

1. Report No. FHWA/TX-97/1439-3		2. Government Accession No.		3. Recipient's Catalog No.	
4. Title and Subtitle TEXAS A&M ITS RESEARCH CENTER OF EXCELLENCE NARRATIVE SUMMARY REPORT: FISCAL YEAR 1995-96				5. Report Date October 1996	
				6. Performing Organization Code	
7. Author(s) Raymond A. Krammes, Katherine F. Turnbull, Thomas Urbanik II, Richard T. Bartoskewitz, Dan Middleton, Charles W. Blumentritt, Gary Lobaugh				8. Performing Organization Report No. Letter Report 1439-3	
9. Performing Organization Name and Address Texas Transportation Institute The Texas A&M University System College Station, Texas 77843-3135				10. Work Unit No. (TRAIS)	
				11. Contract or Grant No. Project No. 0-1439	
12. Sponsoring Agency Name and Address Texas Department of Transportation Research and Technology Transfer Office P. O. Box 5080 Austin, Texas 78763-5080				13. Type of Report and Period Covered Letter Report: September 1995-August 1996	
				14. Sponsoring Agency Code	
15. Supplementary Notes Research performed in cooperation with the Texas Department of Transportation and the U.S. Department of Transportation, Federal Highway Administration Research Project Title: TxDOT Support of the Texas A&M IVHS Research Center of Excellence					
16. Abstract This report summarizes the accomplishments of the Texas A&M Intelligent Transportation Systems (ITS) Research Center of Excellence (RCE) during Fiscal Year 1995-96. The research program targets the intelligent transportation infrastructure. It focuses on three technical thrusts—public transportation, transportation management, and international border transportation—and two crosscutting concerns—institutional and non-technical issues, and technology integration. Accomplishments in the public transportation area include completing an assessment of the METROLift AVL system, developing a rural AVL system demonstration, and conducting a workshop on <i>Integrating Transit with Advanced Traffic Management Systems</i> . Accomplishments in the transportation management area include enhancements to and field implementation of the Smart Diamond Control System, development of functional requirements for interfacing train position information from a Positive Train Separation system with a highway-rail grade crossing control system, and enhancement of an open-architecture in-vehicle communications and information system to expedite police vehicles' incident response and commercial vehicle enforcement capabilities. Accomplishments in the international border transportation area include development of an ITS plan for the Texas-Mexico border, evaluation of institutional barriers to implementing ITS technologies along the Texas-Mexico border, and assessment of the effects of telecommunications deregulation					
17. Key Words Public Transportation, Transportation Management, International Border Transportation, Institutional and Non-Technical Issues, Technology Integration, Technology Transfer, Human Resource Development			18. Distribution Statement No restrictions. This document is available to the public through NTIS: National Technical Information Service 5285 Port Royal Road Springfield, Virginia 22161		
19. Security Classif.(of this report) Unclassified		20. Security Classif.(of this page) Unclassified		21. No. of Pages 7	22. Price

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## **Texas A&M ITS Research Center of Excellence Narrative Summary Report Fiscal Year 1995-96**

During Fiscal Year 1995-96, ITS America recognized the Texas A&M Intelligent Transportation Systems (ITS) Research Center of Excellence (RCE) "for outstanding leadership and excellence in advancing the development and deployment of ITS." This narrative summary report highlights some of the RCE's accomplishments during the fiscal year which warranted this recognition. The report is organized according to the three missions of the RCE: research, technology transfer, and human resource development.

### **RESEARCH**

The Texas A&M RCE's research mission is to conduct a balanced program of ITS research and technology applications that enhances the operation, management, and integration of the U.S. surface transportation system. The research program targets the intelligent transportation infrastructure upon which ITS services are built. It focuses on three technical thrusts—public transportation, transportation management, and international border transportation—and two crosscutting concerns—institutional and non-technical issues, and technology integration.

#### **Public Transportation Services Technical Thrust**

Major accomplishments in the public transportation area included completing an assessment of the METROLift Automated Vehicle Location (AVL) system, developing a rural AVL system demonstration, and conducting a workshop on *Integrating Transit with Advanced Traffic Management Systems (ATMS)*. These efforts helped to accelerate the deployment of ITS with public transit, facilitated interaction among representatives from transit agencies and ITS vendors, and documented the benefits of transit ITS projects.

The results from the Houston METROLift AVL assessment indicate that the AVL system has helped meet increasing demands for services in a time of limited resources by improving fleet management, vehicle dispatch functions, and operational efficiencies.

The workshop on *Integrating Transit with ATMS* brought diverse groups together to develop a strategic agenda for better integrating transit with ATMS. The workshop also enhanced communication among public and private sector groups.

The development of a GPS-based rural transit AVL system further advances the deployment of ITS technologies in rural settings.

## **Transportation Management Services Technical Thrust**

Major accomplishments in the transportation management area include field implementation of the Smart Diamond traffic-adaptive control system, development of strategies for improving the interaction between the highway and rail modes at grade crossings, and implementing prototype, open-architecture information and communications systems in police vehicles.

Significant progress was made during 1995-1996 in the field implementation of the Smart Diamond traffic-adaptive control system. In this system, RCE researchers combine state-of-the-art traffic control technology with adaptive control software to dynamically optimize the lane use and operation of a signalized diamond interchange. The Smart Diamond implementation will demonstrate that through the use of video detection, traffic information processing, and real-time optimization and control, road users will experience less delay, less congestion and fewer safety problems. During the fiscal year, a video detection system, two changeable lane assignment signs, an industrial microcomputer, and a 2070 advanced transportation controller were installed at the field implementation site. Software developments include: an algorithm that collects turning movement volume data from the video system and transfers the data to the 2070 controller, and a prediction algorithm that uses the collected data in conjunction with stored historical data to predict volumes for the next time period. The Smart Diamond expert system was refined, and several new functionalities were added, including lane-assignment handling, saturation-flow adjustment, and unbalanced-flow adjustment. The controller manager software was fine-tuned to interpret the optimal phasing pattern suggested by the expert system on the 2070 and to program the NEMA controller accordingly. Modifications to PASSER IV software allow coordination of a diamond interchange with adjacent traffic signals on the arterial.

The products of the RCE's research to *Integrate Railroad Information into ITS* will improve the interaction between the highway and rail modes and reduce vehicle-train collisions and travel delays through the provision of real-time information on train movements. Benefits of the research will extend to traffic managers, the traveling public, railroads, and freight shippers. An early objective of the research was identifying and recommending a place for highway-rail grade crossings in the national architecture for ITS; this objective was fulfilled by the recent approval of a highway rail intersection user service, which was developed with considerable input from RCE research. The more recent focus is on systems for Positive Train Separation, which offer the advantages of real-time train position information. Technical documentation was acquired on the Positive Train Separation system being developed by two major U.S. freight railroads and pilot tested on a high-speed passenger rail corridor in the Pacific Northwest. The documentation is being used to develop a communications interface for integrating train position reports into a highway traffic management

system. Research activities included developing functional requirements for the train location, obstruction detection, health/status monitoring, and associated components of the grade crossing control system. Researchers also evaluated vehicle detection technologies that might be beneficially integrated at highway-railroad grade crossings to detect a highway vehicle stopped or stalled on a highway-railroad grade crossing or a vehicle entrapped between the gates at a four-quadrant gate installation.

The RCE continues to participate in the Advanced Emergency Response and Operations (AERO) vehicle initiative at TTI. The goal of this initiative is to develop, test, implement and evaluate open architecture communications and information systems in vehicles to improve productivity, efficiency, effectiveness, and safety of public agencies and to expand and transfer these technologies to the private sector for full deployment. The RCE is expanding the functionality of the system for two applications. In a Houston METRO Police vehicle, system enhancements improve vehicle-to-traffic management center communication to expedite incident response and management. A prototype of the Houston METRO Police vehicle was demonstrated at the ITS America Annual Meeting in Houston. Upgrading the communications and information system for on-the-road use is nearing completion. In a second vehicle, system enhancements will improve the effectiveness of commercial vehicle enforcement activities. These enhancements target communications between a police vehicle and a roadside weigh-in-motion station with video capabilities. The roadside equipment will capture and transmit a video image of the truck passing the site at the same time that weigh-in-motion equipment records and transmits the weight and speed of the truck to a police vehicle that is patrolling nearby. Demonstration of a prototype of these system features at the ITS America Annual Meeting in Houston provided an excellent test for the technology being proposed for communicating video—ISDN service through the local telephone service provider.

### **International Border Transportation Technical Thrust**

RCE researchers drafted a Texas-Mexico Intelligent Transportation Systems Border Plan that was reviewed internally and by the RCE's Border Transportation Advisory Panel. Final revisions to the plan are being made in preparation for publication. The Border Transportation Advisory Panel met twice during the year. The Panel continues to provide excellent insight and guidance on RCE research efforts and assistance in monitoring the uncertainty surrounding NAFTA rule and schedule changes. RCE staff at Texas A&M International University conducted initial data collection for a benefit/cost comparison of cross border transportation costs for the automotive industry under current versus ITS environments in Laredo, Texas. The design phase for Border LINK, an Internet web page, was completed, and content input was initiated. RCE researchers assessed "Institutional Barriers to Implementing ITS Technologies Along the Texas-Mexico Border" and "Effects of Telecommunications Deregulation on the Deployment of ITS in the U.S. and at the U.S.-Mexico Border." They also drafted "An Emissions Investigation Plan for Commercial Vehicles at the El Paso Border." The development of border transportation and international trade expertise has enabled RCE staff to participate in design and implementation meetings sponsored by the U.S. Treasury for their North American Trade Automation Prototype (NATAP). Staff has also provided support for the Binational Transportation Planning Study, sponsored by the four U.S. southern border states, Mexico, and the World Bank.

## **Crosscutting Institutional, Non-Technical, and Technology Integration Issues**

With respect to institutional issues, the RCE is examining public/public and public/private institutional arrangements to advance ITS deployment within Texas. A particular focus is to identify opportunities to streamline and expedite agreements to implement ITS projects between public agencies in Texas (e.g., between transit authorities and the Texas Department of Transportation).

RCE researchers developed a general framework for technology integration issues and concepts. In addition, focused studies are underway on wireless communications, communication of video surveillance images, and vehicle routing. The wireless communications study examines communications between buses and bus stops. Algorithms were tested for interference suppression between moving platforms via software simulation. Researchers also evaluated the potential of two emerging technologies for better communication of video surveillance images: fractals, and wavelets. Both areas show promise for the next generation of image transmission technology to minimize communication bandwidth. The RCE also initiated a study to develop new algorithms for vehicle routing. Preliminary results show that network structure, time of day, origin/destination location, and amount of link travel time information affect the number of alternative routes.

## **TECHNOLOGY TRANSFER**

Supporting the mission of promoting the awareness, acceptance, and implementation of RCE products, technology transfer and clearinghouse staff continue to provide support for the research initiatives at the three RCE's, Texas A&M, University of Michigan and Virginia Tech, and at the ITS Institute at the University of Minnesota. The Clearinghouse continued the writing, design, and production of the quarterly program newsletter, the *Intelliscope*, and the second annual report. Both the program newsletter and annual report are distributed to a unified RCE Program mailing list consisting of more than 1,500 names. Continued improvements were made to the World Wide Web pages for the RCE Program to add on-line access to issues of the *Intelliscope* newsletter and to update the searchable database of RCE project abstracts, as well as adding additional links to other ITS and transportation web sites.

Technology transfer staff also showcased the research initiatives of the RCE Program at the TxDOT Transportation Conference in College Station, the AASHTO Technology Transfer Fair in Norfolk, VA, and at the ITS America Annual Meeting and ITS Texas Annual Meeting, both held in Houston. Through a computer with an Internet connection at these conferences, staff showcased the web pages of the Integrated Traffic Management Center, the Houston real-time traffic map, and other real-time traffic web sites as well as RCE web sites in general.

The research program generated a significant number of technology transfer products during Fiscal Year 1995-96: 3 technical reports, 13 conference or journal papers, 4 undergraduate fellows papers, 17 technical committee or conference presentations, and 1 national workshop. One paper won the Institute of Transportation Engineers Traffic Engineering Council 1996 Outstanding Paper Award.

The Integrated Transportation Management Center laboratory provides an integrated facility to both study and showcase ITS applications. The laboratory currently supports three main functions: monitoring, control, and information. The laboratory accesses video, loop detector, and automatic vehicle identification technologies for real-time system monitoring. These real-time data are valuable in the development of intelligent control systems, including the Smart Diamond and ramp metering applications. The laboratory also showcases alternative methods for communicating information effectively to public and private users, including innovative uses of the Internet via displays of speed data and actual video feeds. On October 1, 1996, the RCE turned over operations of the laboratory to the TransLink™ research program. TransLink™ will continue to further the programs developed under the RCE and to add functionality to the laboratory. TransLink™ will now build upon this foundation to develop a research tool to study the next generation of Transportation Management Centers.

## **HUMAN RESOURCE DEVELOPMENT**

The RCE uses its research and technology transfer programs to expand the number and diversity of transportation professionals, and increase the breadth and depth of their ITS-related expertise. To upgrade current faculty, staff, and student understanding of wireless communications principles and applications, the RCE sponsored a one-half day short course presented at Texas A&M University. More than 30 individuals from Texas A&M and the Texas Department of Transportation attended the course.

RCE recruiting efforts targeted 2 candidates for transportation engineering faculty positions, 5 candidates for full-time research positions, and 9 candidates for graduate research assistantships. The RCE also cooperated with the Southwest Region University Transportation Center in its Undergraduate Transportation Fellows Program through advertising to targeted non-engineering programs and to universities with significant minority student populations.

Since its inception, the RCE has provided support (partial or full) for 44 undergraduate students, 13 undergraduate fellows, 54 graduate students, 12 faculty members, and 3 minority faculty fellows.