mission of training the transportation professionals of the 21st century. During fiscal year 1992-93 that mission became embedded in a new theme—transportation safety—which continues to guide the activities of STC’s research and education programs.

In keeping with its new theme, STC sponsored eight research projects during the past two years. These projects reflect important safety issues to both highway and public transportation modes.

In addition to its research program, STC administers a strong education program, grounded chiefly in the activities of three advanced institutes. Vanderbilt University offers graduate students advanced studies in transportation through the Vanderbilt Information Systems in Transportation Academy (VISTA). University of Kentucky offers graduate students advanced studies through its Transportation Management Systems (TMS) program. The Southeast Transportation Safety Institute (STSI) at The University of Tennessee-Knoxville offers graduate students a specialized transportation safety curriculum.

North Carolina A&T State University, co-lead institution for STC and administrator of its education program, has built a strong foundation for all education initiatives emerging from the Center. A regional internship program introduces undergraduate and graduate students to public and private sector career opportunities. Each year, NCA&T also hosts the Summer High School Transportation Institute, introducing high school seniors to the field of transportation and its various disciplines.

Projects
Assessment of Crime Against Taxi Drivers and the Effectiveness of Countermeasures
Dr. John R. Stone, North Carolina State University

Commercial Motor Vehicle Driver Safety
Dr. Arun Chatterjee, The University of Tennessee, Knoxville

Identifying Hazardous Locations Using GIS
Dr. Gary S. Spring, North Carolina A&T State University

Analysis of the Perception of Personal Safety on Public Transit
Dr. Julian M. Benjamin, NCA&T

Ceramic Road Striping Materials to Improve Pedestrian/Bicycle Safety
Dr. Charles Beatty, University of Florida

Innovative Traffic Control Devices to Improve Pedestrian/Bicycle Safety
Dr. Joseph Hummer, NCSU

Analysis of the Choice by African Americans to Use Seat Belts
Dr. Julian Benjamin, NCA&T

Potential for Increased Use of Intermodal Freight Transportation to Reduce Highway Accidents/Fatalities Involving Commercial Motor Vehicles
Dr. Arun Chatterjee, UT-Knoxville

STC Schools:
Georgia State University
NC A&T State University
NC Central University
NC State University
UNC Chapel Hill
UNC Charlotte
University of Florida
University of Kentucky
University of Tennessee
Vanderbilt University
Duke University
The Center for Transportation and the Environment is a USDOT university research institute committed to conducting research that mitigates the effects of surface transportation on the environment. The Center’s environmental theme is a recognition of the critical relationships which exist between transportation facilities and services, and the environment. This theme also takes into account the reciprocal nature of these relationships: not only do transportation decisions affect the environment, but also environmental factors influence transportation decisions.

The Center focuses on developing methodologies whereby regional and national environmentally-related transportation problems are tackled by interdisciplinary teams of researchers and practitioners. These teams include a diverse group from the academic community, e.g., engineers, scientists, planners, and economists, as well as members of state and federal transportation agencies, and when appropriate, elected officials and private citizens. NCDOT provides the 20 percent match funding required for the USDOT-URI grant. With the nation’s largest state highway system, second largest ferry system, and a wide range of multi-modal programming, NCDOT brings to CTE a keen awareness of environmental concerns in transportation.

The Center is directed by Dr. John S. Fisher, associate head of the civil engineering department at North Carolina State University. Dr. Fisher brings to this position extensive research experience in such areas as coastal processes, water quality, and applications of GIS to natural hazard planning.

Projects

- Functional Assessment of Wetland Ecosystem Response to Highways
  Duke University

- Restoring Wetlands for a Mitigation Bank for Surface Transportation Projects in Western Carolina
  University of North Carolina-Asheville

- Development of Guidelines for the Restoration of Forested Wetlands in North Carolina
  North Carolina State University

- Bridging the Gap Between Transportation and Air Quality Modeling: Development of Emission Inventory Tools and Impact Analysis
  University of North Carolina-Chapel Hill

- Probabilistic Evaluation of Technological, Environmental and Economic Factors in Mobile Source Air Pollution
  North Carolina State University

  University of North Carolina-Charlotte

- Monitoring and Statistical Modeling of North Carolina Highway Runoff
  University of North Carolina-Charlotte

- System for Managing Highway Vegetation with Reduced Environmental Impact
  North Carolina State University

- Using Socioeconomic Information to Assess Impacts of Surface Transportation in North Carolina Coastal Communities
  East Carolina University
ITRE's Highway Program helps ensure that work zones are operated safely, that the maintenance of roads occurs in a timely manner, and that roads are constructed properly.

**PROJECT HIGHLIGHT**

The past year was as busy for the instructors of ITRE's *Asphalt Emulsion Workshop* as it was productive for the NCDOT Division of Highways employees who benefited from their training. The result of a partnership between ITRE and NCDOT's steering committee on asphalt emulsion, 28 such workshops were held throughout North Carolina last year.

The five-hour classes, which drew nearly 700 participants, emphasized proper storage and handling techniques of asphalt emulsion, in an effort to increase on-the-job safety and awareness. Making use of visual displays, demonstrations, and hands-on activities, two teams of instructors demonstrated how to use, without abusing, asphalt emulsion.

The project also served to foster internal communication and cooperation. Through their participation in the workshops, as both instructors and students, equipment personnel strengthened their working relationships with highway maintenance operations.

Employee response to the workshops was positive, as were the scholastic results: Classes averaged a 97 percent pass rate.
PUBLIC TRANSPORTATION

With a growing national emphasis on multimodal approaches to transportation, public transit has been receiving more attention and consideration as a viable mode choice within the broader transportation network.

Public transportation systems will be enhanced with the addition of technological innovations to increase operational efficiencies and to make transit more attractive to the public. ITRE's Public Transportation Program has recognized the need for continued research in advanced public transportation (APTS) technologies and accordingly, has focused much of its research efforts in this direction.

This program area continues to collaborate with University of North Carolina system professors to bring in the range and depth of expertise required for its various projects. ITRE also continues to work in cooperation with the North Carolina Department of Transportation Public Transportation Division (NCDOT/PTD) toward the common goal of increased efficiencies and ridership in North Carolina transit operations.

PROJECT HIGHLIGHTS

The system implementation phase for the demand-response Mobility Manager system at the Winston-Salem Transit Authority (WSTA) is underway. The purpose of this national demonstration project is to design and implement a transit management system to integrate and automate operations functions (i.e., dispatching, scheduling, recordkeeping) for both paratransit and fixed-route service at WSTA.

The project will provide an operational test-bed for computerized dispatch and related technologies, such as digital communications, automatic vehicle location (AVL) technologies, and electronic fare card media. Research is also being conducted on algorithms and mathematical optimization models.

The Urban Transit Assistance Program (UTAP) began in January 1994 for the purpose of providing user defined assistance in management, operations, and technology to the 18 fixed-route operations in North Carolina. The program’s activities for its first six months included: site visits, preparation of The UTAP Resource Manual, UTAP News and UTAP Alert, and the development of work program items for UTAP and NCDOT/PTD.
The Local Governments Program was established in 1983, when ITRE began providing pavement management system services for municipalities in the State of North Carolina. Since then the program has added management services for traffic signs and sidewalks. To date, over 100 municipalities in North Carolina, South Carolina, and Virginia have utilized the management services provided through the Local Governments Program.

Pavement, sign, and sidewalk management systems for a municipality involve conducting an inventory of the existing facilities. During each type of survey, location characteristics and distress types are noted and entered into a database. Computer programs have been developed by ITRE to analyze each type of database. Results provided to municipalities include a listing of the inventory, recommendations, summary tables, and a technical report.

Geographic information systems has been integrated with ITRE's pavement management system to provide graphical mapping and analysis capabilities. A similar combination is currently being developed for the sign management system.

### PROJECT HIGHLIGHT

In response to local government concerns about liability associated with traffic signs, ITRE developed the Sign and Marking Management System (SMS-ITRE). In 1993, SMS-ITRE software was used to develop a sign and marking management system for the City of Gastonia. The project included the inventory and evaluation of over 3,300 regulatory and warning signs, 68 miles of pavement markings, as well as all cross walks and special markings (i.e., railroad and school legends).

The City of Gastonia has realized several benefits as a result of its marking management system: maintenance needs and budget requirements are easier to define; maintenance scheduling is completed with greater efficiency; and, most importantly, traffic safety has improved.

### Projects

<table>
<thead>
<tr>
<th>1992 Pavement Management System</th>
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<tbody>
<tr>
<td>Town of Alamance, NC</td>
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<td>City of Charlotte, NC</td>
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<td>City of Columbia, SC</td>
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<td>Town of Enfield, NC</td>
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<td>City of Fayetteville, NC</td>
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<td>City of Kinston, NC</td>
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<td>City of Lexington, NC</td>
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<td>Town of Mocksville, NC</td>
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<td>City of Raleigh, NC</td>
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<td>City of Reidville, NC</td>
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<td>Town of Southern Pines, NC</td>
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| 1992 ADA Sidewalk Study         |
| City of Durham, NC              |

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<th>1993 Pavement Management System</th>
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<tr>
<td>Town of Biltmore Forest, NC</td>
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<td>Town of Carrboro, NC</td>
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<td>Town of Drexel, NC</td>
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<td>City of Dunn, NC</td>
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<td>Town of Edenton, NC</td>
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<td>City of Elizabeth City, NC</td>
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<td>Foxfire Village, NC</td>
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<td>City of Graham, NC</td>
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<td>City of Greensboro, NC</td>
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<td>City of High Point, NC</td>
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<td>Town of Hillsborough, NC</td>
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<td>Town of Kernersville, NC</td>
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<td>Town of Pine Knoll Shores, NC</td>
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| 1993 GIS/Pavement Management System |
| City of Rockingham, NC            |
| City of Salisbury, NC             |
| City of Sanford, NC               |
| City of Thomasville, NC           |
| Village of Whispering Pines, NC   |
| Town of Yaupon Beach, NC          |

| 1993 Sign Management System      |
| City of Wilson, NC               |

| 1993 Sidewalk Management System  |
| Town of Mocksville, NC           |

| 1994 Pavement Condition Survey   |
| Town of Galabash, NC             |
| Town of Cary, NC                 |
| Town of Clayton, NC              |
| Town of Elizabethtown, NC        |
| City of Fayetteville, NC         |
| Town of Garner, NC               |
| Town of Hamlet, NC               |
| Town of Long Beach, NC           |
| Town of Mocksville, NC           |
| Town of Mooresville, NC          |
| Town of Wallace, NC              |
| City of Charlotte, NC            |
TECHNOLOGY TRANSFER FOR LOCAL AGENCIES

One of 55 centers nationwide, the North Carolina Technology Transfer (T²) Center for Local Transportation Agencies provides a vital form of training and technical assistance. The T² Center is funded by the Federal Highway Administration through the Local Technical Assistance Program grant and serves North Carolina’s urban and rural local transportation agencies. Since it was established in 1986, the center has trained over 5,500 individuals in current road maintenance and management practices. Local agencies also receive a quarterly newsletter and have access to a technical information referral service as well as a report and videotape lending library.

PROJECT HIGHLIGHT
The North Carolina Roads Scholar Program recognizes local government employees who want to increase their knowledge of road maintenance procedures and improve their technical and managerial skills. The program consists of 12 different training sessions regularly offered by the T² Center. To become a North Carolina Roads Scholar, one must attend 7 of the 12 training sessions.

Projects
RTAP 809 Bridge Posting Evaluation
FHWA
Cherokee Transportation Planning Project
NCDOT, FHWA
Tort Liability: A Manual for North Carolina Local Governments
FHWA
North Carolina Roads Scholar Program
FHWA

Upon completion of the program, individuals receive
• Roads Scholar certificate of training and cap
• Recognition at the NCAPWA Streets Division Annual Meeting
• Recognition in North Carolina’s Transportation Tracks newsletter
• Letter of commendation, copied to one’s supervisor and city mayor
• Press release sent to local newspaper
Pupil Transportation

The projects ITRE began in the area of computer-assisted pupil transportation in the early 1980s gave rise to the development of a program area that specialized in computerized routing and scheduling of school buses to improve pupil transportation efficiency. Among several projects, notably, was the Transportation Information Management System (TIMS). First installed in 1986, TIMS continues to prosper today.

Through the successful installation of TIMS, ITRE has built strong relationships with school districts in North Carolina and gained unique insight into the issues that impact the operation of local school district transportation. This insight has led to the development of new technical assistance efforts that provide valuable tools, training, and information to school administrators throughout the state.

**PROJECT HIGHLIGHT**

As a result of the success of the initial in-state TIMS installations, the North Carolina General Assembly enacted legislation that required all school districts to implement TIMS as of September 1, 1992.

With the help of the funding incentives that the Department of Public Instruction offered to school districts with improved pupil transportation efficiency and the conservation measures enacted in the wake of the Gulf War, TIMS has garnered the State of North Carolina significant savings. Over 1991-92 as compared to 1989-90, the state fleet was reduced by nearly 500 buses; annual mileage was reduced by nearly three million miles; and fuel was reduced by nearly one million gallons.

For sites already TIMS equipped, ITRE continues its program of technical assistance and training. The TIMS staff at ITRE works with DPI to identify necessary software enhancements and hardware system improvements. Four of the largest school districts in the state (Wake, Mecklenburg, Guilford, and Forsyth counties) have installed TIMS on an IBM RISC/6000 minicomputer. The multi-user, multi-processing RISC minicomputer allows the transportation supervisors to access TIMS software from remote locations, thereby integrating it as a "demand-response" tool to assist their daily operations.

In July 1993, the TIMS project received a national award in the category of operations automation by the Urban and Regional Information Systems Association (URISA).
In accordance with its mission to help local and state governments keep pace with emerging geographic information technology, ITRE's GIS program in 1992-94 continued to advise governmental agencies in the selection, purchase, and application of geographic information systems. The program also continued to support government-related GIS activities for a variety of applications, including vehicle routing and scheduling, facility siting, mapping, rural addressing, redistricting, address-matching, accident analysis, and environmental review.

**Project Highlights**

**GIS Training/Technology Transfer Laboratory**
In March 1993, the GIS Program was the recipient of a grant from Sun Microsystems, Inc., of Mountain View, California. Donated in the form of Sun workstations, the grant was awarded to promote the development of GIS in the public sector. ITRE used this grant to facilitate the establishment of a five-seat, hands-on GIS Laboratory, and immediately began developing a GIS curriculum centered around ARC/INFO, the GIS software generally acknowledged as the standard in its field. Today, ARC/INFO courses in the Lab offer instruction for the beginner as well as the expert. Attention is paid to the technical user, who creates a database and programs its software, as well as the casual user, who needs only to query geographic databases on an occasional basis.

**City of Wilson Pavement Management System**
The City of Wilson wanted to adapt the PMS-ITRE pavement management system to a GIS environment. Under the terms of this project, the City's centerline street file was converted to PMS database format, and the entire PMS-ITRE application was written to run under ARC/INFO. Users in the City's GIS Department are now able to produce spatial queries and thematic maps of the condition of its streets.

**Student Assignment Plans for Durham Public Schools**
The GIS Program was contracted by Durham Public Schools to develop and study the impact of three alternatives for developing student assignment plans necessitated by the merging of city and county school systems. The scenarios were modeled, using 1993-94 facilities and enrollment for elementary, middle, and high school grade levels; neighborhood assignments; and assignments based on race and income balance.
Office of Information Services

ITRE's program areas, research centers, and administrative staff are supported by the Office of Information Services. OIS was created in 1992 to centralize the Institute's communication resources. Acting essentially as an in-house service bureau, OIS facilitates the production, distribution, and implementation of ITRE products and services to the transportation community.

An important function of OIS is to respond to requests for technical information and disseminate final project reports. Research reports produced by the Institute are forwarded to the State Documents Clearinghouse as well as USDOT, TRIS, and NTIS for mass distribution.

ITRE Report Listing:

- Alternative Fuels Study for the Energy Division, North Carolina Department of Commerce
- Assessment of Computer Equipment and Training Needs [of North Carolina Transit Systems]
- Assessment of Software for Computerized Paratransit Operations
- Development of a Roadway Management System for the North Carolina State Parks System
- Maintenance Crew Size Study for Division of Highways, North Carolina Department of Transportation
- North Carolina Litter Prevention Coloring Book
- Paratransit Scheduling and Dispatching System Options for Capital Metro Special Transit Services, Austin, Texas
- Proceedings of the Tenth National Conference on Rural Public Transportation
- Sign and Marking Management System for the City of Charlotte, North Carolina
- South Carolina Flagging Handbook
- Study of the NCDOH Roadway Maintenance Unit
- Technical Assistance in Paratransit Routing
- TIMS System Installation Report
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