LONG RANGE PLAN UPDATE 1989-1993

TEXAS TRANSPORTATION INSTITUTE

JUNE 1, 1988

THE TEXAS A&M UNIVERSITY SYSTEM
COLLEGE STATION, TEXAS

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EXECUTIVE SUMMARY

PROGRESS TO DATE ON FIVE-YEAR PLAN

In implementing its current five-year plan, TTI has made robust and significant progress toward its goals. The contract research program is up more than 20% from a year ago; new office and laboratory space is being utilized at capacity; cooperation between TAMU and TTI is being improved; and TTI's leadership in transportation research in the U.S. remains strong.

PROGRESS EXPECTED TO 1989 ON FIVE-YEAR PLAN

TTI identified 14 research objectives as the central feature of its five-year plan. Expanded multi-modal, basic, materials, advanced vehicle technology, and economics research will be targeted objectives for emphasis through 1989. A minimal real annual growth rate of 3%-5% is expected overall; depending upon funding availabilities, the growth could be above 10%.

PRIORITY OF INITIATIVES THROUGH 1993

TTI will focus on these following initiatives to guide its highest priority efforts through 1993:

1. Establish and nurture the early growth of a federal Regional Transportation Research Center (RTC).

2. Establish a fundamental, solid program of advanced vehicle and highway technology research, including initial efforts to construct needed testing facilities at BREC.

3. Enhance significantly the research efforts in the interactions of transportation with economic activities.

4. Expand the already significant work being done in materials and pavements research under the SHRP initiative.

5. Assist TAMUS in establishing its Research Enhancement Program, particularly in achieving the goals identified for the **Transportation Systems** research initiative.

6. Maintain and pursue the Research Objectives in the balance of the TTI contract research program.

PERSONNEL NEEDS THROUGH 1993

TTI will expand its cooperation with TAMU academic programs in jointly-acquiring and utilizing faculty members to conduct research in transportation science. The particular disciplines needed will be: engineering (mechanical, electrical, civil, and industrial), materials science and physics, computer science, economics, and business. Full time professional researchers will also be needed to enhance the Institute's multi-disciplinary potentialities.

RESOURCE AND EQUIPMENT NEEDS THROUGH 1993

The Institute will need the following resource support :

1. Additional laboratory, equipment, and office space house on campus expanding programs, principally in materials, advanced vehicle/highway technology (AV/AH), the regional transportation center (RTC), and the TAMUS **Transportation Systems** research initiative.

2. New and improved testing facilities at the Bryan Research and Extension Center (BREC) Annex to prepare TAMUS for leadership in advanced vehicle/highway technology.

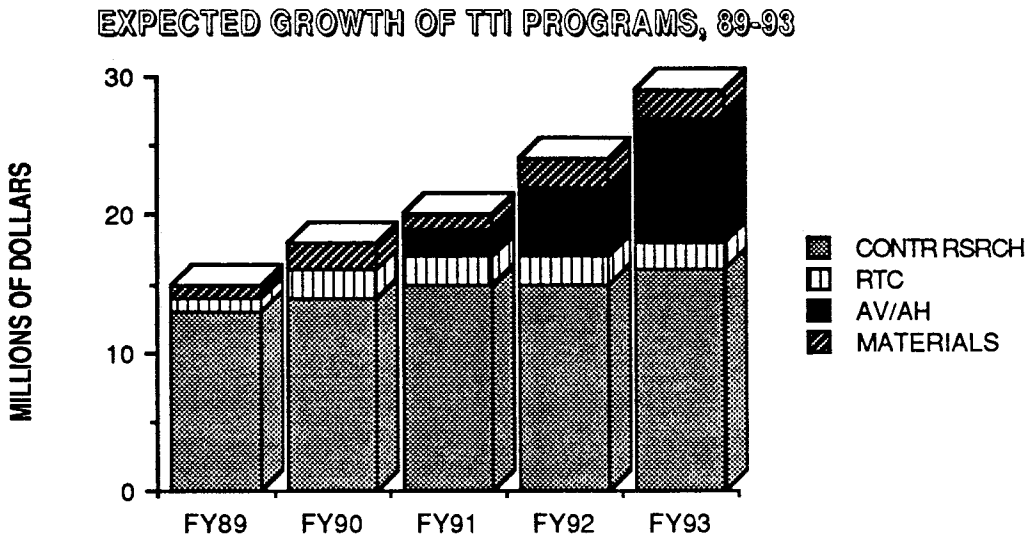
3. New computer at BREC, other computers for networking with TAMU Ethernet system, high speed data links to remote stations, and computerized engineering work stations.

ORGANIZATION THROUGH 1993

TTI's flexible, program-unit structure will continue to serve as the Institute's basic organization. Growth and change in the priority research areas can be readily accommodated. Additional research growth and change, as determined partially by the changing availabilities of contract source funding, will be reflected by program-unit growth in the Institute.

EXPECTED GROWTH 1989-1993

The projected growth of TTI's program for the period 1989–1993 is shown on the following chart.



I. ASSESSMENT OF CURRENT FIVE YEAR PLAN

In implementing its current five-year plan, TTI has made robust and significant progress toward its goals.

Goals

1. To enhance the quality of education in the Texas A&M University System by providing research facilities and opportunities to the faculty, graduate students, and undergraduate students in the research programs of the Institute.

2. To engage in research on all forms of transportation including all phases of activities concerned with the movement of people, goods, and services.

3. To conduct basic research in the various fields of transportation.

4. To identify and help solve major state and national transportation problems.

5. To serve as a focal point for transportation research in the State of Texas and to serve the research and development needs of various state agencies in the broad field of transportation.

6. To disseminate research findings to the transportation profession and to the general public of the State and Nation.

A. Progress to Date

Since the implementation and last up-date of its long range plan, TTI has moved, with varying levels of success, toward each of the Institute's present six goals. For this up-date of the long range plan, assessment of the progress toward these goals will be summarized using the principal elements of the long range plan: research programs and objectives, personnel, organizational structures, funding, and facilities.

Current Research Programs and Objectives

There are fourteen research program objectives in TTI's long-range plan. As summarized below, three of these programs are currently being implemented ahead of schedule; eight are on schedule; and three are behind schedule.

Currently ahead of schedule

Materials for Transportation Facilities

Objective: To develop better materials to be used in the construction of roadways.

Automatic Vehicle Data Systems

Objective: To develop automatic methods to collect data on vehicles.

Automatic Road Information Systems

Objective: To develop data bases and analyses on the geometrics and conditions of the roadway system.

Currently on schedule

Transportation, Policy, Planning, and Management

Objective: To develop and implement methodologies for analyzing policies, goals, organizations, plans, and operations of transportation service delivery agencies.

Cost Effectiveness and Cost Benefit Analysis

Objective: To develop and implement methodologies for applying economic analysis in evaluations of transportation programs, projects, and alternatives.

Highway Facilities Design

Objective: To improve the safety and operations of the highway system by improvements in geometrics, signing, and lighting.

Test Engineering

Objective: To perform test engineering for transportation vehicles, components, facilities, and appurtenances.

Safety Information Systems

Objective: To develop safety policy analyses and accident data files related to the roadway system to improve the safety of Texas' highways.

Research Implementation

Objective: To put research results to work in the transportation industry.

Facilities Maintenance

Objective: To develop procedures to improve the cost effectiveness and safety during maintenance of transportation facilities.

Urban Mobility

Objective: To design new methods of moving people and improve the utilization of the existing systems in urban areas.

Currently behind schedule

Basic Research

Objective: To conduct basic research in selected scientific fields.

Transportation Facilities Requirements

Objective: To develop transportation research efforts in all non-highway modes used for the transportation of people and commodities.

Large Truck Vehicles

Objective: To develop criteria that will promote the optimum use of large cargo vehicles on the highway network.

Current Personnel

While no specific personnel targets or quotas are quantified in this long range plan up-date, the success of the Institute is inextricably tied to its ability to recruit and retain high quality people. Recent salary increases at TAMUS (and particularly at TAMU's College of Engineering) have enhanced TTI's ability to successfully recruit needed professionals. Although predominantly oriented toward engineering applications in transportation research, the Institute must secure and develop a multidisciplinary staff to successfully accomplish all of its fourteen research objectives.

TTI is making progress in its attempts to diversify its staff, both ethnically and professionally. Presently, TTI has approximately three hundred (FTE) personnel. These include twenty-three Hispanics, twelve Blacks, and twenty Asian and Pacific Islanders.

More than thirty of TTI's engineering research professionals presently hold joint faculty appointments in the civil engineering department at TAMU. Fifteen other TTI engineers have joint-appointments in mechanical, industrial, chemical, aerospace, and engineering technology. Additionally, transportation researchers in landscape architecture, urban/regional planning, and industrial education presently hold joint appointments with TTI.

Current Organizational Structure

As shown on its organizational chart (next page), TTI has eight primary research divisions. In implementing the long range plan, the composition of these divisions can be expected to change, thereby reflecting the changing emphases and opportunities in the markets for competitive research contract funding. For example, Division II has significantly expanded, reflecting the recent growth in the pavement design and materials research areas.

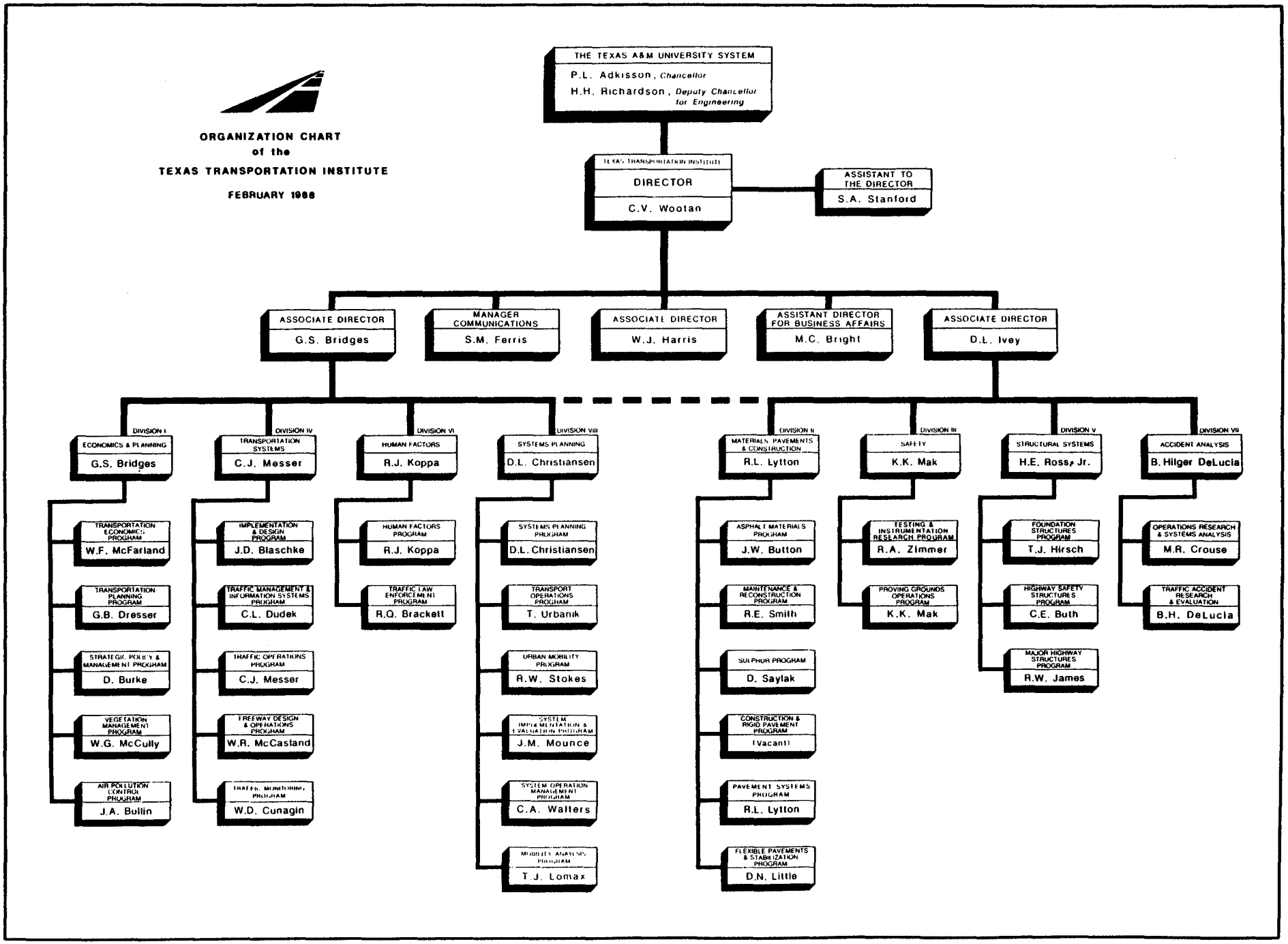
Additionally, the Institute has acquired Dr. W. J. Harris as an Associate Director. His appointment will boost TTI's attempts to move more rapidly into transportation modes other than highways. Also, his position in TAMU (as the W. C. Snead Professor of Transportation and a Distinguished Professor in the Department of Civil Engineering) makes him uniquely qualified to assist the Institute in expanding its cooperative initiatives with TAMU and other parts of the TAMU System.

Not shown on the chart, TTI has established an Advisory Committee to the Director (TTI). This Advisory Committee consists of the department heads of civil, mechanical, industrial, chemical, and engineering technology. The Committee and the Director of TTI are currently developing specific measures to enhance the productive interaction of the academic departments with the TTI research program.

Current Funding

All but approximately one million of TTI's expected $13 million expenditures this year will be generated by contract research agreements. The significant growth in the TTI research program (including the most recent $1.2 million contract in pavement materials research) has always come from increased contract research funding. This will remain true in the foreseeable future.

However, the Institute also relies on increased general revenue appropriations as a crucial part of long range funding sources. Several program enhancements and research initiatives (such as basic research, multimodal and other non-highway modes, new technology) that are needed simply can not be funded by contract sources. Without these aspects in its program, TTI's ability to maintain its competitive edge will be eroded.


ORGANIZATION CHART
of the
TEXAS TRANSPORTATION INSTITUTE
FEBRUARY 1988
THE TEXAS A&M UNIVERSITY SYSTEM
P.L. Adkisson, Chancellor
H.H. Richardson, Deputy Chancellor for Engineering
TEXAS TRANSPORTATION INSTITUTE
DIRECTOR
C.V. Wootan
ASSISTANT TO THE DIRECTOR
S.A. Stanford
ASSOCIATE DIRECTOR
G.S. Bridges
MANAGER COMMUNICATIONS
S.M. Ferris
ASSOCIATE DIRECTOR
W.J. Harris
ASSISTANT DIRECTOR FOR BUSINESS AFFAIRS
M.C. Bright
ASSOCIATE DIRECTOR
D.L. Ivey
DIVISION I
ECONOMICS & PLANNING
G.S. Bridges
TRANSPORTATION ECONOMICS PROGRAM
W.F. McFarland
TRANSPORTATION PLANNING PROGRAM
G.B. Dresser
STRATEGIC POLICY & MANAGEMENT PROGRAM
D. Burke
VEGETATION MANAGEMENT PROGRAM
W.G. McCully
AIR POLLUTION CONTROL PROGRAM
J.A. Bullin
DIVISION IV
TRANSPORTATION SYSTEMS
C.J. Messer
IMPLEMENTATION & DESIGN PROGRAM
J.D. Blaschke
TRAFFIC MANAGEMENT & INFORMATION SYSTEMS PROGRAM
C.L. Dudek
TRAFFIC OPERATIONS PROGRAM
C.J. Messer
FREEWAY DESIGN & OPERATIONS PROGRAM
W.R. McCasland
TRAFFIC MONITORING PROGRAM
W.D. Cunagin
DIVISION VI
HUMAN FACTORS
R.J. Koppa
HUMAN FACTORS PROGRAM
R.J. Koppa
TRAFFIC LAW ENFORCEMENT PROGRAM
R.O. Brackett
DIVISION VIII
SYSTEMS PLANNING
D.L. Christiansen
SYSTEMS PLANNING PROGRAM
D.L. Christiansen
TRANSPORT OPERATIONS PROGRAM
T. Urbanik
URBAN MOBILITY PROGRAM
R.W. Stokes
SYSTEM IMPLEMENTATION & EVALUATION PROGRAM
J.M. Mounce
SYSTEM OPERATION MANAGEMENT PROGRAM
C.A. Walters
MOBILITY ANALYSIS PROGRAM
T.J. Lomax
DIVISION II
MATERIALS, PAVEMENTS & CONSTRUCTION
R.L. Lytton
ASPHALT MATERIALS PROGRAM
J.W. Button
MAINTENANCE & RECONSTRUCTION PROGRAM
R.E. Smith
SULPHUR PROGRAM
D. Saylak
CONSTRUCTION & RIGID PAVEMENT PROGRAM
(Vacant)
PAVEMENT SYSTEMS PROGRAM
R.L. Lytton
FLEXIBLE PAVEMENTS & STABILIZATION PROGRAM
D.N. Little
DIVISION III
SAFETY
K.K. Mak
TESTING & INSTRUMENTATION RESEARCH PROGRAM
R.A. Zimmer
PROVING GROUNDS OPERATIONS PROGRAM
K.K. Mak
DIVISION V
STRUCTURAL SYSTEMS
H.E. Ross, Jr.
FOUNDATION STRUCTURES PROGRAM
T.J. Hirsch
HIGHWAY SAFETY STRUCTURES PROGRAM
C.E. Buth
MAJOR HIGHWAY STRUCTURES PROGRAM
R.W. James
DIVISION VII
ACCIDENT ANALYSIS
B. Hilger DeLucia
OPERATIONS RESEARCH & SYSTEMS ANALYSIS
M.R. Crouse
TRAFFIC ACCIDENT RESEARCH & EVALUATION
B.H. DeLucia

TTI'S Facilities

In November 1987, TTI moved into new quarters in the eight-story TTI/CE building. Critically needed, this new office space is already being utilized to its capacity. The supplemental (PUF-BP) funds for equipment enabled the Institute to procure some of the scientific equipment and computer hardware that was desperately needed.

The enhancement of the BREC laboratory and test facilities and the replacement of the Automotive Research Laboratory (destroyed by fire in December, 1984) still are unattended. These facilities need immediate improvement and replacement so the Institute can resume its once very successful research effort in this highly competitive field of automotive systems testing and performance analysis.

B. Anticipated Short Term Progress

TTI's research programs are well underway toward major accomplishments by the end of FY 1989. The Institute's progress toward the objectives of the five-year plan are highlighted below.

Materials for Transportation Facilities

Objective: To develop better materials to be used in the construction of roadways. *This program will continue as a major focus of growth in the Institute. Funding sources at both the national and state levels portend a healthy future for several aspects of pavement research.*

Automatic Vehicle Data Systems

Objective: To develop automatic methods to collect data on vehicles. *The "hi-tech" aspects of the automated roadway will be an important source of new productive thinking and research. The research program is currently positioned to capitalize on funding improvements that will likely occur in the federal and private research markets.*

Transportation, Policy, Planning, and Management

Objective: To develop and implement methodologies for analyzing policies, goals, organizations, plans, and operations of transportation service delivery agencies. *The viability of this program will be strengthened through the expected funding the Institute will receive upon being designated by the U.S. Department of Transportation as one of its ten newly formed Regional Transportation Centers.*

Cost Effectiveness and Cost Benefit Analysis

Objective: To develop and implement methodologies for applying economic analysis in evaluations of transportation programs, projects, and alternatives. *TTI will expand its economic analysis capabilities to include he initiation of the development of an input-output model with a detailed transportation sector for Texas.*

Basic Research

Objective: To conduct basic research in selected scientific fields. *State funding will be sought to finance a beginning level of effort in unsponsored, basic research. This program will partially be used to support an enhanced effort to secure more research projects awarded by the National Science Foundation.*

Transportation Facilities Requirements

Objective: To develop transportation research efforts in all non-highway modes used for the transportation of people and commodities. *An effort has just begun in TTI to develop a viable research program in waterborne transportation. State funding will be sought for the preparation of an economic impact study of the Gulf Intracoastal Waterway upon the State's economy. Additionally, railroad safety research is again surfacing at the Federal level and projects at TTI are expected to be underway soon.*

Highway Facilities Design

Objective: To improve the safety and operations of the highway system by improvements in geometrics, signing, and lighting. *The application of expert systems and other emerging analytical techniques will be increasingly introduced into the research performed in this program.*

Test Engineering

Objective: To perform test engineering for transportation vehicles, components, facilities, and appurtenances. *The Institute's worldwide reputation in this program continues to underwrite even greater successes in acquiring sponsors. Improved facilities at BREC are needed to complement this activity.*

Safety Information Systems and Evaluation

Objective: To develop safety policy analyses and accident data files related to the roadway system to assist in improving the safety of Texas' highways. *Legislative changes in safety policy (e.g., speed limits, seat belts, DWI) will mandate continuation of the evaluative aspects of this program. Also, TTI is likely to remain the principal state agency involved with the design, development, and use of the computerized traffic accident record system.*

Automatic Road Information Systems

Objective: To develop data bases and analyses on the geometrics and conditions of the roadway system. *TTI has several active projects in this program and will expand even more when equipment availability permits.*

Research Implementation

Objective: To put research results to work in the transportation industry. *TTI will continue to emphasize implementation of its research program findings. On-site staff support to transportation agencies (particularly in the urban areas of Texas), published research reports and papers, and short course curricula will be used.*

Facilities Maintenance

Objective: To develop procedures to improve the cost effectiveness and safety during maintenance of transportation facilities. *This program will continue to grow in importance as maintenance of existing facilities takes on higher priorities in the transportation agencies. Funding improvements are expected at both the state and national levels, particularly for pavement maintenance research.*

Urban Mobility

Objective: To design new methods of moving people and improve the utilization of the existing systems in urban areas. *Dramatic increases in TTI's urban presence in Dallas-Fort Worth are expected to complement our widely known successes in TTI's Houston-based research and operations of urban transportation systems.*

Large Truck Vehicles

Objective: To develop criteria that will promote the optimum use of large cargo vehicles on the highway network. *Development of this program will receive attention from TTI's top management to take advantage of new and exciting developments at the national level, e.g., establishment of the Trucking Research Institute and also the new U.S.D.O.T. administrative unit for truck operations.*

TTI Personnel

As the above-described research opportunities develop, the Institute will be enhancing its staff to acquire and supplement needed skills, mainly professional researchers that will become principal investigators — the core of TTI's success. TAMU faculty members (and prospective faculty members) are always favored candidates for joint appointments to TTI, and this will be emphasized even more in the future, in engineering and in other colleges. Professional researchers' salary levels at TTI have not kept pace with the overall growth in recent years of

the salaries for teaching faculty members in TAMU College of Engineering. Salary parity needs to be re-established.

TTI Organizational Structure

As a research organization, TTI is always mindful that the form of the organization should adapt to the functions. As those functions change, TTI will adjust its organization. For example, TTI and UT's Center for Transportation Research will soon be jointly designated as a federal Regional Transportation Research Center. This arrangement may entail an appropriate organizational adjustment to insure the ideal degree of cooperation and coordination between TTI and CTR.

Funding for TTI

Upon becoming a federally-designated Regional Transportation Research Center, the TTI-lead consortium will receive up to $1,000,000 annually from U.S.D.O.T. in each of the next five years. ***This amount must be matched with funds from non-federal sources.*** TTI's contracted research amounts from the state, national, and private sources are expected to facilitate the overall 3-5% annual growth in the research program; much of this increase for the next year or two is likely to be in materials and pavements research contracted in the SHRP program.

TTI Facilities and Equipment

The existing space occupied by TTI at the new TTI/CE building just meets the Institute's current requirements for office space in College Station. Expected growth in the Institute's research program during the current biennium will require additional office and laboratory space. Throughout the current biennium, TTI will continue to upgrade its research equipment, computer systems hardware, and research facilities. The Institute's limited ability to acquire equipment with contract funds is well-known. TTI expects to continue to benefit from allocations of PUF-BP and from other TAMUS equipment funding decisions. The research activities at BREC need additional capital improvement support.

C. General Assessment of TTI's Program and Personnel

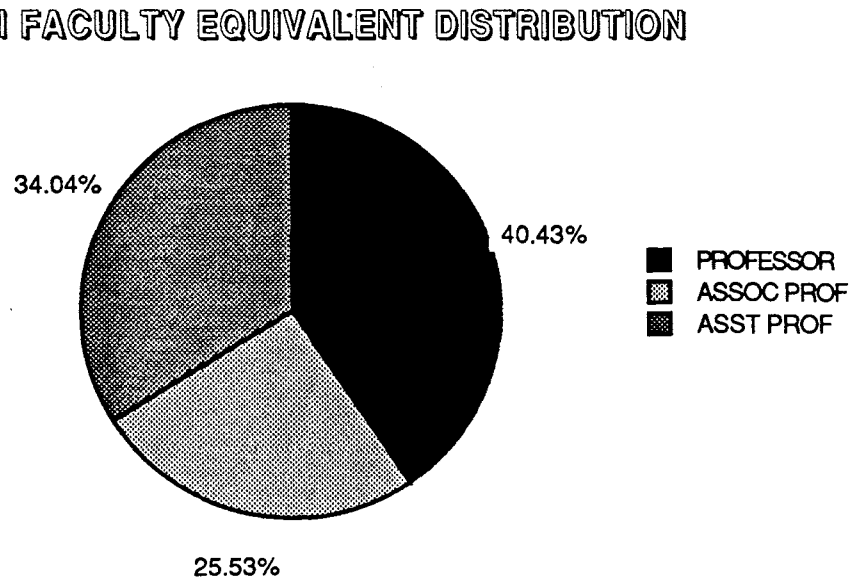
The organization of TTI is flexibly structured to allow for the rapid adjustment to changing conditions in the Institute's sponsored research "markets". The key to the organizational success of TTI is its reliance upon the initiatives of the individual researchers — the principal investigators— to identify research topics, find sponsors, and then combine sponsored funding with research ideas. Ultimately, the test of success in evaluating how well this works is provided in the research contract market. Using this test, TTI does an exceptionally successful job of identifying transportation research needs and finding the funds to support the work.

The formal structure of the Institute contains eight primary research divisions. Each of these is comprised of 2-5 program units, which house the Institute's principal investigators. As research priorities undergo change, the composition of the organizational program units is adjusted to accommodate the changing realities of the research markets and the interests of the researchers. Individual programs wax and wane depending on the initiative of the principal investigators and the research market conditions. The flexible nature of this organizational format allows controlled growth and also mitigates against disruptions in continuity that arise when particular research efforts are reduced and/or eliminated. The program unit structure has proven to be a successful organizational umbrella for developing and maintaining a highly competitive contract research capability.

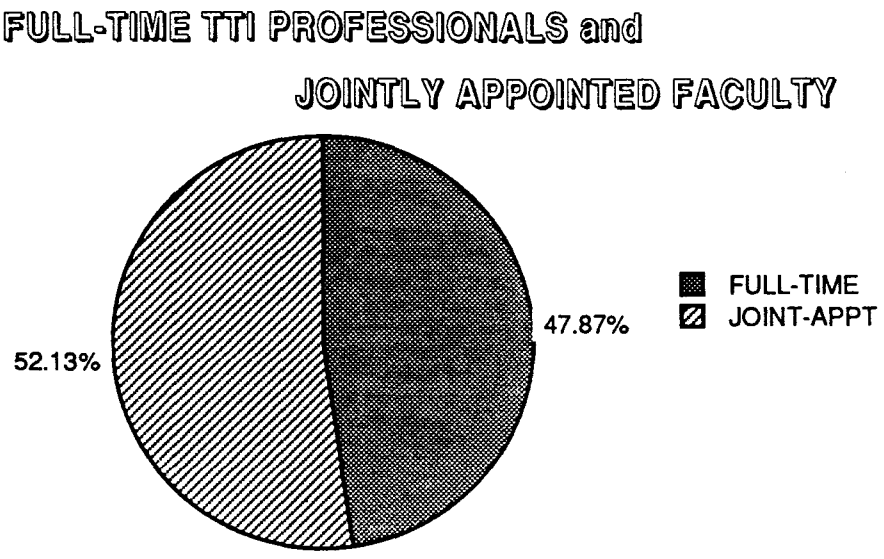
The organizational structure also provides managerial and administrative opportunities for those professionals who are interested in organized research management. An individual principal investigator can, though successful initiatives, generate enough research contracts to justify the creation of a separate program unit or an entire research division. This is a source of organizational change produced by the internal dynamics of the Institute. This opportunity leads to a rapid development of skills in the Institute's most productive researchers.

Presently the research staff is supported by administrative units at the Institute level that perform fiscal and accounting functions, publication and proposal preparation, and general administrative functions. Each division and program unit maintains clerical and/or administrative personnel to support the day-to-day research efforts. The division and program unit support activities are directed by the researchers themselves and, consequently, are kept focused to the needs, funding, and resource requirements of the individual research projects.

TTI's research staff currently comprises thirty-eight senior research professionals (equivalent in rank to full professor), twenty-four research professionals equivalent in rank to associate professors, and thirty-two research professionals equivalent in rank to assistant professors.



This distribution provides age/experience balance needed for long-term organizational stability and continuity of efforts. Additionally, TTI employs forty-seven research associates and forty-eight graduate student research assistants, and ninety-nine undergraduate student workers.
Of the ninety-four researchers having faculty equivalent rank, forty-nine also hold joint academic appointments, principally in the College of Engineering. This distribution is shown on the next chart.



Having TTI research appointments enhances these teachers' abilities to bring the knowledge production process into the daily experiences of TAMU students. TTI support of academic staff members is vital to the successful educational process in the TAMUS Engineering Program and, to a lesser extent, in other academic departments.

The full-time professional researchers are the other source of strength in the organization. Fully dedicated to the Institute's organized research activities, these members of the professional staff are vital to the success in each of TTI's eight divisions. As stated earlier, TTI's organizational structure relies upon the performance of its individual principal investigators in developing sponsored funding. The full-time researchers have done a very commendable job in securing sponsor funding that has produced useful research results and contributed to the overall success of TTI's role in the TAMUS.

Recent Changes in the Organizational Structure

The most notable changes in the organizational structure of TTI during the past four years are reflected in the accompanying organizational chart and summarized as:

1. Addition of W. J. Harris as an Associate Director in 1987. Dr. Harris will have a crucial role in developing the Institute's non-highway research programs and plans for the 1990's.

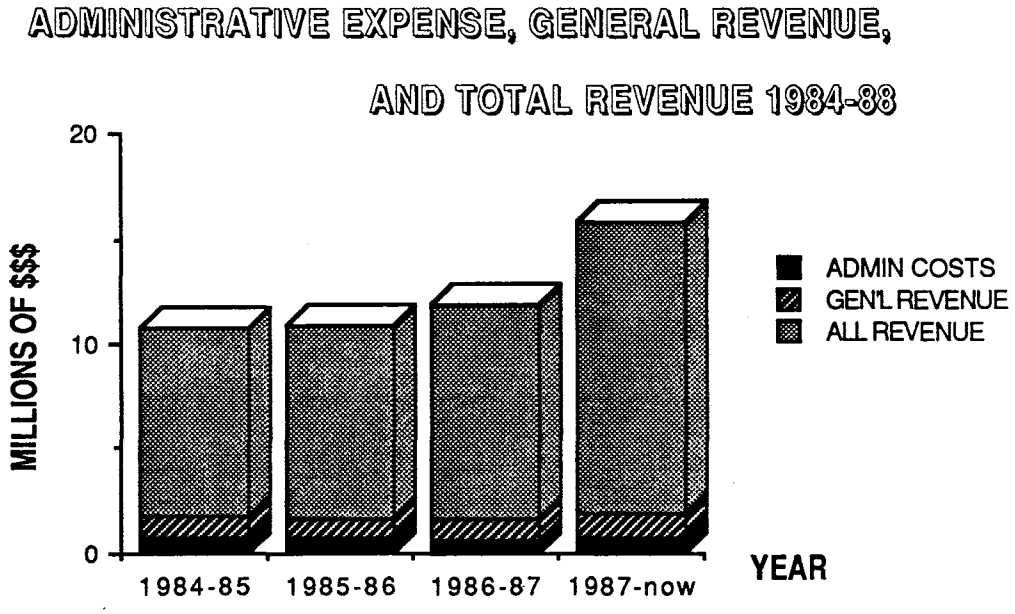
2. The growth of the Materials Division (II) and the Systems Planning Division (VIII) to the present five program units each.

3. The reduction of the Safety Division (III) and the Accident Analysis Divisions (VII) each from four program units to a present configuration of two program units.

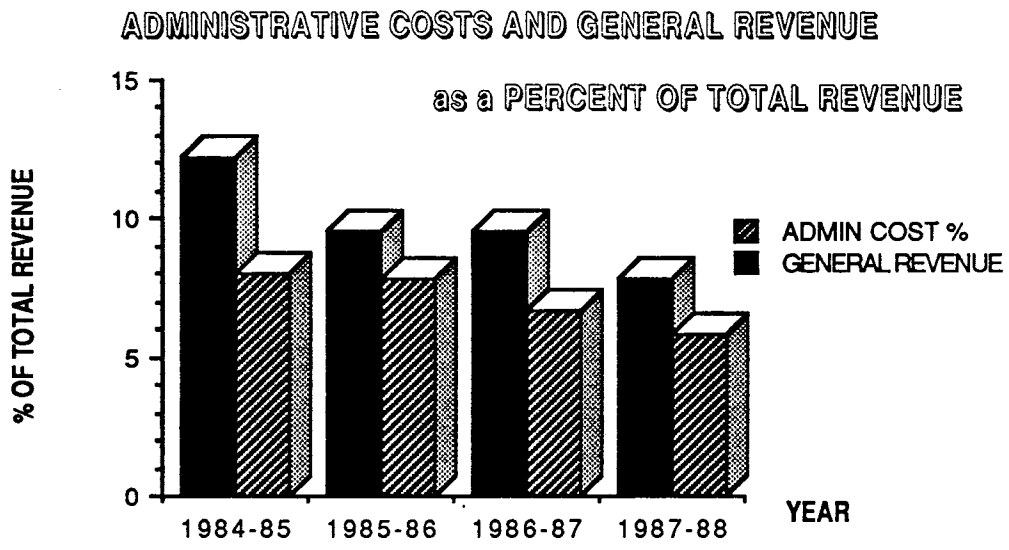
4. The consolidation of support services—publications, library and research proposals, and technology transfer—into a single Communications Program.

Selected Costs and Revenues

From TTI's accounting data, the following chart shows expenditures for administrative services, general revenue appropriations, and total (functional) revenues expended for the past four years. Obviously reflecting the large amount of funding TTI obtained from outside the System, general revenues are a relatively small though very important part of the funding sources for TTI's activities. The recent growth in the Institute's total revenue has been partially the result of large increases in contract awards for pavement materials research.



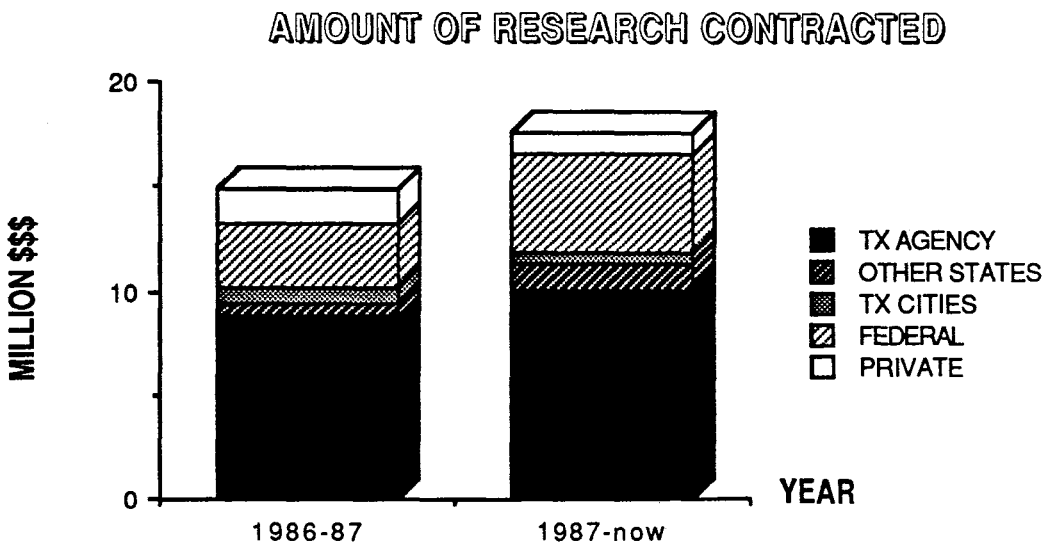
As a percentage of total revenues generated for expenditures at TTI, the expenditures for administrative functions have declined in each of the four previous years from 8.0% in 1984-85 to a level of 5.8% in 1987-88. These relationships are shown in the following chart.



Since TTI receives a relatively small amount of general revenue in the State's appropriations process, comparing administrative expenses with general revenue can be misleading. For the past four years, TTI administrative expenses as a percent of general revenue received by TTI have been: 67% (in 1984-85), 82% (in 1985-86), 70% (in 1986-87) and 75% (est. in 1987-88).

D. Assessment of Importance of TTI's Programs

As shown in the chart on the following page, state agency sponsored research projects are the primary source of income for the Institute's organized research efforts. Principally, the Texas State Department of Highways and Public Transportation is the central agency with a funded program of transportation research. As one of the the SDHPT's official research agencies, TTI has had a successful history of performing contract research that is translated into improved transportation services for the "customers" of both TAMUS and SDHPT, namely -- the People of Texas. The research program developed between TTI and SDHPT is a model of success in utilizing university based researchers to directly improve the operational performance of a state's transportation agency.



Research programs from federally supported transportation agencies and consortia are another source of strength in TTI's applied research activities. The Institute and its principal investigators are very successful in competing for contracts issued under procurements from the Federal Highway Administration (FHWA), the National Cooperative Highway Research Program (NCHRP), and the newly-funded Strategic Highway Research Program (SHRP) being implemented by an arm of the National Academy of Sciences. Last year, TTI's success in competing for FHWA contracts was dramatized by its being awarded contracts in value that exceeded the combined value of contracts awarded to the nearest two competitors--University of Texas at Austin and University of Michigan at Ann Arbor. Also, in the NCHRP procurement process, TTI submitted 97 proposals and was awarded 30 contracts; whereas, the nearest competitor to TTI, Pennsylvania State University, proposed on 80 topics and was successful on only 14 contracts. More recently, TTI won the initial procurement ($1.2 million) issued by the administrators of the SHRP.

While TTI has a larger volume of research than does any other center of transportation research in the U.S., the Institute does not yet have an on-going research program in non-highway modes. The dearth of funding for research on the other modes has made it very difficult for any research organization, even one with the reputation of TTI, to establish a balanced, multi-modal effort. Also, TTI currently lacks support for a viable program of basic, fundamental research that would complement the Institute's renowned programs in applied transportation problem-solving. Without a separate source of funding, a program of basic research inquiry has little chance of becoming viable in the constrained environment of sponsored research.

Until TTI can find funding sources from other modes, robust research efforts in non-highway modes and in basic inquiry, will not be possible. As a result, the overall quality of the Institute's performance will continue to be limited by the inherent nature of the problems identified and solved via the sponsored research (largely highway-related) mechanism.

E. Assessment of the Quality and Productivity of TTI's Staff

TTI's professional staff is evaluated using these sets of criteria:

- **Technical proficiency** -- How well does the researcher understand and execute the technical aspects of research projects?
- **Managerial proficiency**-- How well does the researcher identify, secure, organize, and successfully execute research projects and/or programs?
- **Professional standing** -- What are the researcher's professional credentials in the context of a particular discipline or field of research?

Technical Proficiency

This is a minimum requirement for continued association with the Institute as a research professional. Presently, almost all of the staff clearly exceed this minimum requirement. In a few instances, marginal performers are now being scrutinized to determine their fitness for continued employment.

Managerial Proficiency

Beginning with the principal investigators, these criteria are also applied to the unit program managers and the division heads. Being a "self-supporting" professional is considered to be a minimum condition for fulfilling the managerial criteria. TTI encourages each of its professionals to secure enough funding to defray personnel and operational expenses for that individual. Principal investigators must satisfactorily perform this function, or they are removed from this responsibility. Subsequent to receiving a research contract award, the principal investigator is responsible for organizing and managing the project resources to successfully complete the technical requirements of the contract on time and within budget.

The productivity of a researcher at TTI is largely evaluated on the basis of the contracted research underway-- number of projects, size of projects. The most productive principal investigators normally are supervising several projects at any point in time. Subsequently, these individuals are expected to take on (and to date have done so) additional managerial responsibilities as either unit program managers (supervising, in addition to individual research

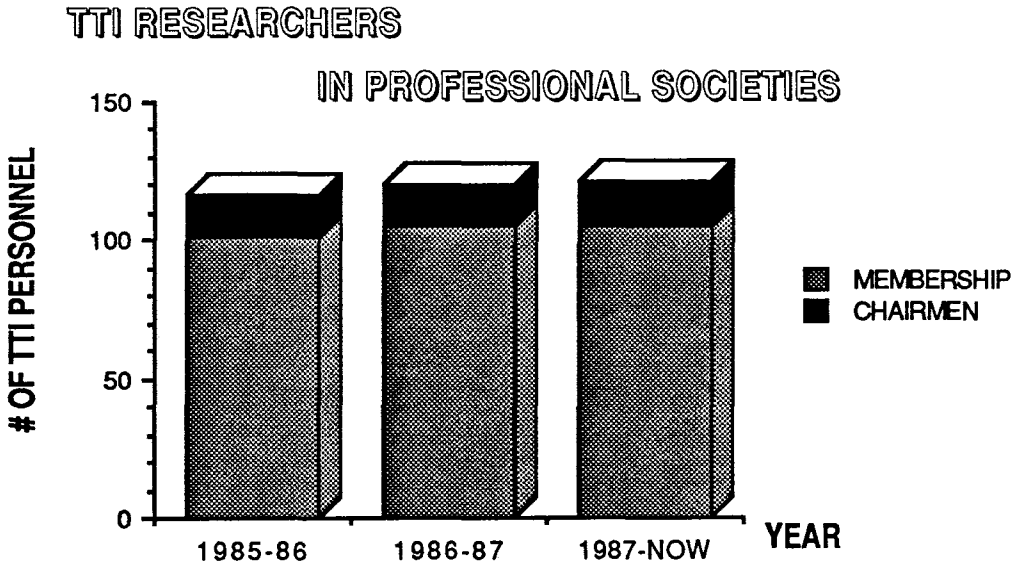
projects, more than one principal investigator) or division heads (supervising, in addition to individual research projects, more than one unit program). Presently all the principal investigators, the unit program managers, and the division heads in the Institute are performing clearly above average, and in several cases, exceptional or superior.

Professional Standing

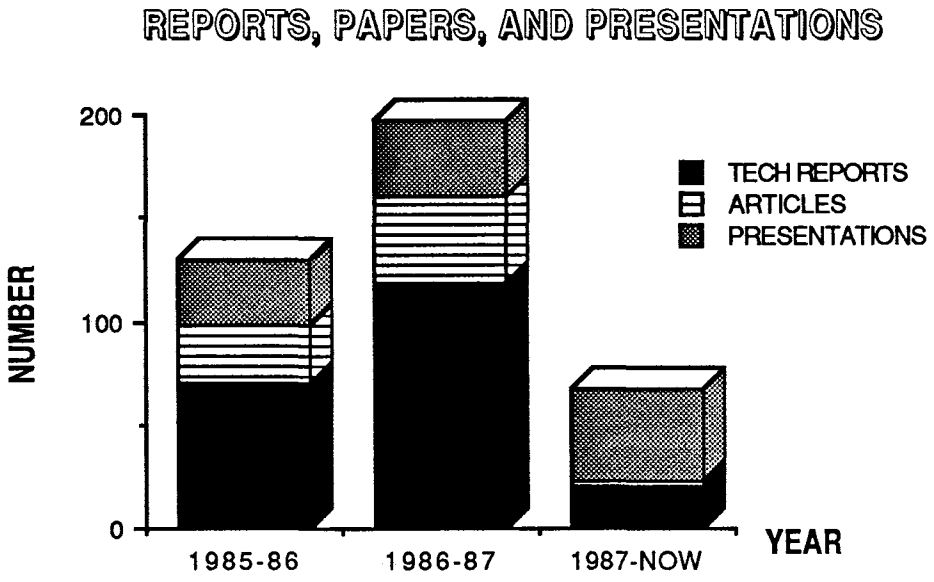
Beyond the responsibilities to the Institute's sponsored research efforts, TTI researchers obtain professional credentials and standing that brings credit them and to the Institute. This professional standing is manifested in professional memberships, publications, presentations, office-holding, committee memberships and chairs, awards, and honors. TTI's staff presently has some of the nation's best researchers in the fields of pavements, highway safety, materials, and traffic engineering. Other staff members in these fields and in other fields—economics, planning, and design for example—are presently building strong reputations beyond TTI.

Productivity and Quality Indicators

As shown in the following two charts, TTI professionals are energetic and prolific participants in pursuing professional activities. Memberships and committee chair positions in professional societies indicate one aspect of the extent of TTI's commitment to professional development and success.



As professionals, TTI researchers are acutely interested in the preparation of written and oral presentations reporting the results of their research. Normally, technical reports are used to document the procedures and findings of contract research projects. Additionally, articles and papers are prepared for publication/presentation to professional journals and audiences.



Also within the last three years, the following TTI professionals have held national offices in professional societies:

Wanda Hinshaw, Olga Pendleton, C. V. Wootan, and W. J. Harris.

Additionally, the following TTI professionals have received national awards or honors during the past year:

Jean-Louis Briaud, W. J. Harris, and C. V. Wootan.

II. ENVIRONMENTAL ASSESSMENT

A. Assessment of External Influences

Several sources of external influence will affect TTI through the 1990s. Particular political, economic, demographic and technological outcomes will have marked impact upon the Institute and its programs, personnel and performance.

Political Environment

State and Federal Roles in Transportation Research. The federal-aid to states for highway construction and maintenance will undergo fundamental re-assessment during the 1990s. Of particular importance for transportation research, the current designation of one- and one-half percent of federal highway taxes for use in "highway planning and research" needs to be retained. Without this base, the principal sources of TTI's current contract research funding (SDHPT, NCHRP, FHWA) would be severely eroded, probably eliminated. Currently, federal transportation programs, including the SHRP program and the newly-authorized Regional Transportation Research Centers, are funded through federal FY 1991. Beyond that, continued funding at current levels will be a difficult political struggle in the federal executive departments and congressional proceedings. The SDHPT will remain as the lead state agency in transportation, possibly acquiring additional responsibilities in other modes, particularly inland waterways.

Transportation Taxation and Expenditures. At the state level, user-based transportation taxes and fees will remain as the fundamental feature of our State's approach to financing transportation improvements. Highway revenues will continue to be the primary source of transportation funding in Texas. Appropriate means of allocating the revenues from federal highway user taxes and expenditures will need to be resolved in Congress once the Interstate Highway construction program is completed. Texas may argue for an end to a significant role for the federal government and for a return of the federal user fees (motor fuel taxes and other fees) back to the individual states in proportion to the contribution of each state to the trust fund

Support for Higher Education. Texas will continue its support of higher education and the research activities of the flagship systems - TAMUS and UT— including continuing general revenue appropriations for TTI at current (minimum) levels. The Target 2000 Committee recommended that one-fourth of TTI's expenditures — compared with the current amount of less than 10% — be financed by general revenues appropriated by the Texas Legislature.

Economic Environment

The growth of the national economy is projected at an annual rate of about 3% through 1990. Beyond that, forecasts are widely differing, principally dependent upon the international performance of the currency and the economy's export industries. Continued 3% growth beyond 1990 is optimistic. The budget deficits and foreign trade deficits will continue, but at steadily decreasing levels to avoid creating a recession by unnecessarily restrictive economic policies. Inflation through 1990 is forecasted to be 4%-6% each year.

The economy of the State will likely continue its diversification throughout the 1990s, although oil and gas will recover from the present industrial recession. Gross state product is forecasted to increase at a statewide average of 3.5% through 2005. Statewide employment (nonfarm) is projected at a 2.2% annual growth rate. Statewide transportation expenditures should increase 2%-3% annually for the same time period.

Within the State, the regional distribution of growth will emanate from the currently growing urban/suburban centers. The Texas coastal zone and the D-FW areas will likely lead the State.

Demographic Environment

Texas' population is forecasted to increase 1.7% each year until 1995 and 1.1% each year for 1996-2005. By 2005 the population of the State will be around 21.5 million.

The percentage of Texans beyond age 65 will increase from current levels.

The size of the labor force will likely be reduced from current levels as the aging population begins to dominate.

The Hispanic element of the Texas population will be an increasingly larger part of the State's totals, not just in the Valley or South Texas region.

Market and Technological Influences

Transportation Regulation. The transportation service sector is likely to remain largely de-regulated (including the state level) except for possibly enhanced safety regulations.

Transportation Modes. The automobile will continue as the dominant form of transportation through 2000. Advanced vehicle and highway technology will enhance the use of the personal auto. The role of the U.S. auto making industry, though, is not clear, as the U. S. and its trading partners continue to joust in settling major foreign trade issues. Airlines will improve their position in long-middle distance passenger service. Rails will continue to fight against the secular decline in their industry; a significant revival of rail passenger travel is unlikely.

Transportation Indicators. Through 1990, the following indicators for transportation in the State of Texas have been projected:

Economic value created by transportation —$90 billion
Vehicle miles of travel on highways — 158 billion
Traffic fatality rate—2.4 (per 100 million miles)
Economic loss from traffic accidents— $6.6 billion
Highway maintenance cost—$640 million
Automotive fuel consumed—10.8 billion gallons
Urban trips by transit—2.9% of total trips
Tons of freight by rail movements—137 billion
Tons of freight on Gulf Intracoastal Waterway—60 million
Air passenger boardings—49 million

Communications. Increasingly, communications technologies will be sought that will serve as substitutes for transportation. To date, none of these has had a major effect on the demand for transportation.

Materials. The superconducting materials will be a featured arena for significant and rapid technological breakthroughs. For land-based transportation facilities, more traditional materials (such as petroleum, steel, and concrete) are expected to continue as primary materials.

Privatization. To date privatization in transportation has been largely limited to some aspects of urban transit operations. Major shifts in the governmental responsibilities for transportation facilities are not likely to occur independent of significant technological breakthroughs (such as superconducting mag-lev vehicles) that attract commercial applications. In Texas, the performance of recently authorized transportation corporations and road utility districts will be carefully evaluated over the next few years.

B. Critical Transportation Research Needs of Texas and U. S.

The following list of transportation research problems forms the basis of the Institute's assessment of its challenging future programs. TTI plans to dominate selected areas of transportation research and to focus upon problems that will improve the health and well-being of this State and Nation's transportation sector.

Improved Management of Transportation Facilities

- Cost effective maintenance of highway facilities.
- Expert system applications in the design and management of transportation facilities.
- Privatization and the management of publicly-financed transportation facilities.

Improved Transportation Productivity

- Evaluation of the economics of bulk commodity shipments.
- Application of intermodal concepts to improve productivity.
- Smart vehicles, smart highways —a productivity enhancing advanced vehicle/highway technology.
- Superconductivity and the possibilities for productive applications in transportation.

Priorities for Improved Transportation Safety

- Evaluating public policy changes in transportation safety.
- Speed, productivity and safety: an analysis of trade-offs.
- Human behavioral aspects of transportation safety.

Transportation Finance

- Governmental use of impact fees, user fees, tolls, and other "market surrogates" to finance transportation improvements.
- Mechanisms for financing transportation research projects.

Changing Roles of Federal, State, and Local Governments

- Beyond the Interstate—the federal role in highway policy.
- The transportation corporation and the road utility district forms of transportation service delivery.

- Effective organization of state transportation agencies
- Selecting appropriate transit service providers.

Transportation and the U.S. world position

- The role of the Texas ports in U.S. and international trade.
- Changes in international trade patterns and the impacts on demands for domestic transportation.
- Military logistics and transportation requirements for a reduced nuclear defense policy.

Transportation and Economic Activity

- The role of the Gulf Intracoastal Waterway in the coastal zone and the Texas economy.
- Economic development, competition for plant location, and transportation infrastructures.
- The role of the transportation sector in macroeconomic activity.
- Economic forecasting and transportation planning.

Deregulation of Transportation

- Vertical and horizontal integration in transportation service providers.
- Analysis of safety implications of deregulation.

Congestion of Transportation Facilities

- Analysis of urban congestion and alternative transportation solutions.
- Safety implications of congestion.
- Economic solutions to transportation congestion.

Environmental Consequences of Transportation

- The transportation of hazardous materials—a multi-modal analysis for Texas.
- Transportation improvements in environmentally sensitive areas, e.g., the Texas wetlands.

C. Implications of Environmental Assessment

TTI's mission statement is:

> *"to provide a transportation research staff and facilities of the highest quality; to develop solutions to the transportation problems confronting the State and the Nation; to occupy a leadership role in transportation research at the State and National levels; and to operate as a university-based research organization in such a manner as to complement and assist the teaching and extension activities of the Texas A&M University System."*

Given the forecasts and assessment of the influences important to TTI, the mission of TTI will be even more important in the Texas of the 1990s. The transportation problems to be solved are significant, having crucial implications for our citizens. TTI's leadership in the transportation research profession will depend upon its continued success in defining and solving the research problems associated with the delivery of modern, efficient transportation services to the people of Texas.

TTI's sponsored, contract research program—the quintessential activity of the Institute—should flourish in the 1990s unless one or more of the following occurs:

1. if the federal-aid transportation funding formula for research is not continued and the state agency (SDHPT) funding does not step in to fill the void;

2. if funding for the SHRP and the RTC programs is not extended beyond the current authorizations through federal FY 1991;

3. if the user-based form of funding for transportation in Texas (and the U.S.) is diluted or abandoned, the funding for TTI research would likely suffer; or

4. if TTI should suffer drastic reductions in its already meager general revenue appropriations.

TTI's ability to secure a future source of funding for basic and non-highway modal research will enhance the research capacity and the prestige of the Institute and TAMUS nationwide. It is imperative to convince the Texas Legislature to invest some of its confidence and dollars in additional appropriations for TTI to initiate such a program.

III. LONG TERM GOALS

A. Goal Statement

Six specific charges for the Institute were identified when TTI became a separate part of the System. Those six charges became identified in the *Target 2000* study as the basic goals of the Institute and were incorporated into the current five-year plan. With minor modifications in emphasis, they will serve as six of the now seven goals charting the Institute's progress into the twenty-first century.

1. To become the premier university-based transportation research organization in the world. *Stable and varied funding mechanisms, expected success in transportation materials research programs, technological breakthroughs in advanced vehicle/highway systems, and superior performance as a federally designated Regional Transportation Center are key elements in TTI's successful drive to pre-eminence.*

2. To enhance the quality of education in the Texas A&M University System by providing expanded opportunities for TAMUS students and teaching faculty members to participate in TTI's research programs. *Expected increased academic emphasis on graduate/research-based growth will complement TTI's own initiatives to support and enhance the teaching mission of TAMU. Strengthening TTI research efforts in several aspects of transportation science will broaden the Institute's capacity to work with an even greater number of academic colleges, departments, and centers in TAMU.*

3. To continue the excellent program of sponsored transportation research. *This program will thrive except in the most pessimistic scenario for research funding support from federal and state transportation agencies. Moderate growth should be expected in contract funding sources.*

4. To develop research programs of excellence in all transportation modes. *Currently, a key element in obtaining its goal is the successful establishment and growth of the federally-designated Regional Transportation Center.*

5. To develop a vigorous program of basic, non-sponsored research in transportation. *A key element in obtaining this goal is the successful establishment and growth of the federally-designated Regional Transportation Center. Matching funding from general revenues is likely to be crucial to the success of this endeavor.*

6. To identify and help solve major State and national transportation problems and disseminate research findings to the transportation profession and the the general public. *Varied and stable funding sources will be needed to allow TTI to maintain its lead in pursuit of this goal. The RTC program and its technology transfer are critical elements.*

7. To serve as a focal point for transportation research in Texas and to serve the transportation research and development needs of various state agencies. *TTI is currently in a dominant role in Texas, and this goal should be attained and repeated year-in-year out. Only a draconian scenario of funding reductions and/or program cutbacks could prevent the Institute's achieving this goal.*

B. TTI'S Goals and Critical Issues

There are two generic sets of issues that bear upon the Institute's ability to achieve its goals over the long term. These are:

1. issues affecting the health and growth of the transportation sector in the U.S. and in Texas; and

2. issues affecting the health and growth of higher education in the U. S. and in Texas.

In the first instance, TTI's success as a separate part of the TAMUS depends on the Institute's ability to acquire outside funding for ninety percent of its expenditures. TTI can continue to be the leader in the U.S. in pursuit of its contract research program *if both federal and state sources of transportation funding are secured. The historical and productive relationship between the Institute and the State Department of Highways is likely to remain a source of program strength upon which TTI and TAMUS can build an even greater, bolder, and far-reaching transportation research effort.*

As a member of the State's flagship research university system, TTI is affected by issues that impact higher education. Funding sources, professional and faculty recruitment, faculty and professional researchers salaries, office and research facilities on campus, computer and other specialized research equipment, research organization and management in higher education—issues in each of these areas are of vital significance to the Institute. *TTI will need to continue to receive part of its funds from general revenues. The PUFB allocation for equipment is vital to the Institute's ability to compete for and win contracts in the "research marketplace." A*

research enhancement program initiative in Transportation Systems and funded by special TAMUS allocations would greatly stimulate the Institute's drive to pre-eminence in selected transportation research areas.

IV. PRIORITY PROGRAMS AND NEW INITIATIVES —1993

A. Strengthen and Expand Selected Current Efforts

Materials Research. This research activity has recently been boosted by an infusion of funding from the Strategic Highway Research Program (SHRP). Increased funding is expected in each FY of the five-year program. TTI has placed a high priority designation on this effort. The professionals, equipment, and facilities committed to this research are expected to produce results unmatched anywhere else in the world.

Transportation and Economic Activity. TTI will encourage the rapid increase in this research effort by making it a prominent part of the Regional Transportation Center's research program. This will give a needed funding and program content supplement to a vigorous contract research effort that has focused upon the micro-relationships between transportation and economics. The development of a regional input-output model with a highly detailed transportation sector will be a central focus of this research initiative through 1993.

Urban Transportation. The importance of urban transportation problems continues to dictate a high priority for the Institute's focus in this program area. Traffic signalization and optimization, maintenance in work-zones, planning, congestion reduction, safety, land use, public/mass transit—these (and more) specific activities will become more important to urban Texans. TTI will devote a significant effort in the Regional Transportation Center program to urban transportation.

Automatic Vehicle Data Collection. A rapid, recent growth in this activity will propel it further into TTI's research priorities for the 1990s. This effort will be expanded in both urban and inter-city environments until TTI is convinced that vital data collection processes have been scientifically established. Sponsored funding is expected to be the main source of this growth and development.

Multi-modal Transportation. Resource commitment to this program area is likely to be limited in the near-term (through 1993). Nonetheless, TTI wants to enhance a multi-modal research effort, beginning with initial program support in the RTC. This will complement and greatly strengthen the current multi-modal program. Multi-modal transportation research is essential if the Institute is to diversify beyond its current limited highway specialities.

B. Implement New Research Initiatives

Regional Transportation Research Center. TTI is expected to be designated as the location for a newly-established federal Regional Transportation Research Center. TTI will lead a consortium that includes the University of Texas, Texas Southern University, and other selected universities (from TX, OK, LA, NM, AR). Federal funding is expected to be up to an annual one million dollars, with a required dollar-for-dollar matching amount from non-federal sources. Once underway, this RTC will allow TTI to initiate and strengthen research programs (elsewhere identified in this planning update) for which traditional contract funding is scarce or non-existent. TTI will likely seek general revenue support from the Texas Legislature to obtain the matching funds for FY 90 and beyond. This RTC initiative carries the highest priority of TTI, and its success will be essential to the Institute's pursuit of pre-eminence in selected areas of its research program.

Advanced Vehicle/Highway Systems. Beginning in the current year, TTI will develop a vital, new research and development effort to bring knowledge-based technological advancements into the vehicle/highway nexus. The expected long-term outcome of this work is a revolutionary advance in the use of computerized guidance and control systems for every vehicle operating over the public roadway network. "Automatic cars, automatic highways—smart vehicles, smart highways" are phrases which delineate the implementation of this technology. This effort has implications in every facet of known highway transportation, as well as international commercial ramifications for the manufacture and sale of the vehicles and the technology incorporated into highway construction. TTI will eventually have a level of effort in this program area that will support a major investment in a multi-million dollar test facility to interface with the instrumented vehicles. This effort will expand TTI's national and international presence with almost unlimited possibilities.

Transportation Systems: A Strategic Initiative. TTI will make resources available to assist TAMUS in implementing the transportation initiative element of the system-wide Research Enhancement Program. This strategic initiative will demand multi-disciplinary inquiries on a wide range of vital, and fundamental, issues in transportation. Exciting topics for this research include military logistics, transportation, and geo-political alliances; demographic change and transportation services; transportation systems and technology; human behavior and transportation possibilities; transportation and international economic relationships; economic activity, productivity, and transportation. TTI has identified several intra-system linkages that will be needed to make maximum productive use of the

resources allocated by the System for this initiative. These resource bases are located in several colleges and centers in TAMU, including: engineering, science, liberal arts, business, environmental design, the Center for International Business Studies, the Institute of Asian Pacific Studies, and the Mosher Center for Defense Studies. This strategic initiative is described more completely in the Appendix.

C. Potentially Pre-eminent Programs

TTI plans to press ahead in the following programs to achieve research pre-eminence:

- Materials Research
- Advanced Vehicle/Highway Systems
- Transportation and Economic Activity

V. PROGRAMS TARGETED FOR RE-DIRECTION THROUGH 1993

TTI's research program in test engineering, based at the Bryan Research and Extension Center, will be re-directed to support the new initiative in advanced vehicle/highway technology.

VI. CONTINUING PROGRAMS THROUGH 1993

TTI expects that its contract research program funding in the following areas will continue at a level adequate to support viable and productive research objectives:

Transportation Safety. A traditionally strong research area, safety continues to be a critical element of transportation agency programs and citizen concerns. Changing demographics portend a different mix of safety-related problems, e.g, older-drivers, impaired drivers. Safety devices, safety policy and programs, accident analysis, data collection and reduction, and accident countermeasures will be important activities in this research program.

Research Implementation. TTI will continue to emphasize implementation of its research program findings. On-site staff support to transportation agencies (particularly in the urban areas of Texas), published research reports and papers, and short course curricula will be used.

Transportation Maintenance. This program will continue its importance as maintenance of existing facilities takes on higher priorities in the transportation agencies. Funding improvements are expected at both the state and national levels, particularly for pavement maintenance research.

Large Truck Vehicles. Development and maintenance of this program effort will depend upon the materialization of funding promised in some new and exciting developments at the national level, e.g., establishment of the Trucking Research Institute in the private sector and also the new U.S.D.O.T. organizational unit for administering truck operations.

VII. OBJECTIVES FOR FY 1990-91 AND FY 1992-93

A. Academic Support Activities

One of the primary goals of TTI is *"to enhance the quality of education in the Texas A&M University System by providing research facilities and opportunities to the faculty, graduate students, and undergraduate students in the research programs of the Institute."* Since TTI has no prime jurisdiction or responsibility for academic programs, its activities are essentially limited to support of TTI researchers who hold joint academic appointments and to the support for graduate and undergraduate students assigned to TTI research projects. The newly formed Advisory Committee to the Director of TTI (consisting of selected academic departments heads from the TAMU College of Engineering) will be a mechanism to enhance TTI's enthusiastic support of TAMU's academic programs.

B. Specific Research Objectives for 1990-91 and 1992-93

Priority ratings assigned to the research objectives are:

Priority 1—encourage accelerated development
Priority 2—normal rate of development
Priority 3—cease development

Priority 1—**Materials for Transportation Facilities**

Objective: To develop better materials to be used in the construction of roadways. *This program will continue as a major focus of growth in the Institute. Funding sources at both the national and state levels portend a healthy future for several aspects of pavement research. A new, exciting aspect of materials study is the potential application of new superconducting materials to transportation facilities.*

Priority 1—**Automatic Vehicle and Highway Data Systems**

Objective: To develop automatic methods to collect and use data on vehicles and highways. *The "hi-tech" aspects of the automated roadway will be an important source of new productive thinking and research. This research program is currently positioned to capitalize on funding improvements that will likely occur in the federal and private research markets. "Smart vehicles, smart highways" aspects of advanced technology will be initiated.*

Priority 1—**Cost Effectiveness and Cost Benefit Analysis**

Objective: To develop and implement methodologies for applying economic analysis in evaluations of transportation programs, projects, and alternatives. *Priority studies in this program include: economic development, competition for plant location, and transportation infrastructures; economic solutions to urban transportation congestion; governmental use of impact fees, user fees, tolls, and other market surrogates to identify and finance needed transportation improvements.*

Priority 1—**Basic Research**

Objective: To conduct basic research in selected scientific fields. *State funding will be sought to finance a beginning level of effort in unsponsored, basic research. This program will partially be used to support an enhanced effort to secure more research projects awarded by the National Science Foundation. An initial project will be the modelling of the transportation sector (input/output) to better understand the role of transportation in macroeconomic activity.*

Priority 1—**Transportation, Policy, Planning, and Management**

Objective: To develop and implement methodologies for analyzing policies, goals, organizations, plans, and operations of transportation service delivery agencies. *Several studies are urgently needed. They include: the federal role in highway policy beyond the interstate program; changes in international trade patterns and the impacts on the demand for domestic transportation; vertical and horizontal integration in transportation service providers; transportation of hazardous materials; transportation improvement in environmentally sensitive areas; mechanisms for financing transportation research.*

Priority 1—**Transportation Facilities Requirements**

Objective: To develop transportation research efforts in all non-highway modes used for the transportation of people and commodities. *An effort has just begun in TTI to develop a viable research program in waterborne transportation. State funding will be sought for the preparation of an economic impact study of the Gulf Intracoastal Waterway upon the State's economy. Other studies contemplated are: an evaluation of the economics of bulk commodity shipment is needed; the application of intermodal concepts and facilities to improve transportation productivity; and a study the role of Texas ports in international trade.*

Priority 1—**Urban Mobility**

Objective: To design new methods of moving people and to improve the utilization of the existing systems in urban areas. *Dramatic increases in TTI's urban presence in Dallas-Fort Worth are expected to complement successes in TTI's Houston-based research and operations of urban transportation systems. Other topics to be pursued are: selecting appropriate transit providers; the operation of transportation corporations and road utility districts in urban areas; privatization and the management of publicly-financed transportation facilities and services; and the development of advanced vehicle, advanced highway technology to improve urban mobility.*

Priority 2—**Highway Facilities Design**

Objective: To improve the safety and operations of the highway system by improvements in geometrics, signing, and lighting. *The application of expert systems and other emerging analytical techniques will be increasingly introduced into the research performed in this program. Continued analysis of the use of design principles to alleviate congestion on transportation facilities.*

Priority 2—**Safety Information Systems**

Objective: To develop safety policy analyses and accident data files related to the roadway system to assist in improving the safety of Texas' highways. *TTI needs to continue it evaluation of public policy changes in transportation safety. Also, the safety implications of transportation facility congestion need to be analyzed. An analysis of the effects of deregulation upon safety is needed. Speed, productivity, and safety trade-offs need analysis.*

Priority 2—**Research Implementation**

Objective: To put research results to work in the transportation industry. *TTI will continue to emphasize implementation of its research program findings. On-site staff support to transportation agencies (particularly in the urban areas of Texas), published research reports and papers, and short course curricula will be used.*

Priority 2—**Facilities Maintenance**

Objective: To develop procedures to improve the cost effectiveness and safety during maintenance of transportation facilities. *This program will continue to grow in importance as maintenance of existing facilities takes on higher priorities in the transportation agencies. Funding improvements are expected at both the state and national levels, particularly for pavement maintenance research.*

Priority 2—**Test Engineering**

Objective: To perform test engineering for transportation vehicles, components, facilities, and appurtenances. *The Institute's worldwide reputation in this program continues to underwrite even greater successes in acquiring sponsors. Improved facilities at BREC are needed to complement this activity.*

Priority 2—**Large Truck Vehicles**

Objective: To develop criteria that will promote the optimum use of large cargo vehicles on the highway network. *Development of this program will receive attention from TTI's top management to take advantage of new and exciting developments at the national level, e.g., establishment of the Trucking Research Institute and also the new U.S.D.O.T. organizational unit for administering truck operations.*

C. Specific Objectives for Service and Outreach

The service and outreach activities of TTI are largely focused in the Research Implementation functional program. This program supports the Institute's efforts to achieve one of our goals which states that TTI will "disseminate research findings to the transportation profession and to the general public of the State and the Nation."

The specific objective of this program is: *"To put research results to work in the transportation industry."* Implementation is the desired product of most of the contract research projects performed at the Institute. A principal activity of this effort will be the Institute's support and direction of short courses (particularly the annual highway short course) conducted for its various sponsors and for TEEX. Annual meetings of TII's Advisory Committee will be used to impart research results to transportation industry leaders and to State governmental and legislative leaders. The publication and presentation of papers, reports, and books by the Institute's researchers will be a principal part of the service/outreach effort to disseminate the results of TTI's research. Also, the Institute will increasingly utilize it research staff to provide "on-site" assistance to transportation agency sponsors.

D. Anticipated Organizational and Administrative Changes

TTI expects appropriate organizational/administrative changes to be made during the next two biennia as program functions change. The flexibility of the Institute's current "program oriented" structure will accommodate changing research emphases and funding availabilities for the predominant contract research effort. Thus, TTI's program structure will be adapted to take advantage of funding opportunities that are presented during the next four years.

E. Recruitment and Retention of Minority Faculty, Staff and Students

The following procedures will be established (during the next four years) by TTI's personnel officer and management to further the Institute's pursuit of qualified minority professional staff and students:

1. Insure that TTI is adequately represented at TAMUS recruiting functions and in TAMUS brochures directed at minority recruiting efforts.

2. Make presentations to campus organizations of minorities to apprise them of professional opportunities as well as the possibilities for students to work at TTI.

3. Retain existing minority undergraduate student workers to continue graduate studies and work at TAMU/TTI.

4. Seek and utilize recommendations from existing minority staff members during recruiting of additional personnel (students, support staff, and professional staff).

5. Establish the following recruiting goals for the Institute:

   a. Recruit and retain two additional minority professionals during each of the FY 90-91 and FY 92-93 biennia.

   b. Promote or recruit one minority professional to managerial responsibilities during each of the two biennia.

VIII. RESOURCE REQUIREMENTS

A. Facilities

The expected growth in the contract research program and the rapid increase in activities in some beginning initiatives will generate a need for additional office and laboratory facilities for TTI during the next two biennia. The growth in the demands for office space for TTI researchers historically has translated into the following: each additional million dollars of contracted research will require office space for approximately thirty new workers (average 140 sq. ft. each worker). For laboratory space, the following relationship can be expected: about 700 square feet of research lab space is needed for each additional two million dollars in contract research funding acquired. Adjusted to current conditions, the additional space requirements for TTI during the long range planning period are estimated at 23,000 square feet of office and laboratory space.

Total additional office and laboratory space for TTI needs to be allocated according to: 90%-95% needs to be on the main campus, with 5%-10% needed at the BREC. Additionally, TTI's new initiative in advanced vehicle/highway technology will require the construction of a test track facility to be built and instrumented at BREC beginning no later than FY 1992.

TTI expects that the needed space to accommodate program expansion will come from existing facilities, as well as from future construction projects funded from PUFB(TAMU) sources. For planning purposes, incremental space requirements have been estimated at $120/sq. ft. **The resulting budget estimates have been included in the PUFB(TAMU) source of funds on forms PF-1 and PF-2 later in this update.**

B. Computer Equipment

TTI now urgently needs a network to the main campus Ethernet along with additional high speed data links to remote facilities at BREC, Arlington, and Houston. The combined cost for these is approximately $300,000. Additional computer costs will arise to equip engineering work stations at a cost of $15,000-$20,000 each. To fully equip the Institute for its 1993 level of contract research, the total cost of these work stations will approach $1.5 million. Other computer costs include a mini-computer for the BREC test track facility for the advanced vehicle/highway program.

C. Research Equipment

TTI needs to acquire four pieces of major equipment to support the expanded materials research program. This equipment is needed early during the rapid development in the SHRP initiative. This equipment is valued at $800,000. Also, between FY1990 and FY1993, the Institute's advanced vehicle/highway initiative will need to acquire approximately one million dollars in mixed electronic equipment and vehicles.

D. Program Enhancements

TTI anticipates being one of the key TAMUS participants in the **Transportation Systems** initiative of the TAMU System-level program of research enhancement (see Appendix). Many of the intra-system efforts in the transportation research initiative will come between TTI and the academic departments and centers in the TAMU colleges. Electrical, mechanical, chemical, and industrial engineering along with computer science, materials sciences and physics will play an important role in the **Transportation Systems** research enhancement initiative. Further, there are some exciting possibilities of intra-system collaboration with the colleges of business, liberal arts, and environmental design--including the Center for International Business Studies, the Center for Asian and Pacific Studies, and the Mosher Center for Defense Studies. Additionally, TTI will explore the use of personnel from the private sector and the potentialities of locating selected companies in the TAMUS Research Park.

E. Seed Funds

TTI has a known and existing need for funds to match the federal dollars being acquired under the Regional Transportation Research Center Program. Up to one million dollars each year (beginning in FY 89) must be found, either from increased general revenue appropriations, research enhancement allocations, or other non-federal funding to secure for TAMUS the benefits of having the federally designated center located in College Station. Additionally, TTI will pursue seed money to begin its advanced vehicle/advanced highway initiative. Most of this money is expected to come from outside sources, but TTI is likely to need approximately $500,000, mostly for equipment, from TAMUS resources.

F. External Funding

Of course, this is where TTI gets more than 90% of the revenues needed for its operations. The contract research program with governmental transportation agencies is the bulk of the Institute's activity. These contracts will be crucial to the growth and stability of TTI through FY 1993. TTI's general revenue appropriations have steadily declined (as a percentage of total revenue) for the past few years. This trend needs to be reversed so that TTI may realistically expect some movement toward the **Target 2000** recommendation that 25% of the Institute's funding come from state general revenue appropriations. These funds will provide TTI with an opportunity to seek new sponsors and new fields of work, such as Department of Defense logistics studies.

IX. FUNDING REQUIREMENTS AND SOURCES

The following budget summary sheets (Form PF-1 Modified) show the planned expenditures and sources for TTI's four highest priority research activities:

1. Contract Research
2. Regional Transportation Centers
3. Advanced Vehicle/ Advanced Highway Technology
4. Materials Research

Some important aspects of these budget data are not apparent from the PF-1's. The most important of these are:

- The PUFB(TAMU) source, though not a part of TTI's budgetary authority, has been included to show the monetary value of the office/lab space needed on campus and at BREC for the growth of TTI's programs. This estimate is for planning purposes only and does not represent a budget request from TTI for PUFB(TAMU) funds.

- The PUFB(TTI) category shows the budgetary estimates for equipment needed to support the expected growth of TTI's programs.

- The Regional Transportation Center is funded by a federal-state matching (50%-50%) formula. Increased general revenues will be sought in FY90-91 and FY92-93 to provide the matching amount from state sources.

- The Materials Research activities, already experiencing rapid development, will need some large, sophisticated equipment in the near future—in fact, in FY 1989.

- The advanced vehicle/advanced highway activities will need a major investment (in FY 92-93) outlay for an instrumented test-track facility. Funding for this is expected to come from contract sources, but supplemental funds may be needed from TAMUS to secure this vital capital improvement.

MAJOR PROGRAM EXPANSION AND NEW INITIATIVES — FORM PF-1

CONTRACT RESEARCH PROGRAM — INCREMENTAL COSTS AND SOURCES OF FUNDS — (MODIFIED)

Program Expansion

1 — $ 13, 700, 000

PRIORITY NUMBER — FY1989 BUDGET ESTIMATE

TEXAS TRANSPORTATION INSTITUTE

FISCAL YEAR 90

	TOTAL	GENERAL REV	PUFB (TAMU)	PUFB (TTI)	CONTRACTS & GRANTS
Personnel:					
Professional	$390,000	$30,000	$0	$0	$360,000
Other	$60,000	$0	$0	$0	$60,000
Capital					
Office	$0	$0	$0	$0	$0
Laboratories	$0	$0	$0	$0	$0
Equipment					
Computer	$0	$0	$0	$0	$0
Research Equipment	$0	$0	$0	$0	$0
Other Opns & Maintenance	$210,000	$30,000	$0	$0	$180,000
Totals	$660,000	$60,000	$0	$0	$600,000

MAJOR PROGRAM EXPANSION AND NEW INITIATIVES — FORM PF-1

CONTRACT RESEARCH PROGRAM — INCREMENTAL COSTS AND SOURCES OF FUNDS — (MODIFIED)

Program Expansion

1 — $ 13, 700, 000

PRIORITY NUMBER — FY1989 BUDGET ESTIMATE

TEXAS TRANSPORTATION INSTITUTE

FISCAL YEAR 91

	TOTAL	GENERAL REV	PUFB (TAMU)	PUFB (TTI)	CONTRACTS & GRANTS
Personnel:					
Professional	$880,000	$60,000	$0	$0	$820,000
Other	$130,000	$10,000	$0	$0	$120,000
Capital					
Office	$0	$0	$0	$0	$0
Laboratories	$0	$0	$0	$0	$0
Equipment					
Computer	$0	$0	$0	$0	$0
Research Equipment	$0	$0	$0	$0	$0
Other Opns & Maintenance	$400,000	$40,000	$0	$0	$360,000
Totals	$1,410,000	$110,000	$0	$0	$1,300,000

MAJOR PROGRAM EXPANSION AND NEW INITIATIVES — FORM PF-1

CONTRACT RESEARCH PROGRAM — INCREMENTAL COSTS AND SOURCES OF FUNDS — (MODIFIED)

Program Expansion

1 — **$ 13, 700, 000**

PRIORITY NUMBER — FY1989 BUDGET ESTIMATE

TEXAS TRANSPORTATION INSTITUTE

FISCAL YEAR 92

	TOTAL	**GENERAL REV**	**PUFB*** (TAMU)	**PUFB** (TTI)	**CONTRACTS & GRANTS**
Personnel:					
Professional	$1,260,000	$90,000	$0	$0	$1,170,000
Other	$135,000	$15,000	$0	$0	$120,000
Capital					
Office	$35,000	$0	$35,000	$0	$0
Laboratories	$0	$0	$0	$0	$0
Equipment					
Computer	$0	$0	$0	$0	$0
Research Equipment	$0	$0	$0	$0	$0
Other Opns & Maintenance	$705,000	$45,000	$0	$0	$660,000
Totals	$2,115,000	$150,000	$35,000	$0	$1,950,000

*For planning purposes only; not a budget request (SEE PAGE 36)

MAJOR PROGRAM EXPANSION AND NEW INITIATIVES — FORM PF-1

CONTRACT RESEARCH PROGRAM — INCREMENTAL COSTS AND SOURCES OF FUNDS — (MODIFIED)

Program Expansion

1 — **$ 13, 700, 000**

PRIORITY NUMBER — FY1989 BUDGET ESTIMATE

TEXAS TRANSPORTATION INSTITUTE

FISCAL YEAR 93

	TOTAL	GENERAL REV	PUFB* (TAMU)	PUFB (TTI)	CONTRACTS & GRANTS
Personnel:					
Professional	$1,750,000	$130,000	$0	$0	$1,620,000
Other	$300,000	$20,000	$0	$0	$280,000
Capital					
Office	$35,000	$0	$35,000	$0	$0
Laboratories	$0	$0	$0	$0	$0
Equipment					
Computer	$0	$0	$0	$0	$0
Research Equipment	$0	$0	$0	$0	$0
Other Opns & Maintenance	$920,000	$60,000	$0	$0	$860,000
Totals	$3,005,000	$210,000	$35,000	$0	$2,760,000
RECAP OF INCREMENTAL COSTS					
FY 1990	$660,000	$60,000	$0	$0	$600,000
FY 1991	$1,410,000	$110,000	$0	$0	$1,300,000
FY 1992	$2,135,000	$150,000	$35,000	$0	$1,950,000
FY 1993	$3,005,000	$210,000	$35,000	$0	$2,760,000
TOTAL	$7,210,000	$530,000	$70,000	$0	$6,610,000

*For planning purposes only; not a budget request (SEE PAGE 36)

MAJOR PROGRAM EXPANSION AND NEW INITIATIVES — FORM PF-1
INCREMENTAL COSTS AND SOURCES OF FUNDS — (MODIFIED)

REGIONAL TRANSPORTATION CENTER
Program Expansion

2 — PRIORITY NUMBER
$1,030,000 — FY1989 BUDGET ESTIMATE

TEXAS TRANSPORTATION INSTITUTE

FISCAL YEAR 90

	TOTAL	GENERAL REV	PUFB* (TAMU)	PUFB (TTI)	CONTRACTS & GRANTS
Personnel:					
Professional	$290,000	$360,000	$0	$0	($70,000)
Other	$50,000	$60,000	$0		($10,000)
Capital				$0	$0
Office	$350,000	$0	$350,000	$0	$0
Laboratories	$0	$0	$0	$0	$0
Equipment					$0
Computer	$0	$0	$0	$0	$0
Research Equipment	$10,000	$0	$0	$10,000	$0
Other Opns & Maintenance	$660,000	$580,000	$0	$0	$80,000
Totals	$1,360,000	$1,000,000	$350,000	$10,000	$0

*For planning purposes only; not a budget request (SEE PAGE 36)

MAJOR PROGRAM EXPANSION AND NEW INITIATIVES — FORM PF-1
INCREMENTAL COSTS AND SOURCES OF FUNDS — (MODIFIED)

REGIONAL TRANSPORTATION CENTER
Program Expansion

2 — PRIORITY NUMBER
$1,030,000 — FY1989 BUDGET ESTIMATE

TEXAS TRANSPORTATION INSTITUTE

FISCAL YEAR 91

	TOTAL	GENERAL REV	PUFB (TAMU)	PUFB (TTI)	CONTRACTS & GRANTS
Personnel:					
Professional	$570,000	$450,000	$0	$0	$120,000
Other	$55,000	$50,000	$0	$0	$5,000
Capital					
Office	$0	$0	$0	$0	$0
Laboratories	$0	$0	$0	$0	$0
Equipment					
Computer	$30,000	$0	$0	$30,000	$0
Research Equipment	$10,000	$0	$0	$10,000	$0
Other Opns & Maintenance	$660,000	$500,000	$0	$0	$160,000
Totals	$1,325,000	$1,000,000	$0	$40,000	$285,000

MAJOR PROGRAM EXPANSION AND NEW INITIATIVES
INCREMENTAL COSTS AND SOURCES OF FUNDS

FORM PF-1
(MODIFIED)

REGIONAL TRANSPORTATION CENTER
Program Expansion

2 PRIORITY NUMBER

$1,030,000 FY1989 BUDGET ESTIMATE

TEXAS TRANSPORTATION INSTITUTE

FISCAL YEAR 92

	TOTAL	GENERAL REV	PUFB (TAMU)	PUFB (TTI)	CONTRACTS & GRANTS
Personnel:					
Professional	$640,000	$450,000	$0	$0	$190,000
Other	$90,000	$50,000	$0	$0	$40,000
Capital					
Office	$0	$0	$0	$0	$0
Laboratories	$0	$0	$0	$0	$0
Equipment					
Computer	$30,000	$0	$0	$30,000	$0
Research Equipment	$15,000	$0	$0	$15,000	$0
Other Opns & Maintenance	$580,000	$500,000	$0	$0	$80,000
Totals	$1,355,000	$1,000,000	$0	$45,000	$310,000

MAJOR PROGRAM EXPANSION AND NEW INITIATIVES — FORM PF-1
INCREMENTAL COSTS AND SOURCES OF FUNDS — (MODIFIED)

REGIONAL TRANSPORTATION CENTER
Program Expansion

2 — PRIORITY NUMBER
$1,030,000 — FY1989 BUDGET ESTIMATE

TEXAS TRANSPORTATION INSTITUTE

FISCAL YEAR 93

	TOTAL	GENERAL REV	PUFB* (TAMU)	PUFB (TTI)	CONTRACTS & GRANTS
Personnel:					
Professional	$680,000	$450,000	$0	$0	$230,000
Other	$90,000	$50,000	$0	$0	$40,000
Capital					
Office	$0	$0	$0	$0	$0
Laboratories	$0	$0	$0	$0	$0
Equipment					
Computer	$20,000	$0	$0	$20,000	$0
Research Equipment	$10,000	$0	$0	$10,000	$0
Other Opns & Maintenance	$580,000	$500,000	$0	$0	($420,000)
Totals	$1,380,000	$1,000,000	$0	$30,000	$350,000
RECAP OF INCREMENTAL COSTS					
FY 1990	$1,360,000	$1,000,000	$350,000	$10,000	$0
FY 1991	$1,325,000	$1,000,000	$0	$40,000	$285,000
FY 1992	$1,355,000	$1,000,000	$0	$45,000	$310,000
FY 1993	$1,380,000	$1,000,000	$0	$30,000	$350,000
TOTAL	$5,420,000	$4,000,000	$350,000	$125,000	$945,000

*For planning purposes only; not a budget request (SEE PAGE 36)

MAJOR PROGRAM EXPANSION AND NEW INITIATIVES — FORM PF-1
INCREMENTAL COSTS AND SOURCES OF FUNDS — (MODIFIED)

ADVANCED VEHICLE/ADVANCED HIGHWAY
Program Expansion

3 — PRIORITY NUMBER
$400,000 — FY1989 BUDGET ESTIMATE

TEXAS TRANSPORTATION INSTITUTE

FISCAL YEAR 90

	TOTAL	GENERAL REV	PUFB (TAMU)	PUFB (TTI)	CONTRACTS & GRANTS
Personnel:					
Professional	$270,000	$120,000	$0	$0	$150,000
Other	$45,000	$20,000	$0	$0	$25,000
Capital					
Office	$0	$0	$0	$0	$0
Laboratories	$0	$0	$0	$0	$0
Test Track	$0	$0	$0	$0	$0
Equipment					
Computer	$0	$0	$0	$0	$0
Research Equipment	$20,000	$0	$0	$20,000	$0
Other Opns & Maintenance	$135,000	$60,000	$0	$0	$75,000
Totals	$470,000	$200,000	$0	$20,000	$250,000

MAJOR PROGRAM EXPANSION AND NEW INITIATIVES — FORM PF-1
INCREMENTAL COSTS AND SOURCES OF FUNDS — (MODIFIED)

ADVANCED VEHICLE/ADVANCED HIGHWAY
Program Expansion

3 — PRIORITY NUMBER
$400,000 — FY1989 BUDGET ESTIMATE

TEXAS TRANSPORTATION INSTITUTE

FISCAL YEAR 92

	TOTAL	GENERAL REV	PUFB* (TAMU)	PUFB (TTI)	CONTRACTS & GRANTS
Personnel:					
Professional	$1,650,000	$240,000	$0	$0	$1,410,000
Other	$275,000	$40,000	$0	$0	$235,000
Capital					
Office	$616,000	$0	$616,000	$0	$0
Laboratories	$28,000	$0	$28,000	$0	$0
Test Track	$1,000,000	$0	$0	$0	$1,000,000
Equipment					
Computer	$130,000	$0	$0	$130,000	$0
Research Equipment	$300,000	$0	$0	$300,000	$0
Other Opns & Maintenance	$825,000	$120,000	$0	$0	$705,000
Totals	$4,824,000	$400,000	$644,000	$430,000	$3,350,000

*For planning purposes only; not a budget request (SEE PAGE 36)

MAJOR PROGRAM EXPANSION AND NEW INITIATIVES — FORM PF-1
INCREMENTAL COSTS AND SOURCES OF FUNDS — (MODIFIED)

ADVANCED VEHICLE/ADVANCED HIGHWAY
Program Expansion

3 — PRIORITY NUMBER
$400,000 — FY1989 BUDGET ESTIMATE

TEXAS TRANSPORTATION INSTITUTE

FISCAL YEAR 93

	TOTAL	GENERAL REV	PUFB* (TAMU)	PUFB (TTI)	CONTRACTS & GRANTS
Personnel:					
Professional	$2,910,000	$410,000	$0	$0	$2,500,000
Other	$485,000	$70,000	$0	$0	$415,000
Capital					
Office	$616,000	$0	$616,000	$0	$0
Laboratories	$63,000	$0	$63,000	$0	$0
Test Track	$3,000,000	$0	$0	$0	$3,000,000
Equipment					
Computer	$180,000	$0	$0	$180,000	$0
Research Equipment	$500,000	$0	$0	$500,000	$0
Other Opns & Maintenance	$1,455,000	$200,000	$0	$0	$1,255,000
Totals	$9,209,000	$680,000	$679,000	$680,000	$7,170,000

RECAP OF INCREMENTAL COSTS					
FY 1990	$470,000	$200,000	$0	$20,000	$250,000
FY 1991	$1,710,000	$200,000	$280,000	$180,000	$1,050,000
FY 1992	$4,824,000	$400,000	$644,000	$430,000	$3,350,000
FY 1993	$9,209,000	$680,000	$679,000	$680,000	$7,170,000
TOTAL	$16,213,000	$1,480,000	$1,603,000	$1,310,000	$11,820,000

*For planning purposes only; not a budget request (SEE PAGE 36)

MAJOR PROGRAM EXPANSION AND NEW INITIATIVES — FORM PF-1
INCREMENTAL COSTS AND SOURCES OF FUNDS — (MODIFIED)

MATERIALS RESEARCH PROGRAM
Program Expansion

4 — **$1,720,000**
PRIORITY NUMBER — FY1989 BUDGET ESTIMATE

TEXAS TRANSPORTATION INSTITUTE

FISCAL YEAR 90

	TOTAL	GENERAL REV	PUFB* (TAMU)	PUFB (TTI)	CONTRACTS & GRANTS
Personnel:					
Professional	$84,000	$84,000	$0	$0	$0
Other	$14,000	$14,000	$0	$0	$0
Capital					
Office	$532,000	$0	$532,000	$0	$0
Laboratories	$35,000	$0	$35,000	$0	$0
Equipment					
Computer	$0	$0	$0	$0	$0
Research Equipment	$140,000	$0	$0	$140,000	$0
Other Opns & Maintenance	$42,000	$42,000	$0	$0	$0
Totals	$847,000	$140,000	$567,000	$140,000	$0

*For planning purposes only; not a budget request (SEE PAGE 36)

MAJOR PROGRAM EXPANSION AND NEW INITIATIVES — FORM PF-1
INCREMENTAL COSTS AND SOURCES OF FUNDS — (MODIFIED)

MATERIALS RESEARCH PROGRAM
Program Expansion

4 — PRIORITY NUMBER
$1,720,000 — FY1989 BUDGET ESTIMATE

TEXAS TRANSPORTATION INSTITUTE

FISCAL YEAR 91

	TOTAL	GENERAL REV	PUFB (TAMU)	PUFB (TTI)	CONTRACTS & GRANTS
Personnel:					
Professional	$146,000	$96,000	$0	$0	$50,000
Other	$26,000	$16,000	$0	$0	$10,000
Capital					
Office	$0	$0	$0	$0	$0
Laboratories	$0	$0	$0	$0	$0
Equipment					
Computer	$0	$0	$0	$0	$0
Research Equipment	($30,000)	$0	$0	($30,000)	$0
Other Opns & Maintenance	$88,000	$48,000	$0	$0	$40,000
Totals	$230,000	$160,000	$0	($30,000)	$100,000

MAJOR PROGRAM EXPANSION AND NEW INITIATIVES — FORM PF-1
INCREMENTAL COSTS AND SOURCES OF FUNDS — (MODIFIED)

MATERIALS RESEARCH PROGRAM
Program Expansion

4 — PRIORITY NUMBER
$1,720,000 — FY1989 BUDGET ESTIMATE

TEXAS TRANSPORTATION INSTITUTE

FISCAL YEAR 92

	TOTAL	GENERAL REV	PUFB (TAMU)	PUFB (TTI)	CONTRACTS & GRANTS
Personnel:					
Professional	$220,000	$120,000	$0	$0	$100,000
Other	$40,000	$20,000	$0	$0	$20,000
Capital					
Office	$0	$0	$0	$0	$0
Laboratories	$0	$0	$0	$0	$0
Equipment					
Computer	$0	$0	$0	$0	$0
Research Equipment	($30,000)	$0	$0	($30,000)	$0
Other Opns & Maintenance	$140,000	$60,000	$0	$0	$80,000
Totals	$370,000	$200,000	$0	($30,000)	$200,000

MAJOR PROGRAM EXPANSION AND NEW INITIATIVES — FORM PF-1
INCREMENTAL COSTS AND SOURCES OF FUNDS — (MODIFIED)

MATERIALS RESEARCH PROGRAM
Program Expansion

4 — PRIORITY NUMBER
$1,720,000 — FY1989 BUDGET ESTIMATE

TEXAS TRANSPORTATION INSTITUTE

FISCAL YEAR 93

	TOTAL	GENERAL REV	PUFB* (TAMU)	PUFB (TTI)	CONTRACTS & GRANTS
Personnel:					
Professional	$276,000	$126,000	$0	$0	$150,000
Other	$51,000	$21,000	$0	$0	$30,000
Capital					
Office	$175,000	$0	$175,000	$0	$0
Laboratories	$35,000	$0	$35,000	$0	$0
Equipment					
Computer	$0	$0	$0	$0	$0
Research Equipment	$20,000	$0	$0	$20,000	$0
Other Opns & Maintenance	$183,000	$63,000	$0	$0	$120,000
Totals	$740,000	$210,000	$210,000	$20,000	$300,000

RECAP OF INCREMENTAL COSTS					
FY 1990	$847,000	$140,000	$567,000	$140,000	$0
FY 1991	$230,000	$160,000	$0	($30,000)	$100,000
FY 1992	$370,000	$200,000	$0	($30,000)	$200,000
FY 1993	$740,000	$210,000	$210,000	$20,000	$300,000
TOTAL	$2,187,000	$710,000	$777,000	$100,000	$600,000

*For planning purposes only; not a budget reques (SEE PAGE 36)

SUMMARY : INCREMENTAL COSTS FOR PROGRAM EXPANSIONS AND NEW INITIATIVES

FORM PF-2 (MODIFIED)

TEXAS TRANSPORTATION INSTITUTE

I. SOURCES OF FUNDS	FY 1990	FY 1991	FY 1992	FY 1993	FY90-93
INCREASED GENERAL REVENUE	$1,400,000	$1,470,000	$1,750,000	$2,100,000	**$6,720,000**
PUFB(TAMU)*	$917,000	$280,000	$679,000	$924,000	**$2,800,000**
PUFB(TTI)	$170,000	$190,000	$445,000	$730,000	**$1,535,000**
CONTRACTS/GRANTS	$850,000	$2,735,000	$5,810,000	$10,580,000	**$19,975,000**
TOTALS	$3,337,000	$4,675,000	$8,684,000	$14,334,000	**$31,030,000**

*For planning purposes only; not a budget request (SEE PAGE 36)

II. USES OF FUNDS					
CONTRACT RESEARCH	$660,000	$1,410,000	$2,135,000	$3,005,000	**$7,210,000**
REGIONAL TRANSP CENTER	$1,360,000	$1,325,000	$1,355,000	$1,380,000	**$5,420,000**
ADVANCED VEHICLE/ ADVANCED HIGHWAY	$470,000	$1,710,000	$4,824,000	$9,209,000	**$16,213,000**
MATERIALS RESEARCH	$847,000	$230,000	$370,000	$740,000	**$2,187,000**
TOTALS	$3,337,000	$4,675,000	$8,684,000	$14,334,000	**$31,030,000**

X. APPENDIX: TRANSPORTATION SYSTEMS

A. Scope

The **Transportation Systems** research initiative is being focused to understand the forces that are changing the level of demand for transportation and the nature of future transportation systems. This research must develop a clear understanding of fundamental relationships between transportation activities and major societal variables such as technological change, economic activity and industrial productivity, demographic changes, population distribution, living patterns and behavior, geo-political and international relationships. It must also recognize the impact of advanced technology on transportation systems and operations. To this end, technological and engineering applications in materials, electronic control systems, energy, and knowledge-based systems are vital elements. Behavioral studies, policy analysis, and safety analysis also need to be conducted in the transportation sector. This initiative is multi-modal in scope.

B. Description and Importance

Transportation Systems research at TAMUS is currently positioned to make significant, potentially revolutionary, advancements in the movements of people and goods in the society. New and changing demands on the transportation sector, along with the changing preferences and behavior of people, require that a global concept of transportation research be implemented.

Advanced technological applications in vehicles and facilities promise exciting potentials for research breakthroughs. Major improvements in integrating transportation and information technology have been made in both air and railway modes. Similar advances now need to be applied to highways and highway vehicles. Systems to provide for effective communication between vehicles, the vehicles and the highway, and the vehicles and the drivers can increase throughput in urban freeways, as well as increase both safety and speeds for intercity travel. Research efforts are presently underway in Europe, Japan, and in a few states and private companies in the U.S.

The role of the transportation sector in the economy must be clearly identified, documented, analyzed, and understood. Major changes in international trade, competition, and cooperation must be incorporated into an understanding of the interaction of transportation with world trade and foreign policy. Recent nuclear weapons control agreements will vastly expand the logistic

and transportation services needed to provide the necessary level of national defense with conventional weapons.

Major and significant impacts in transportation safety can be realized from research applications to improve collision avoidance, to segregate and separate competing vehicles and modes, and to achieve more effective adaptation of technology to accommodate human behavior.

A continuing effort is necessary to analyze changes in fuel availability and prices on transportation. These changes can have relatively short term effects, such as: reduced transportation demand when the oil embargoes were in place; longer term effects such as the down-sizing of cars and the consequent impact on motor fuel tax receipts; and ultimate effects on modal balances, if petroleum products are far less available.

Specific research program goals for **Transportation Systems** at TAMUS include:

- Establish a federally supported (USDOT) Regional Transportation Center.
- Establish an advanced highway/vehicle technology research program and test facilities.
- Enhance the Strategic Highway Materials Research Program (SHRP) just getting underway in TTI.
- Establish a military transportation logistics and support research effort designed for expanded conventional defense requirements resulting from reduced nuclear forces.
- Establish an interdisciplinary research program to analyze the relationships between the transportation sector and the following : domestic economic activity, demographic changes, and international business and trade policy.
- Enhance research support for academic faculty members and students in disciplines related to transportation science, including chemical, civil, mechanical, electrical, and industrial engineering; business administration; liberal arts; architecture; agriculture; and science.
- Expand on-going TAMUS research programs in basic and applied transportation research.

C. TAMUS Interrelationships

The **Transportation Systems** initiative builds upon the existing strength of the Engineering Program's Texas Transportation Institute and extends research activities across several colleges and independent centers in TAMU. Immediate growth in research in mechanical and electrical engineering, materials, physics and computer science is crucial to the accomplishment of the program objectives. Additionally, major efforts from departments in the colleges of business administration, liberal arts, agriculture, and architecture will be needed in several of the

elements of this initiative. The Institute of Pacific-Asian Studies, the Center for International Business Studies, and the Mosher Center for Defense Studies are TAMU centers having vital roles in providing the resource depth needed for the **Transportation Systems** program.

D. Resource Base

The **Transportation Systems** research initiative will amplify the currently successful transportation research effort in the TAMUS Engineering Program. Through decades of dedicated work in highway-related research, TAMUS has developed credibility and leadership positions in national and state supported research programs, e.g., the Strategic Highway Research Program, the Federal Highway Administration, and the Texas Department of Highways and Public Transportation. This experience will help the pursuit of new funding opportunities in DOT and in DOD. Financial support from TAMU System sources for the **Transportation Systems** research initiative will be needed to complement funding sources from other governmental and private sector entities.

Texas A&M University
Prairie View A&M University
Tarleton State University
Texas A&M University at Galveston

Texas Agricultural Experiment Station
Texas Agricultural Extension Service
Texas Engineering Experiment Station
Texas Engineering Extension Service
Texas Forest Service
Texas Transportation Institute
Texas Veterinary Medical Diagnostic Laboratory

THE TEXAS A&M UNIVERSITY SYSTEM
COLLEGE STATION, TEXAS 77843-1122

Office of the Executive Deputy Chancellor
(409) 845-4333

10 March 1988

MEMORANDUM

TO: Dr. Charley V. Wootan

THROUGH: Dr. Herbert H. Richardson

SUBJECT: Long Range Plan - 1989-1993

We have reviewed your preliminary long range plan update through 1993. Overall, your planning document does a good job in summarizing your progress and plans. Several questions, issues, and comments are offered for your consideration.

1. Have the external planners working on the Riverside Campus (BREC) master plan solicited and received your specific facility requirements for that campus?

2. What source(s) of matching funds do you consider probable for the federally designated Regional Transportation Research Center?

3. Could a higher percentage of TTI's growth space requirements go to the Riverside Campus (BREC), assuming better transportation, environment, food services, etc.? (p. 36).

4. Are the computer network to BREC and other computer needs in the University's computing master plan?

5. Is your "AUF planning request" intended for the test track and office facilities? If so, should be under PUFB rather than AUF.

6. The Research enhancement initiative for transportation systems will be coordinated with the Research Enhancement Committee review of interunit priorities.

Your feedback on these questions and comments would be appreciated.

Further feedback on System Part plans, priorities and resources will be given later this spring.

Thank you for your time and assistance in the planning process.

WHM

William H. Mobley
Executive Deputy Chancellor

WHM:bd

cc: Dr. Perry L. Adkisson
Dr. Eddie J. Davis
Ms. Verna L. Dewees

TEXAS TRANSPORTATION INSTITUTE

OFFICE OF THE DIRECTOR

Area Code 409
Telephone 845 • 1711
TTI/CE Bldg.
Suite 801

March 15, 1988

TO: William A. Mobley
Executive Deputy Chancellor

FROM: C. V. Wootan
Director

SUBJECT: Long Range Plan - 1989-1993

We have reviewed your memorandum of March 10, 1988 and are presenting the following responses to your questions and comments.

1. I was contacted by Jerry Gaston to complete a questionnaire concerning our use of space at the BREC. We reported that information to Bovey Engineers in a meeting held on October 15, 1987 and have not been contacted by Dr. Gaston nor Bovey Engineers since that time. I assume that our completed questionnaire answered their questions about programs, but it did not address facilities.

2. As indicated on p. 37 and p. 39 of the *LRP Update*, TTI will seek increased general revenue appropriations as the primary source of matching funds for the Regional Transportation Research Center. The other two principal members of the consortium, UT-Austin and Texas Southern University, have agreed that increased general revenues for TTI are the preferred source of matching funds for the *entire* Texas portion of the RTC. For the first year, we plan to use other "not-federal research funding" to provide the match; however, this would not enhance the program as additional appropriations would. The technical soft match would limit the effectiveness of the entire program and will be used in subsequent years only if we are unsuccessful in obtaining additional General Revenue funds.

3. TTI's integrated role in the academic program is expected to be enhanced, even beyond its current high levels; thus, possibilities of reassigning to BREC significantly larger percentages of future growth are very limited. TTI's near-term growth (through 1993) is expected to come from expanded initiatives involving academic departments not currently heavily integrated into TTI programs. One of the implications of this is that the use of jointly appointed faculty members will increase beyond current levels. These "new" TTI staffers may have space provided on campus in their academic departments. Similarly, TTI is expecting to continue and even expand its support of graduate (and undergraduate) research assistants. These students have classroom requirements that preclude efficient re-assignment to BREC.

4. The University currently has a T1 link to the BREC. The TTI plan would call for a local area network in our facilities. Any network installed by TTI would be fully compatible with any network that might be extended by the University. We work with Butch Kemper of the CSC to assure complete compatibility. Mr. Kemper says that more extensive capacity will be extended to the BREC when demand grows. The computing needs for TTI shown in our Long Range Plan are not included in the University's computing master plan. TTI, along with all other state agencies, is required to file an independent computing master plan with AITC. In addition, TTI does make use of many of the global computing facilities which are a part of the University's plan, and we obviously work closely with both the CSC and the ECS to insure compatibility of our computers and others available on campus. This is particularly true of the planned TTI network, which must be fully compatible with the Campus Eathernet, however, it will be acquired by TTI and not the University. It is my understanding the only computers included in the University's plan, as it is with ours, are those computers which they will be responsible for.

5. The "AUF planning request" is intended to indicate to TAMUS that expected growth in TTI will generate additional office/lab requirements. Much of this growth is targeted for programs that will utilize jointly-appointed faculty members (and research assistants) in TAMU departments, principally in the College of Engineering. The additional space requirements shown in the TTI plan includes offices and labs that may already exist (or be in the TAMU plans), but will be newly used in the TTI program. The total value of the required additional space ($4 million) is, obviously, **not**, an estimate of the value of newly constructed facilities to be assigned to TTI. Rather, it is an indication that, *caeterus paribus*, TTI growth will place new demands on the space available for TTI and its collaborators within the academic departments.

   The test track facility will be financed entirely with contract funds. Implementing your suggestion, we have modified the sources of funding categories by eliminating the "AUF" source and substituting "PUF-BP (TAMU)" to indicate the office/lab portions of our growth budget which will be included in academic departments of the university. The "PUF-BP (TTI)" includes the equipment budget that is unique to TTI programs.

6. TTI is pleased to have played a role in drafting the **Transportation Systems** research enhancement initiative being coordinated by the Research Enhancement Committee. We fully support the indicated intra-System collaborations and are eager to pursue many of the exciting research possibilities to advance the state-of-the-art in transportation sciences.

I hope that this will assist you in your evaluation of our preliminary plan. We have a revised plan that deletes references to AUF, and should that be the only modifications we need to make, we are prepared to furnish you with a sufficient quantity of the revised version.

cc: Herb Richardson

Texas A&M University
Prairie View A&M University
Tarleton State University
Texas A&M University at Galveston

Texas Agricultural Experiment Station
Texas Agricultural Extension Service
Texas Engineering Experiment Station
Texas Engineering Extension Service
Texas Forest Service
Texas Transportation Institute
Texas Veterinary Medical Diagnostic Laboratory

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COLLEGE STATION, TEXAS 77843-1122

Office of the Executive Deputy Chancellor
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9 May 1988

MEMORANDUM

TO: Chief Executive Officers
The Texas A&M University System

SUBJECT: Final Versions: 1990-1993 Long Range Plans

Final versions of 1990-1993 System Part Plans are due in the Chancellor's Office by June 1, 1988, earlier if convenient. Please submit fifteen (15) copies of your final submission for use by the Board of Regents and the Chancellor.

Agency Directors should submit their plans through the appropriate Deputy Chancellor for Agriculture or Engineering.

Please be sure to include an executive summary, responses to the earlier feedback letters, specific minority goals, prioritizations, and resource expectations more consistent with the fiscal projections discussed with the Presidents and Deputy Chancellors at the May planning meeting, including the need to reduce PUF-B requests by 55-65 percent and reduced general reserve expectations.

William H. Mobley

William H. Mobley
Executive Deputy Chancellor

WHM:bd

cc: Dr. Perry L. Adkisson
Dr. Eddie J. Davis
Dr. Robert S. Stone
Dr. Donald McDonald
Dr. Duwayne Anderson
Ms. Verna L. Dewees