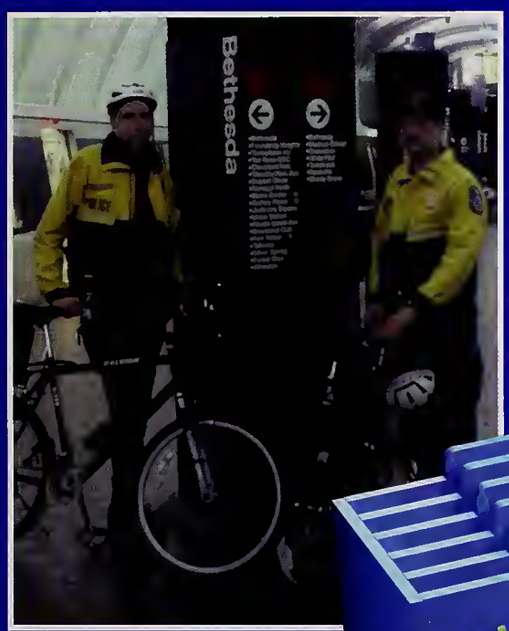
U.S. Department of Transportation

FTA
Federal Transit Administration

Transit Research & Technology 5-Year Plan



PREFACE

The Federal Transit Administration (FTA) developed this Research and Technology Five-Year Plan in response to transit industry trends, needs, and opportunities. Information generated through research and technology provides unprecedented opportunities to boost transit ridership through improving the level and quality of transit service while reducing the capital, operating, and maintenance costs of services and facilities.

This Plan reinforces the innovation goals of the United States Department of Transportation (USDOT) and FTA Strategic Plans. Both of these strategic plans emphasize the necessity for technological innovation to meet the challenges of the 21st century. Transit research and technology is an integral element of the USDOT Surface Transportation Research and Development Plan required by the Transportation Equity Act for the 21st Century (TEA-21). Under the auspices of the National Science and Technology Council (NSTC), transportation research and technology deployment is coordinated with similar activities through the Federal Government and the private sector.

This Research and Technology Five-Year Plan complies with a directive of the House of Representatives Transportation Appropriations Subcommittee. Consistent with the Congressional direction, the Plan addresses objectively short- and long-term activities which offer the greatest benefits; reflects input of the American Public Transit Association (APTA), the American Association of State Highway and Transportation Officials (AASHTO), the National Academy of Sciences and other interested parties; and contains indicators of expected progress and products.

This Plan contains seven chapters. Chapter 1, the Introduction, provides the background of the report, establishes the relationship to other strategic plans, describes the industry consultation process, and provides a vision for FTA's Research and Technology program. Chapter 2, Understanding the Need for Transit Innovation, describes the current state of affairs in transit and establishes the case for innovation in Research and Technology for solving issues facing the provision of transit services. Chapter 3, Five-Year Program Areas, presents the FTA Research and Technology program areas. Chapter 4, Schedules and Milestones, presents and explains the short-term and long-term milestones for the program areas. Chapter 5, Implementation Methods, presents the methods for implementing the activities for the program areas described in Chapter 3. Chapter 6, Performance Measurement, presents methods for measuring accountability, program assessment and evaluation. Finally, Chapter 7 is the summary and conclusion of the report.

Acknowledgments are warranted for the Office Directors and staff of the FTA Office of Research, Demonstration and Innovation; FTA Office of Planning; the USDOT John A. Volpe National Transportation Systems Center (VNTSC), and consulting firms under contract to the VNTSC. Special thanks to Edward L. Thomas, A. M. (Tony) Yen, Joel Washington and Lisa Colbert of FTA, Terrence M. Sheehan (VNTSC), and Terrence F. Smith for providing assistance in producing this Plan, and to the consultants under contract to Thomas J. Luglio, Jr., and Vincent DeMarco.

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List of Acronyms & Abbreviations

AASHTO	American Association of State Highway and Transportation Officials
AATC	Advanced Automatic Train Control
ADA	Americans with Disabilities Act
ADART	Autonomous Dial-A-Ride Transit
ANSI	American National Standards Institute
APTA	American Public Transit Association
APTS	Advanced Public Transportation Systems
ATTB	Advanced Technology Transit Bus
AFI	Alternative Fuels Initiative
BART	Bay Area Rapid Transit District
BRT	Bus Rapid Transit
CAAA	Clean Air Act Amendments of 1990
CBTC	Communication-Based Train Control
CNG	Compressed Natural Gas
CO	Carbon Monoxide
CO_2	Carbon Dioxide
CTA	Chicago Transit Authority
CTV	Community Transportation Vehicle
CUTD	Characteristics of Urban Transportation Demand
CUTS	Characteristics of Urban Transportation Supply
DARPA	Defense Advanced Research Projects Agency
DGPS	Differential Global Positioning Systems
DOT	Department of Transportation
DUETS	Demonstration of Universal Electric Transportation Subsystems
FCC	Federal Communications Commission
FFCA	Full Funding Cooperative Agreement
FFGA	Full Funding Grant Agreement
FHWA	Federal Highway Administration
FRA	Federal Railroad Administration
FTA	Federal Transit Administration
GIS	Geographic Information System
GPRA	Government Performance and Results Act
GPS	Global Positioning System
HC	Hydrocarbons
IMTP	International Mass Transportation Program
ISTEA	Intermodal Surface Transportation Efficiency Act of 1991
ITE	Institute of Transportation Engineers
ITS	Intelligent Transportation Systems
IVI	Intelligent Vehicle Initiative
JPP	Joint Partnership Program
LACMTA	Los Angeles County Metropolitan Transportation Authority
LCI	Livable Communities Initiative
LNG	Liquefied Natural Gas

MBTA	Massachusetts Bay Transportation Authority
MPO	Metropolitan Planning Organization
NASA	National Aeronautics and Space Administration
NATM	New Austrian Tunneling Method
NCHRP	National Cooperative Highway Research Program
NOX	Nitrogen Oxide
NHI	National Highway Institute
NPS	National Park Service
NSTC	National Science and Technology Council
NTD	National Transit Database
NTI	National Transit Institute
NTIA	National Telecommunications and Information Agency
PAFC	Phosphoric Acid Fuel Cell
PCB	Professional Capacity Building
PEMFC	Proton Exchange Membrane Fuel Cell
PM	Particulate Matter
PTI	Pennsylvania Transportation Institute
RSPA	Research and Special Programs Administration
RTAP	Rural Transit Assistance Program
SBIR	Small Business Innovation Research
SDO	Standards Development Organization
SESCB	Subway Environmental Simulation, Chemical and Biological
STURAA	Surface Transportation and Uniform Relocation Assistance Act of 1987
TCIP	Transit Communications Interface Profiles
TCRP	Transit Cooperative Research Program
TEA-21	Transportation Equity Act for the 21st Century
TERM	Transit Economic Requirements Model
TIFIA	Transportation Infrastructure Finance Innovation Act
TOPS	TCRP Oversight and Project Selection
TPMS	Transit Performance Monitoring System
TPR	Transit Planning and Research
TRANSIMS	Transportation Analysis and Simulation System
TRB	Transportation Research Board
UCRD	Urban Chemical Release Detector
UMTRIS	Urban Mass Transportation Research Information Service
USDOD	United States Department of Defense
USDOE	United States Department of Energy
USDOI	United States Department of Interior
USDOJ	United States Department of Justice
USDOT	United States Department of Transportation
USEPA	United States Environmental Protection Agency
USDHHS	United States Department of Health and Human Services
UTC	University Transportation Center
UTCP	University Transportation Centers Program
VMT	Vehicle Miles Traveled
VNTSC	Volpe National Transportation Systems Center
VR	Virtual Reality

1.0 Introduction

Transit innovation is positioned on the threshold of the new millennium playing an increasingly important role in advancing a customer-friendly, seamless, accessible, safe, secure, and environmentally sensitive public transportation system at the lowest possible cost. Development of this Research and Technology Five-Year Plan was done with industry collaboration. Actions identified in the Plan will benefit end users by achieving explicit goals over a five-year period.

The Federal Transit Administration (FTA) currently invests in research and technology that will improve all aspects of transit for transit customers, employees, and communities. Congress established a Federal program to support transit research and technology recognizing that transit innovation is a critical element in the overall transportation system. Transit provides basic mobility for millions of Americans, relieves congestion, and promotes livable communities. FTA's Livable Communities Initiative (LCI) demonstrated that transit is the vital link that connects people to jobs, shopping, education, health care, and the community. Maintaining and strengthening the links between people, communities, economic and social opportunities, and the environment is an important component of building sustainable communities.

Transit research and technology development, demonstration and deployment at the Federal level are needed for several reasons. Transit provides an alternative means to address growing congestion and air quality problems. Metropolitan areas are looking to customize services and to build new transit infrastructure to address these problems. Given funding constraints for these projects, it is important that innovative delivery processes and cost-effective technologies be identified to meet the demand for new services in a timely way at the lowest possible cost. It is also important that these new services be safe, meet customer needs, and address the problems they were designed to solve.

The Federal government is an appropriate sponsor for transit research and technology. It is in the best position to coordinate research activities and address the many issues facing the industry. The Federal government is able to spread the costs of research across the transit sector and identify ways of getting the highest return for the federal transit investment. At the same time, societal problems can be addressed, such as reducing the need for more investment in highways, improving air quality, and providing mobility to all people. Thus transit systems, without sufficient funds to finance similar activities, can also capture the benefits of federal infrastructure investments. Clearly, transit customers benefit from the practical application of federal research.

An important component of research and technology development is the development of industry standards. The National Technology Transfer Act of 1995 (Public Law 104-113) requires the use of consensus technical standards by Federal Agencies. Specifically, the law requires that:

> *...all Federal agencies and departments shall use technical standards that are developed or adopted by voluntary consensus standards bodies, using such technical standards as a means to carry out policy objectives or activities determined by agencies and departments...and, ...Federal agencies and departments shall consult with voluntary, private sector, consensus standards bodies and shall, when such participation is in the public interest and compatible with agency and departmental missions, authorities, priorities, and budget resources, participate with such bodies in the development of technical standards.*

The transit industry, along with the FTA, has identified the need for standards. Specific areas where the need for standards has been identified include intelligent transportation systems, transit vehicles, vehicle subsystem interfaces, and infrastructure, including facilities, signals, guideways, and stations.

This introductory chapter describes the issues facing the transit industry, the consultation process used to identify research and technology needs, and the important role that research and technology plays in meeting national goals and objectives, as well as the goals of the U.S. Department of Transportation (USDOT), the FTA and the transportation industry. The need for transit innovation is described in Chapter Two. Chapter Three describes the six areas that the FTA will emphasize over the next five years. Chapters Four, Five and Six describe how research and technology will be implemented, evaluated, and measured. The last chapter is the summary and conclusion of the plan.

1.1 Relationship to Other Strategic Plans

FTA's Research and Technology Five-Year Plan reinforces ongoing activities addressing the need for a strategic approach to transit research and technology. Strategic plans recently completed by USDOT and FTA established the foundation for the development of this Research and Technology Five-Year Plan. These strategic plans are the product of extensive industry coordination and consultation. Other efforts that contributed to this plan include USDOT's Surface Transportation Research and Development Plan, activities of the National Science and Technology Council (NSTC), and work performed by the transportation industry through the cooperative research project.

The Government Performance and Results Act (GPRA) requires each Federal agency to develop strategic goals, plans, and performance measures with participation and feedback from external customers. USDOT's strategic plan, which was well received by Congress, provided the basis for FTA's strategic planning activities. The FTA strategic plan addresses issues specific to transit while the USDOT strategic plan addresses broader transportation issues. Both plans emphasize the necessity for technological innovation to meet the challenges of the 21st Century.

The Department of Transportation Strategic Plan adopted by Secretary of Transportation Rodney Slater includes the following Vision Statement, Mission Statement, and Strategic Goals, all reflected in this Plan:

Vision Statement:

A visionary and vigilant Department of Transportation leading the way to transportation excellence in the 21st Century.

Mission Statement:

Serve the United States by ensuring a fast, safe, efficient, accessible, and convenient transportation system that meets our vital national interests and enhances the quality of life of the American people, today and into the future.

Strategic Goals:

1. Safety: Promote public health and safety by working toward the elimination of transportation-related deaths, injuries, and property damage.
2. Mobility: Shape America's future by ensuring a transportation system that is accessible, integrated and efficient, and offers flexibility of choices.
3. Economic Growth and Trade: Advance America's economic growth and competitiveness domestically and internationally through efficient and flexible transportation.
4. Human and Natural Environment: Protect and enhance communities and the natural environment affected by transportation.
5. National Security: Advance the nation's vital security interests in support of national strategies such as the National Security Strategy and National Drug Control Strategy by ensuring that the transportation system is secure and available for defense mobility and that our borders are safe from illegal intrusion.

The USDOT Research and Technology Management Strategy, in particular, influences this plan. Its goal is to advance transportation research and technology to shape a fast, safe, efficient, accessible, and convenient transportation system for the 21st century through strategic planning, world-class research, better exchange of information on useful technological innovation, partnerships, and research and education.

The Federal Transit Administration Strategic Plan reflects the USDOT Strategic Plan in establishing strategic goals, outcome and performance goals and performance measures for transit. The five FTA Strategic Goals are:

1. Safety and Security: Promote public health and safety by working toward the elimination of transit-related deaths, injuries, property damage, and the improvement of personal security and property protection.
2. Mobility and Accessibility: Shape America's future by ensuring a transportation system that is accessible, integrated, efficient, and offers flexibility of choices.
3. Economic Growth and Trade: Advance America's economic growth and competitiveness domestically and internationally through efficient and flexible transportation.
4. Human and Natural Environment: Protect and enhance communities and the natural environment affected by transit.
5. Quality Organization: Ensure a quality organization that is responsive to employees' needs, empowers its employees, and provides excellence in customer service.

The FTA Strategic Plan also includes outcome and performance goals and related performance measures. The relationship between the activities in this Plan and those performance goals and measures is discussed in Chapter 6.

Transit research and development is also an integral element of the USDOT Surface Transportation Research and Development Plan and activities of the NSTC Committee on Transportation Research and Development. This committee is hosted in USDOT by the Research and Technology Coordinating Council and is composed of modal representatives and other Federal agencies. Participating agencies include the U.S. Departments of Defense (USDOD) and Energy (USDOE) and the National Aeronautic and Space Administration (NASA).

The NSTC Committee has developed the first *Transportation Science and Technology Strategy* to help Congress, the White House, and Federal agency heads to establish national transportation R&D priorities and coordinated research activities. The Strategy is based on the results of numerous outreach events, environmental scans, and an analysis of the transportation system's current and future strengths, weaknesses, opportunities, and threats. A critical element of this Strategy is the identification of technology-based partnerships among government, industry, and academia. Based on broad public and private sector input, this Strategy identifies twelve partnership initiatives offering some of the greatest benefits for transportation. The initiatives fall into three overlapping and interrelated categories: (1) transportation infrastructure; (2) next-generation vehicles; and (3) transportation physical infrastructure.

The transit community has undertaken other strategic planning activities. Building on the American Public Transit Association's report, *Mobility for the 21st Century: A Blueprint for*

the Future, the Transit Cooperative Research Program (TCRP) began an effort to identify the short-term research needed to address such goals as investing in innovative and sustainable technologies, creating desirable land-use and development patterns, and strengthening regional and metropolitan planning and decision-making. Another TCRP project, New Paradigms for Public Transit, is addressing a long-range strategic transit vision.

1.2 Consultation Process

In the FY 1998 appropriations proceedings, the House of Representatives directed FTA to develop a Research and Technology Five-Year Plan in consultation with the transportation industry. This consultation process played an important role in setting the direction for the development of the Research and Technology Program described later in Chapter 3. During 1997 and 1998, FTA staff participated in eight formal meetings with the transportation industry. The date and participants in these meetings are summarized in Table 1.1.

This consultation process builds on FTA's relationships with all parts of the transportation industry. As the major source of funds for most transit capital investments, FTA has an ongoing dialogue with almost every segment of the transit industry. FTA works closely with universities to identify basic research that is useful to the transportation industry. Through intergovernmental partnerships, FTA is able to identify research being performed by other agencies that is applicable to transit.

DATE	SUBJECT/PARTICIPANTS
September 21, 1997	American Public Transit Association (APTA)
October 18, 1997	American Association of State Highway and Transportation Officials (AASHTO)
November 18, 1997	Universities and Colleges
November 19, 1997	Bus Technology Symposium
December 4, 1997	AASHTO State Public Transit Directors
December 12, 1997	Consolidated Focus Group Convened by the National Academy of Sciences
December 17, 1997	Electric Vehicle Consortia
January 12, 1998	Combined Transportation Research Board Outreach

Table 1.1 Consultation Meetings between FTA and the Transportation Industry

Research and technology development and deployment are collaborative processes, and these collaborations are evident in the decisions made in developing this plan and will be evident as this plan is implemented. The initial consultation with the transportation industry was a starting point for continued dialogue between FTA and the transit community. Industry representatives will be consulted throughout the next five years as this plan is implemented. This Five-Year Plan is to be viewed as a living document and will be periodically updated to reflect new mandates, lessons learned, and input from the industry.

A key element of this Five-Year Plan is an industry review meeting after 30 months of effort. This will be done formally through meetings, workshops, and symposia and informally through the natural course of work.

1.3 Vision & Mission

Several emerging concepts were reinforced during the industry consultation process. The transit community expressed an interest in a research and technology program, which establishes U.S. preeminence and leadership in transportation technology. This recognizes domestic advancements in information, communication, and material technology. These advancements are due, in part, to a significant investment in military technology, technology that is now available for commercial use. Transit industry representatives also wanted to focus on transportation issues including improving the level and quality of services and facilities and reducing the cost of system development, and operation and maintenance. Some industry participants also encouraged focusing on the importance of institutional reform and mobility management. This perspective recognizes the significance of integrating transit technology with organizations and jurisdictions to solve mobility problems. From these ideas, the following vision statement was fashioned:

> *"Integrated transportation technology producing high quality mobility into the 21st century."*

Moving toward this vision, the FTA mission is to partner with the transportation industry in establishing preeminence in U.S. transit technology, institutions, and customer services to increase the quality and level of transit services. This mission is only possible if vigilance is deployed in understanding the trends affecting transportation. These trends are discussed in Chapter 2.

2.0 Understanding the Need for Transit Innovation

Federal support for transit innovation is vital to improving all aspects of the nation's transportation system. This support focuses on improving service to transit customers. Technology sharing and professional capacity building facilitate wider adoption of proven innovations, thus helping to make the transportation system safer, more productive, and more efficient. In addition, federal investment in transit research and technology advances innovations critical to the domestic manufacturing base and global competitiveness.

The transit industry operates in a complex environment. The core customer market has changed, along with domestic and international landscapes. Events are forcing transit agencies to develop new and customer-oriented services, more accessible facilities, and reliable equipment. Innovation holds the keys to providing more cost-effective transit service. Understanding the present operating environment and market trends affecting transit helps identify the role of innovations in improving transit services, infrastructure, and institutions.

Thirty or more years ago, factories polluted the air and water and buried their toxic waste with little interest in the consequences. Now there is an international commitment to environmental protection. Society has gone from a time when industry gave little consideration to giving customers flexibility and appreciation, to a significant emphasis on "putting the customer first." The cold war ended in the last years of the 1980s and the arms race has been slowed, with a call to apply defense technology to civilian and transportation applications. Although America has been engaged in armed conflicts around the world, domestic terrorism is a recent phenomenon as witnessed in New York City and Oklahoma City and needs to be addressed. In the past, the transportation industry reacted to change. The challenge for the future is to prepare for change.

The enactment of the Urban Mass Transportation Act of 1964 identified the need for transit innovation through research, development, and demonstration projects. The objective was to "...assist in the reduction of transportation needs, the improvement of mass transportation service, or the contribution of such service toward meeting total urban transportation needs at minimum cost." At the time, the motivation for this act was the need for improved equipment and infrastructure. Investment in transit was stagnant during most of the 1930s and 1940s, and the combination of new land-use patterns and an increase in automobile use reduced ridership during the 1950s and 1960s. As ridership dropped, many agencies reduced service and increased fares, which led to additional reductions in ridership, leaving little funds available for new equipment and infrastructure improvements. These trends resulted in reduced funding for transit research and development. This deficiency produced a lower quality of service that made transit less competitive with other forms of transportation.

Since the enactment of the Urban Mass Transportation Act of 1964, the Federal Transit Administration and its predecessor agencies, along with other Federal agencies, have worked with the transit industry to support transit-related research, development, and demonstration projects. The focus of this work has been to identify the changing circum-

stances of society, adapt and improve technologies that address societal changes and concerns, and mainstream their applications throughout the entire transit industry. These investments have already resulted in better transit vehicles, new communication and information systems, better signals and controls, new approaches to providing transit services, enhancements in project delivery, and the introduction of innovative financing mechanisms. This FTA Research and Technology Five-Year Plan continues this process of identification and adaptation of technology to meet the demands and needs of transit customers.

2.1 Influencing Trends

FTA accepts a leadership role in coordinating the transit research and technology activities of public transit agencies and the private sector, and promoting global competitiveness and innovation. This leadership requires understanding the problems of the transit industry and the major trends, which will affect the future of transportation. Trends include a focus on customers, an aging population, the need for safety improvements, globalization of economies, an emerging consensus for sustainable transportation, and technology advancements. These trends will influence the demand for specialized services, the need to counter terrorist threats, increased importance of environmentally benign transit services, and the need to have a strong and stable domestic transit manufacturing industry. Continuous improvement in transit technology is essential to addressing these conditions.

2.1.1 Customer Emphasis

The last twenty years have been characterized by significant upheavals and a major shift in both American business and governmental cultures. Through this time, American business has changed. Examples of these changes include flatter organizational structures, worker empowerment, and, most importantly, an increased emphasis on customer satisfaction. These changes have helped to revitalize American business and fuel its robust performance of the mid-to-late 1990s.

Just as business reinvented itself in the 1980s, government began reinventing itself in the 1990s. Faced with increasing public dissatisfaction with governmental programs, public policy thinkers have advocated a more entrepreneurial approach to government, increased public participation in decision making, and placed greater emphasis on meeting customer needs. The Clinton Administration, under the Office of the Vice President, led this re-invention effort. Federal agencies have been charged with developing strategic plans, in part, to carry out this objective. "Putting people first" is a primary theme in the USDOT Strategic Plan. USDOT Secretary Rodney Slater has noted that "transportation is about people, not just concrete and asphalt and steel."

Perhaps the greatest challenge to the transit industry is changing the emphasis of transit providers from a mass-market orientation for urban residents that had no transportation alternatives to an industry that must compete for customers who have other choices. New suburban growth patterns, a growing elderly population, transportation demands of former welfare recipients and other low income persons, disability community needs, and shifts in healthcare policies, all require new transportation customer strategies. These demographic

shifts in the U.S. have created a more diverse set of transportation needs and new travel patterns that call for creative, market-based, solutions by the transit industry. At the heart of these solutions will be the need to recognize and emphasize customer satisfaction as it relates to quality, safety, reliability, and responsiveness of service. It is clear that transit agencies of the future must be willing to focus on different market needs and work with many partners and service providers in creating a variety of services to satisfy these needs. Future transit agencies may be viewed as managers for meeting citizens' broad mobility needs, rather than simply bus or rail operators.

2.1.2 Emerging Information & Communication Technologies

Significant advances in information and communication technologies, made by the commercial and military sectors, provide new opportunities for improving transit services. These technologies provide the opportunity to obtain greater transit capacity at lower costs using existing infrastructure. They also provide ways to improve safety, to better control operations, and to provide reliable and timely information to customers. An important research and technology development issue is identifying appropriate information and communication technologies to address specific transit needs.

Telecommunications technology and regulation are in a period of change. Issues include spectrum allocation and reallocation, and reconsideration of the future roles of the Federal Communications Commission (FCC) and the National Telecommunications and Information Agency (NTIA). The public transit community needs communications for safety and efficiency of operations. The FCC allocates the distribution of available communication airwaves used by transit, and in most cases the licensee is a local government agency. Currently, demand for communication capacity available to transit agencies exceeds supply. This situation will be made more serious in the near future as transit fleets grow in size, and new Intelligent Transportation Systems (ITS) technologies are being deployed. It is important that transit and ITS interests be involved in both technological and regulatory actions to address this growing problem.

Transit agencies must find affordable solutions to increase rail service in response to growing ridership. The historic solution, building more infrastructure, is expensive and often not practical due to physical constraints. Running more trains on existing tracks and higher speeds offers an attractive and cost-effective solution, as long as this can be done safely. Communication and information technologies offer opportunities to double carrying capacity at an affordable cost.

Other advantages of using these technologies include installation without major disruption of the existing transit system, improved system reliability, new capabilities to monitor and communicate train health, and energy savings through improved train control. There are a variety of other potential applications of emerging information and telecommunications technologies. Improvements in fleet management are possible, for example, using location and

communication abilities offered by differential global positioning systems (DGPS) and mobile satellite services. Additional transit applications include communications-based train control, transit traffic signal preemption/prioritization, and on-vehicle video imaging. As these systems are deployed, it will become increasingly important to consider the security of these systems, especially when used for safety-critical applications such as train control.

2.1.3 Global Competitiveness

Research and technology development by the Federal government has as one goal increasing the global competitiveness of U.S. industry. The domestic transit industry has many components, some of which are very competitive on the global market, and others which are not. Domestic electronics, communications, computer, and control system firms are world leaders, as are domestic engineering and construction firms. The U.S. transit vehicle manufacturing industry, however, is in decline largely due to the unpredictability and rapidly changing demand of the domestic marketplace. This Research and Technology Five-Year Plan will reinforce those areas where domestic firms have a competitive edge.

Transit systems increasingly rely on high-technology electronics including computer, communications, and control equipment. The industry is committed to providing better service by using the existing transit system more efficiently. These technologies provide tools for more efficient use of existing equipment and systems. Transit systems demand improved technology when purchasing new equipment. Foreign-owned equipment manufacturers rely on U.S. firms for electronic components that improve the efficiency of the new generation of railcars and buses. FTA is committed to build on these successes.

While the domestic transit component industry is strong in the world market, the domestic transit vehicle manufacturing industry is not. The transit vehicle manufacturing industry has been transformed from a regional base to a global base in the past decade. There are many reasons for this change, but they principally lie in the ability of larger firms to exploit their size as a means of lowering per-unit costs. For example, a large multi-national firm can share a centralized research, design, and marketing work force that is proven to be more effective than small firms. These multi-national firms are also better able to adapt to the cyclical nature of the transit equipment industry. Rather than waiting for new domestic investment, which is what small, regional firms often did, these global firms identify and compete for business on every continent.

The transit vehicle manufacturing market is beginning to look like the market for other transportation equipment, such as the automobile industry. Like the automobile industry, transit vehicle manufacturers are locating assembly facilities in major markets that assemble components made all over the world. As noted above, the U.S. is a leading manufacturer of some components. Continued investment in research and technology is necessary to maintain this lead.

FTA's commitment to develop the Advanced Technology Transit Bus (ATTB) is an attempt to maintain a domestic presence for bus equipment. Six prototype vehicles have been built to-date and are being tested and evaluated. The vehicle was developed with input from domestic transit agencies. Transit agencies want a low-floor, fuel efficient, low emissions bus that can meet the physical demands of urban road systems. This project has identified composite materials and components to address

these issues, as well as designing a fully functional transit bus. The ATTB may be the next generation transit bus, or its development may be a step towards that vehicle.

2.1.4 Global Warming

Global climate change, caused by increasing levels of greenhouse gases, is a mounting environmental concern. The transportation sector contributes significantly to the increase of CO_2, as well as other greenhouse gases, into the environment. According to EPA's *1998 Inventory of U.S. Greenhouse Gas Emissions and Sinks*, in 1996, the transportation sector was responsible for 26-percent of U.S. greenhouse gas emissions, and greenhouse gas emissions from this sector are projected to continue to grow, particularly globally.

There is continuing concern regarding air quality in U.S. cities and increasing levels of "greenhouse gases." Beyond the known health effects of vehicle emissions, climate changes caused by these emissions may, according to many theorists, cause sea levels to rise and flooding in low level areas and coastal cities. As motor vehicle miles traveled in the U.S. and countries around the world grows, vehicle emissions may continue to increase with all its negative impacts on air quality and global climate change.

New transportation technologies offer major opportunities to reduce mobile-source emissions. A number of FTA, USDOT, and USDOE advanced vehicle technology programs support the effort to improve the environment through development, testing, and use of alternative fuel, hybrid electric, and electric vehicles. In particular, the FTA Fuel Cell Transit Bus Program, Hybrid Electric and Electric Bus Programs, and the DOT Partnership for Advanced Vehicles are major efforts for improving bus performance, reducing weight, reducing fuel consumption, increasing transit ridership, and reducing pollutants. Furthermore, the President's Climate Change Initiative and other Administration initiatives call for binding emissions targets, and also foster increased energy efficiency and greater use of renewable energy through tax incentives and Federal investments.

The Kyoto Protocol, negotiated in 1997 under the United National Framework Convention on Climate Change, would put into effect binding targets for the U.S. to reduce national greenhouse gas emissions levels to 7-percent below 1990 levels. The Protocol, which also includes provisions for market-based approaches to reduce emissions, has yet to be ratified by the U.S. Senate.

Activities to reduce mobile source emissions have historically concentrated on improving vehicle technology to reduce emissions. This has significantly reduced the emissions of the average motor vehicle, but further reductions, based on existing technology may not provide significant emissions reductions. Additional reductions in motor vehicle emissions may require reducing the number of trips made by all vehicles. Transit will play a significant role in reducing trips by automobiles occupied by a single occupant.

Transit also provides an energy efficient means of transporting people. Increased efficiency has several environmental advantages, including reducing emissions caused from burning fossil fuels. This also reduces the Nation's dependence on fossil fuels, including foreign oil. One hundred gallons of fuel can be saved each year for every person riding the bus instead of driving. Research and technology can improve the efficiency of transit vehicles and reduce the amount of greenhouse gases emitted from the transportation sector.

2.1.5 Aging Population

Several major demographic trends will greatly impact transit's ability to provide safe, accessible, and affordable transportation for the American public. These trends are the expected increases in elderly population, as illustrated in Figure 2.1, and changes in work and family life. Population has a direct impact on transportation. As the population increases, the aggregate number of trips and miles of travel also increases, leading to additional injury and fatality rates. Moreover, the elderly population is expected to grow 108 percent by 2030 to 70 million, or to one in five Americans, compared to one in ten today. Automobile accident and fatality rates, illustrated in Figure 2.2, for young and elderly drivers are highest among all drivers and increase sharply after age 75.

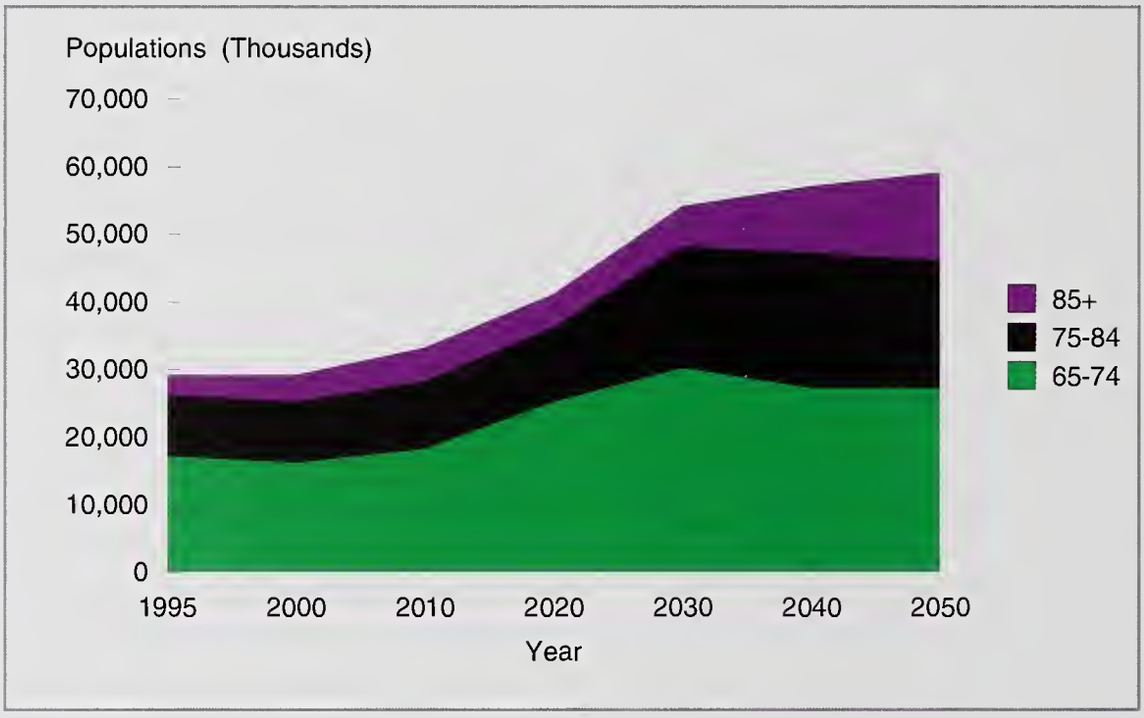


Figure 2.1 Changing Demographics - Population Projections for U.S. Residents

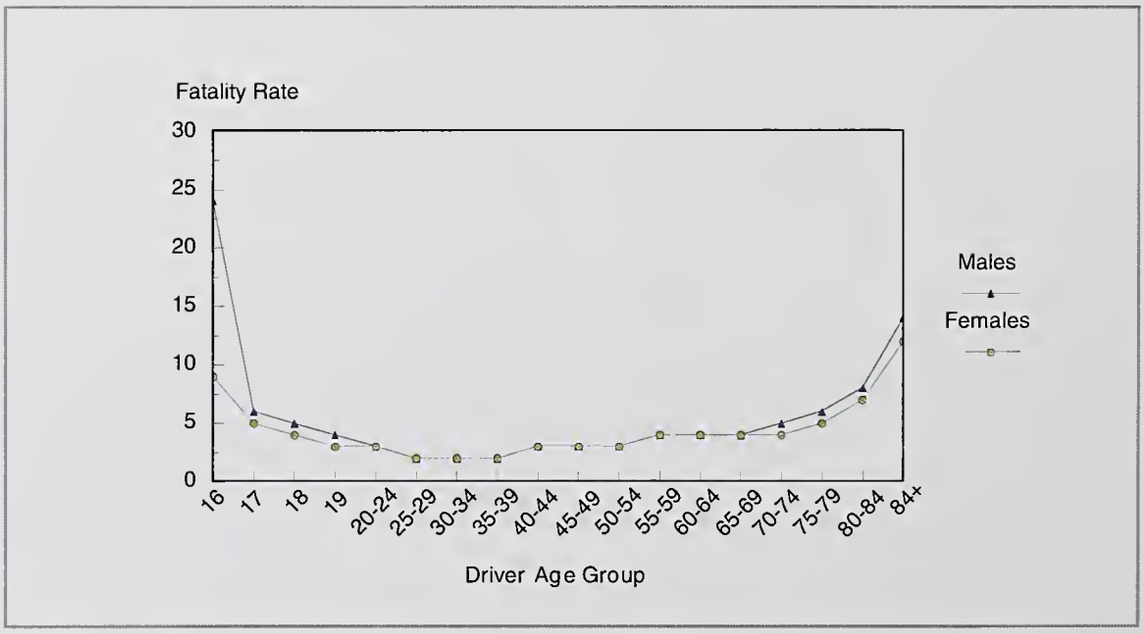


Figure 2.2 Changing Demographics - Age vs. Fatalities

Transit can play an important role in ensuring safety and mobility for the aging population. As research helps us to better understand the travel needs of the elderly, transit can deploy innovations in services, facility design, ease and security of payment methods, and equipment to provide an alternative to the automobile for the elderly population.

2.2 Transit Trends

The transportation industry must maintain and improve its existing infrastructure while adapting to meet new regulatory and market-driven challenges. In 1995, as reported in FTA's National Transit Database (NTD), 537 local public transit operators provided transit services in 316 urbanized areas. An additional 5,010 local and regional organizations provided publicly accessible transit services in rural and small urban areas. In 1995, there were 135,564 total transit vehicles, 9,582 miles of rail track, 2,620 rail stations, and 1,165 maintenance facilities. Rail transit systems provided 1,645 million bus-equivalent vehicle miles, while bus transit systems provided 1,688 million bus-equivalent vehicle miles. Transit rail patronage in 1995 was 19.6 billion passenger miles and transit bus patronage was 18.3 billion passenger miles.

To maintain the 1995 bus and other non-rail service conditions, vehicles must be replaced in accordance with present replacement schedules, rebuilding of equipment must be accomplished, and facilities must be invested in at levels sufficient to keep conditions stable. To maintain 1995 conditions on transit rail systems includes the cost of maintaining the physical infrastructure on the older rail transit systems and the costs of replacing or rebuilding rail vehicles. In addition, transit agencies must address regulatory changes, like the Americans with Disabilities Act (ADA) and welfare reform discussed in Section 2.2.3, and other regulatory changes including the Clean Air Act Amendments of 1990 (CAAA).

According to a 1997 Report to Congress, *1997 Status of the Nation's Surface Transportation System Condition and Performance: A Report to Congress,* the average annual cost to maintain 1995 transit conditions and performance levels through the year 2016 is estimated at $9.7 billion. Under this scenario, transit vehicles will be replaced at about the current rate and transit operators will meet the requirements of the ADA and CAAA. Research and technology development plays an important role in identifying the most effective methods to address these issues at the lowest cost.

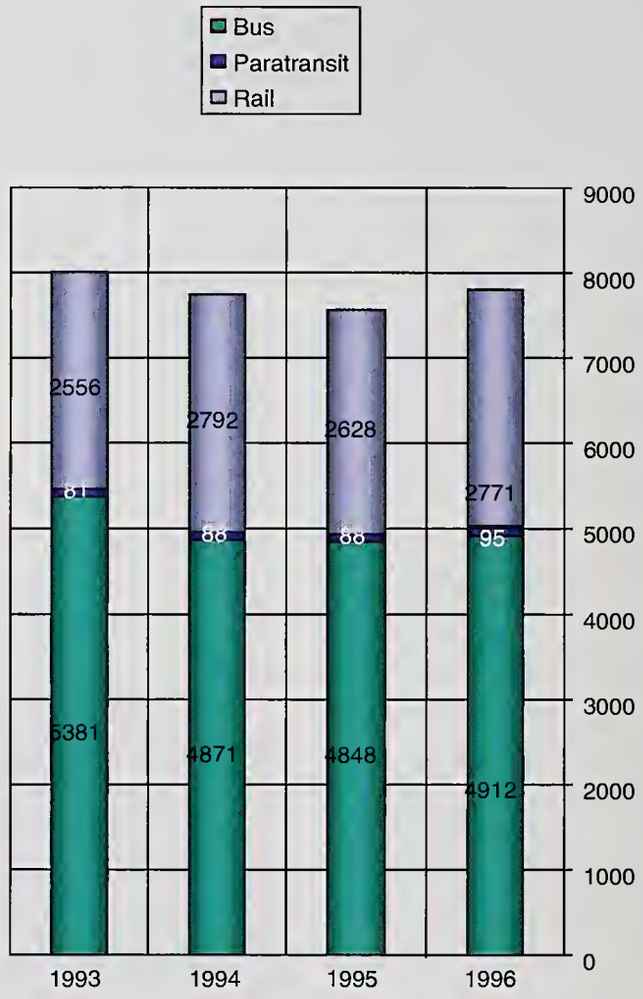
2.2.1 Infrastructure Conditions

The condition and the performance of the nation's transit systems are summarized in the previously referenced Report to Congress, submitted by the USDOT for the 1997 status of the nation's surface transportation systems. According to this report, a total of $23.2 billion was spent for transit in this country in 1995, the nearest year to 1998 with statistics fully reported and analyzed. Of that amount, $16.2 billion was spent for operational purposes and $7 billion for capital improvements.

The sources of funding for the $23.2 billion included 69.8 percent from grants made available by the Federal, State, and local governments, 30.2 percent from collected fares and other revenues derived either from joint development, lease or sale of property, or other sources connected with the operation of the transit systems. In 1995, the Federal contribution to the governments' share was $4.1 billion

or 25.3 percent and the State and local contribution was $12.1 billion or 74.7 percent. With some minor variations, these figures have remained at about the same level since 1991.

With regard to services provided, 38 billion passenger-miles were traveled in 1995. This is an annualized increase of almost three percent for rail transit and a better than one percent increase for non-rail services from 1991. To place transit's current state of affairs in proper perspective, this semi-stable situation must also take into consideration the rapid aging of the transit fleet in this country. The average fleet age of rail vehicles in 1995 was greater than one half of its useful life. Furthermore, the maintenance share of fleet operating costs is on the rise as more labor effort is required as the fleet ages. This means that actions are needed to replace existing rolling stock and capital plants with new, efficient, and affordable equipment and facilities. In addition to increased funding levels in capital investments and operations, improvements in technology changes become critical to achieve optimal levels of transit service.



Source: National Transit Database

Figure 2.3 Transit Ridership Trend By Mode: 1993-96

2.2.2 Transit Travel

As we approach the 21st Century, transit in the United States is progressing in an upward dirction. National ridership figures, presented in Figure 2.3, show a 2.7 percent growth from 1995 to 1996 for all transit modes. With an improved U.S. economy and greater attention to customer service, transit ridership has tumed the corner. Figures from the first three quarters of 1997 indicate that transit ridership has continued to increase. The challenge for transit in the coming years is to maintain ridership growth. Transit has an opportunity to attract higher ridership levels from the elderly and young, welfare to work workers, suburban commuters, and travelers in rural areas, as described later in this document.

A close analysis of the 1993-1996 ridership trend data indicates that light rail, commuter rail, and demand response all showed increases, with light rail having the largest ridership growth at 41.8 percent. This growth in ridership resulted in part from eight light rail transit systems which went into operation in 1993. The light rail transit trend is expected to continue from commitments to build ten additional light rail

transitsystems since 1993 with a Federal investment of $2.4 billion. Heavy rail and bus experienced some decline in ridership during this same period, due mainly to congested traffic networks, longer trips due to increased trip lengths, and aging fleets. The competition from the automobile has never been more fierce. New roads, declining gasoline prices, a more mobile and demanding customer base, and sprawl-producing land-use policies make transit's job even more difficult. However, bus and rail transit are still the major transportation options for many Americans. The industry is adapting and incorporating new technologies into vehicle design, materials, and communications and information systems to increase ridership.

2.2.3 Changing Transit Demand

Most transit systems are designed to move people to and from densely populated neighborhoods built along major roadways to a single major employment center. Since the end of World War II, housing, land-use, and employment location patterns have changed significantly. Most metropolitan areas now have multiple employment centers attracting workers from multiple, low density, suburban communities. Adapting to these changes, while serving the existing customer base, is a major challenge facing most transit agencies.

Demand for transit services is also affected by demographic and regulatory changes. As the population ages, the demand for transit services for the elderly will grow. This will be a challenge for transit agencies because much of this demand will come from people who had relied on the private automobile for mobility and live in areas that have little or no transit services. The additional transit demand forecasted by the growth of the American aging population has been demonstrated in Section 2.1.5.

The Americans with Disabilities Act and Welfare Reform are examples of regulatory changes affecting the transportation industry. The ADA has established access to all public services, including transportation, as a national goal. Transit agencies must adapt infrastructure and equipment to meet the needs of this population.

Welfare Reform has identified a need to better understand the travel demands of low-income people. This issue requires an understanding of where low-income people live, where jobs are being created, and how to best serve this emerging demand. Many transit systems are designed to move people to and from a single center, usually downtown, during the normal workday and work week, 9:00 AM to 5:00 PM, Monday through Friday. For example, as shown in Figure 2.4, emerging employment opportunities in the Rt. 128 High Technology Corridor in Waltham, Massachusetts, are located several miles away from the nearest public transit routes. Few systems have adapted services

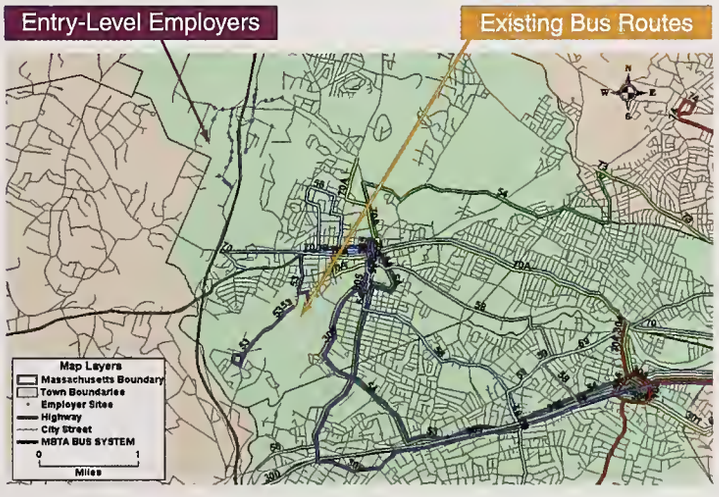


Figure 2.4 Changing Demand — Welfare to Work

to provide access to the multiple suburban job sites being created in most metropolitan areas, nor are systems adapting the time of service to meet the growth of jobs that begin and end outside of the normal workday and work week.

2.2.4 System Operations

System operations involve the coordination of vehicles, facilities, labor, management, and procedures to transport customers safely and efficiently. By improving system operations, it is possible to have the dual benefits of improved customer service and operating efficiency techniques that increase transit operating speed, convenience, and reliability. For example, also increase transit's attractiveness, making travel faster and more convenient for passengers. At the same time, fewer transit vehicles are required for a given route and level of service. Even the number of spare vehicles can be reduced. This reduces both the capital cost of a vehicle fleet, and the operating and maintenance costs as a result of fewer vehicle-miles traveled to provide a given level of service. Figure 2.5 presents operating and maintenance cost data for buses, which indicates a moderate increase in maintenance cost per vehicle-mile. This is in part due to improvements in maintenance procedures and modernization of facilities and equipment. However, Figure 2.5 also indicates costs per vehicle-mile continues to increase mainly due to longer trips, non-revenue miles, higher labor costs, and slow speeds due to traffic delay.

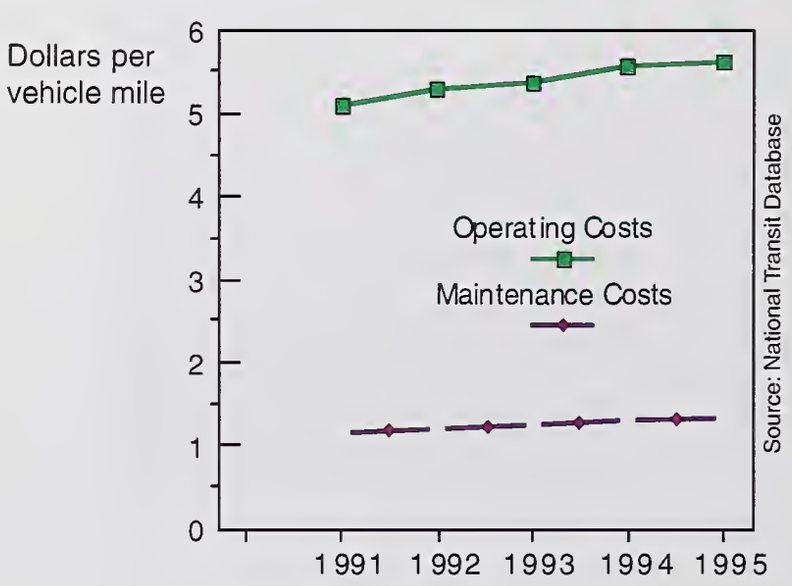


Figure 2.5 Operation and Maintenance Cost Trends

A problem of bus transit travel in metropolitan areas is the length of time it takes to complete a bus trip. In typical mixed traffic arterial operations with frequent bus stops to serve passengers, transit operating speeds can average 8-15 miles per hour. To keep current customers and attract new customers, it is essential to decrease the time it takes buses to complete their routes. The decomposition of bus travel time, shown in Figure 2.6, illustrates the factors that affect bus travel time.

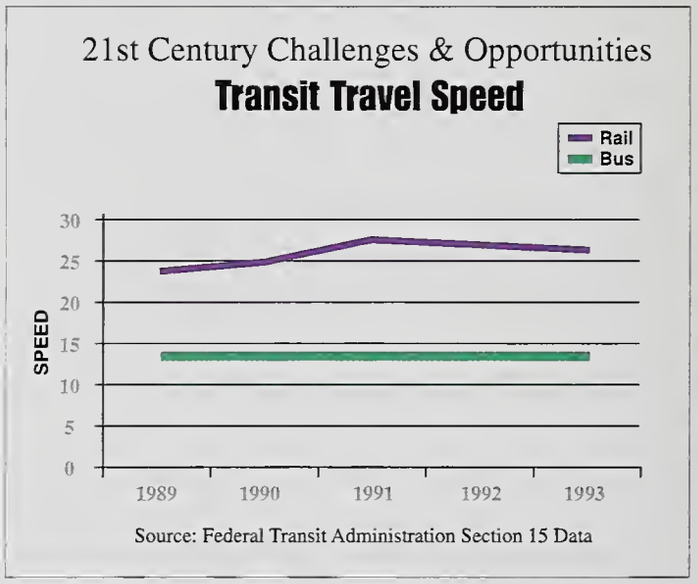


Figure 2.6 Transit Travel Speed

Decreased travel times can result from better signal controls and improvements to vehicle performance. Signals can be better coordinated to allow for a more constant flow of traffic. Delays resulting from vehicle deceleration and acceleration can be reduced with better vehicle performance characteristics. Overall, methods to improve bus transit travel times differ based on existing geographical and travel conditions. Therefore, a mix of technological approaches will be needed to address general congestion as well as improving bus travel time.

Providing information to passengers, coupled with passenger boarding, exiting, and paying fares, can delay transit service. These delays can be improved by changes in equipment, such as low floor buses that allow for faster boarding and exiting, changes in fare payment methods, and better dissemination of information. Improving travel time on uncongested corridors can be done easily, by raising speed limits, but only if safety can be assured.

Technological solutions only address part of the systems operation problem. Longer-range policies such as land-use policies that complement transit system operations can have benefits of more efficient overall surface transportation and more livable communities.

Demand responsive paratransit services, mandated by the Americans with Disabilities Act, and specialized transit services to niche markets, are costly to operate, and provide variable service quality. Advances in automated fleet management, passenger information, communication, and fare-processing techniques, coupled with improved small transit vehicles, offers the potential for the twin benefits of enhanced customer service and reduced capital and operating costs.

Transit system operating improvements fostered by research and technology will also strive to increase both the reality and perception of safety and security, and provide for prompt response when incidents do occur.

2.2.5 Transit Safety and Security

Safety is an important concern of the Department of Transportation, FTA, transit agencies and transit users. Transit safety and security affects transit users, transit employees, and other users of roads and transit rights-of-way. Transit must be perceived to be safe for customers. Workers require a safe workplace to function effectively. Efforts must also ensure that transit vehicles sharing roads with other vehicles perform safely. Transit agencies must also protect themselves from unauthorized use of facilities and equipment.

Customers demand that their entire trip, including waiting areas, be safe and secure. Crime, whether it is petty theft and harassment or the threat of a terrorist attack, on transit vehicles, at transit stations, or near transit facilities significantly affects how the public perceives transit as a transportation alternative. If people with other options perceive transit to be a safe transportation alternative compared to other choices, they are more likely to use transit than if they perceive transit to be less safe.

Transit employees expect to work in facilities and with equipment and rolling-stock that are safe and secure. The introduction of alternative fuels for buses, primarily compressed natural gas (CNG) and liquefied natural gas (LNG), requires changes in facilities to meet the unique safety issues these fuels present. Staff must also be comfortable with the equipment they are using, which requires considering safety training along with other training as new equipment is introduced to the industry.

The shared rights-of-way alignments reduce the cost and complexity of construction. However, they also add a disparate element to the traffic stream that has, in some cases, contributed to accidents and congestion. The potential for accidents is accentuated by the failure of motorists and pedestrians to accurately obey warning devices and traffic controls. The accident potential is also affected by the variations in traffic controls from one system to the next, and occasionally within the same system. The variations within individual systems are, in some cases, due to poor coordination between transit engineering and other traffic engineering efforts. The FTA needs to actively continue its role in evaluating new technologies that will enhance safety at highway-rail transit intersections.

Safety and security of transit properties and equipment has several facets. It is important to keep unauthorized patrons from walking or driving onto rail or other dedicated rights-of-way, or climbing onto rail cars or structures because of the likelihood that they will be injured or killed. It is also important that transit communications and information systems be secure. The issue has been highlighted by the President's Commission on Critical Infrastructure Protection. Increased reliance on communications and information increases the risk that unauthorized access to these systems could lead to a range of problems from service delays to collisions. Transit agencies must also protect themselves against theft of funds, which is an emerging challenge as agencies move to stored-value payment systems.

The strategic approach to achieving the highest practical level of passenger safety and security in all transit modes is through a comprehensive program of research, technology deployment, training, technical assistance and information dissemination to encourage transit agencies in planning, designing and operating decisions, practices, programs, and operations that will have a direct impact. To address customer and employee concerns, it is essential to conduct research to achieve the highest practical level of safety and security in all modes of transit through training, technical assistance, innovation, and technology. Each new technology introduced to the transit industry will bring new safety and security issues which must be considered along with customer service, operation, and other benefits.

Technical assistance and training are provided to the transit industry, as well as state and local jurisdictions, to enhance safety and security for transit passengers and employees. This technical assistance will include peer reviews and on-site assistance. Transit professionals are trained in the best contemporary practices in safety, security, and anti-terrorism. This assistance and training is supported by the production and publishing of guidelines, models, and other technical assistance materials that can be used to develop and implement local procedures and actions; and research that demonstrates state-of-the-art safety and security technologies.

2.3 Industry Articulated Needs

The consultation sessions with the industry were well attended and productive. These sessions allowed the industry and FTA to come together to discuss issues and problems and/or needs impacting the industry's ability to provide quality transit services and the role of research and technology in alleviating these articulated needs.

Several major areas or topics were commonly discussed in the various sessions. As presented in Table 2.1, these are: system safety and personal security; lower cost, environmentally friendly vehicles; transportation management; operations; customer service; equitable access; planning and infrastructure development; and professional development.

System Safety & Personal Security

- Passenger Security
- Anti-Terrorist Provisions
- ITS for Railroad Grade Crossings & Traffic Management
- Computer System Integrity
- Driver Fatigue
- Emergency Response
- Worker Safety

Equitable Access

- Accessibility
- ADA Equipment Standards
- Welfare-to-Work

Lower Cost, Environmentally-Friendly Vehicles

- Open Equipment Architecture & Standards
- Economically Clean Propulsion Systems
- Small Smart Heavy-Duty Bus
- Electric & Hybrid Electric Transit
- Champions for Electric Transit Bus Technology
- Driver, Mechanic & Passenger Ergonomics
- U.S. Preeminence in Technology
- Changed Process for Demonstration & Deployment
- Increase Funding for Advanced Technology for Transit Application

Planning & Infrastructure Development

- Strong Regional Planning
- Land-Use Policy & Transit Oriented Development
- Policy Focus
- Institutional Reform
- Innovative Financing
- Right-of-Way Utilization
- Infrastructure Innovations
- Construction Technology
- Intermodalism
- Livable Communities

Transportation Management

- Mobility Management
- Labor Management
- Gain-Sharing
- Rural Transportation
- Workplace Violence

Professional Development

- Professional Capacity Building
- Awareness & Education
- Foster Education & Public Awareness on Available/Emerging Technology
- Foster Information Sharing on Available/Emerging Technology
- Advanced Simulators for Planning, Designing, Testing & Training
- Balance Basic & Applied Research
- Opportunities for New Innovation

Customer Service

- Advanced Customer Information Technology
- Flexible Services
- Advanced Electronic Payment Systems

Operations

- Resource Allocation Optimization Models
- Advanced Surface Rapid Transit System
- Improved Maintenance Practices
- Quality of Service
- Communications Technology
- Traffic Flow Optimization

Table 2.1 Transit Industry Consultation: High-Priority Needs and Concerns

2.4 Role of Innovation

The challenge of maintaining and improving the nation's transit condition and performance lies in the application of new technologies and innovations in service delivery methods for transit. The role of research and technological innovations for transit becomes more important for the future. For example, advanced information and communication technologies developed and deployed in other fields are being applied to transit systems to increase system throughput and service reliability, and to reduce labor costs. Advanced composite materials, which are being used in the automotive, aviation, and other industries, are resulting in a lightweight, more durable, and long-lasting vehicle body. These metallurgical attributes allow for a reduction in the maintenance requirements of both the vehicle and wayside, and enhancement of vehicle safety.

Improvements via new telecommunication and information technology are needed to accelerate recent ridership gains and reduce transit operating and maintenance costs. Transit systems in the United States provide low-cost mobility for people who cannot operate a motor vehicle because of youth, advancing age, low income, physical disability, or impairment. These groups represent the most transit dependent segments of the population. The travel patterns of these groups are often not adequately served due to changes in demography and land-use that have occurred over the past decades. Specialized service transit vehicles, small buses or vans, guided by computerized communication systems, which are currently in use in other fields, can provide these specialized services in an effective and efficient manner.

Strengthening the domestic transit manufacturing base will stabilize the U.S. transit industry to ensure stronger local economies and higher quality products. As a result, U.S. transit products will be more competitive in the global marketplace, particularly in the growing markets of Africa, South America, and the Pacific Rim nations. This suggests special emphasis on information, communications, computer networking technologies, and management services areas where the U.S. maintains a globally competitive edge, and showcasing these advanced technologies at events of national importance like the Salt Lake City 2002 Winter Olympics.

In addition to encouraging technology innovation, FTA has a new role to play in being the catalyst for establishing open architecture and new technical standards. As information and communication technologies evolve, the protocol for information flow between computer-based systems becomes a critical point for system integration. Inter-operability between different systems provides the rationale for standards. FTA will take a lead role in assisting the transit industry and equipment manufacturers to produce open system architecture that is flexible for technology replacement and integration and inter-operability.

Numerous innovations are available for capital investments. New train technologies can complement or replace costly infrastructure projects for higher capacity rail operations. During the past decade, the cost and time for developing a new start has increased so dramatically that design-build or turnkey project delivery systems and innovative financing mechanisms were introduced. Lessening the financial burden of over $70 billion in potential new starts is a major challenge. Technological innovation is an important factor for finding the solution.

3.0 Five-Year Program Areas

FTA has organized the Research & Technology Program into six program areas:

- **Safety & Security**
- **Equipment & Infrastructure**
- **Fleet Operations**
- **Specialized Customer Services**
- **Policy & Planning**
- **Professional Capacity Building**

These program areas have been selected because they address both the identified needs of the transit industry and broader goals of the Department of Transportation. To ensure system integration, results from one program area become inputs for another with an objective of maximizing achievement of the desired outcomes. Collectively, the programs and projects will improve customer service, increase the cost- effectiveness of transit assets, and contribute to environmental quality while building the professional capacity of the industry. Each program area is the subject of a separate section (3.1-3.6) in which subsections describe specific activities.

FTA will implement its research and technology program, in accordance with the steps in the innovation process. These steps consist of research, testing, evaluations, deployment, architecture/standards, and mainstreaming. A brief definition of each step is as follows:

Research—starts the innovation process. It provides the knowledge about problems, opportunities, and changing conditions; addresses the state-of-the-practice, produces design parameters and technical feasibility of new approaches; and documents human, institutional, and management challenges of new technology.

Testing—determines if prototypes, demonstrations, and pilots of innovations work; identifies risk factors, and establishes how problems can be overcome. State-of-the-art simulation systems may be employed in order to reduce the cost of prototype development and testing.

Evaluations—are conducted to determine and document benefits and costs of tested innovations. In some instances, tests of innovations are compared to conventional practices to assist decision-makers in choosing among future investment options.

Deployment—follows to observe innovations in full-scale implementation. It is where incentives are used to encourage systems integration and best practice documentation is performed.

Architecture & Standards—backed by industry, follow widespread deployment to provide a consistent environment for eliminating incompatibility, streamlining procurement, ensuring safety, and reducing costs.

Mainstreaming—spreads the knowledge gained through the other phases of the innovation process. A variety of technical assistance, peer-to-peer exchange, professional development, training, information sharing, and industry dialogue activities are conducted to best relate lessons learned in order to achieve desired outcome goals.

The program elements within each priority program area are denoted in Table 3.1. To ensure a customer focus, periodic industry reviews with a broad cross-section of affected interest groups, are planned both to inform the industry about progress and to receive industry input on performance and results. Schedules and Milestones, Implementation Methods, and Performance Measurements are discussed later as separate chapters in this document.

Program Elements	Strategic Goals & Outcome Goals [1]
Safety & Security	***Safety & Security***
■ Railroad Safety ■ Information Systems Security ■ Crime Prevention and Anti-Terrorism ■ Bus Vehicle Safety	■ Reduce the number of transit-related fatalities, injuries and incidents. ■ Reduce the vulnerability of transit systems from the consequences of intentional harm to the system, its employees and its users.
Equipment & Infrastructure	***Mobility & Accessibility***
■ Bus Equipment ■ Rail Equipment and Systems ■ Civil Infrastructure ■ Advanced Simulation ■ Innovative Financing	■ Maintain, improve and expand the nation's transit infrastructure, and balance new physical capacity with operational efficiency. ■ Increase intermodal physical, informational, and service connectivity. ■ The nation's transit systems employ the latest technology to meet the increased needs of mobility and accessibility. ■ Safeguard the Federal investment in the nation's public transit systems through effective Federal oversight.
	Economic Growth & Trade
	■ Improve the reliability of the delivery of people, goods and services to their destinations. ■ Improve the U.S. international competitive position by promoting competition in domestic and international markets in transportation-related services, and facilitating the export of domestic transit goods and services. ■ Encourage regional and local economic development through joint development.
	Human & Natural Environment
	■ Reduce the amount of transportation-related pollutants released into the environment.

Table 3.1 Research and Technology Program Elements Support Strategic Goals: **Part 1**

Program Elements	Strategic Goals & Outcome Goals [1]
Fleet Operations ■ Transit Capacity and Quality of Service ■ Transit Intelligent Transportation Systems ■ Bus Rapid Transit Initiative ■ Mixed Rail Corridor Operations	***Mobility & Accessibility*** ■ Maintain, improve and expand the nation's transit infrastructure, and balance new physical capacity with operational efficiency. ■ Increase intermodal physical, informational, and service connectivity. ■ The nation's transit systems employ the latest technology to meet the increased needs of mobility and accessibility. ***Human & Natural Environment*** ■ Reduce the amount of transportation-related pollutants released into the environment. ***Economic Growth & Trade*** ■ Reduce travel time in the delivery of people, goods, and services to their destinations. ■ Improve the reliability of the delivery of people, goods and services to their destinations. ■ Reduce the true economic cost of transportation, taking into account the quality of transit services. ■ Improve the U.S international competitive position by reducing trade barriers, supporting economic deregulation, and promoting competition in domestic and international markets in transportation-related services.
Specialized Customer Services ■ Access to Jobs ■ Accessibility for Persons with Disabilities ■ Elderly Services ■ Low-Density Transportation Services ■ Mobility and Management	***Mobility & Accessibility*** ■ Ensure that all Americans have access to transit to meet basic mobility needs. ■ Ensure that all transit systems are accessible. ***Economic Growth & Trade*** ■ Reduce the true economic cost of transportation, taking into account the quality of transit services.
Policy & Planning ■ Policy Research ■ Transportation Institutional Reform ■ Multimodal System Evaluation	***Mobility & Accessibility*** ■ Maintain, improve and expand the nation's transit infrastructure, and balance new physical capacity with operational efficiency. ■ Increase intermodal physical, informational, and service connectivity. ■ Safeguard the Federal investment in the nation's public transit systems through effective Federal Oversight.

Table 3.1 Research and Technology Program Elements Support Strategic Goals: **Part 2**

Program Elements	Strategic Goals & Outcome Goals [1]
Policy & Planning Continued ■ Planning Technology ■ Sustainable Development ■ Intermodal Connectivity	***Economic Growth & Trade*** ■ Increase intermodal physical, informational, and service connectivity. ■ Encourage regional and local economic development through joint development. ***Human & Natural Environment*** ■ Improve the sustainability and livability of communities through investments in transportation facilities.
Professional Capacity Building ■ Attracting a Quality Workforce ■ Training a Quality Workforce ■ Retaining a Quality Workforce ■ Technology Sharing	***Economic Growth & Trade*** ■ Build professional capacity and promote the education of individuals in transit-related fields. ***Quality Organization*** ■ Deliver results to customers through an agency that works better, is more practical and cost less.

Table 3.1 Research and Technology Program Elements Support Strategic Goals: **Part 3**

[1] These strategic goals and outcome goals were taken from the FTA Strategic Plan.

3.1 Safety & Security

The Safety and Security Program places special emphasis on the promotion of public health and safety by working toward the elimination of transit-related deaths, injuries, property damage and the improvement of personal security and property protection. This is accomplished by promoting transit safety and security in the transit community through training, technical assistance, innovation, and technology. FTA encourages transit systems to collect and disseminate information on safety and security issues, identify and implement best practices, and develop and implement comprehensive system safety and security program plans covering passengers, vehicles, and facilities. The performance goals, performance measures and related program activities for the program area are shown on the next page in Table 3.2:

Performance Goals & Measures for Safety & Security Activities

Performance Goals	Performance Measures	Performance Activities
Reduce the number of fatalities, injuries and incidents per 100 million transit passenger miles – based year is 1996.	Number of transit fatalities, injuries and incidents per 100 million transit passenger miles.	■ Communication-Based Train Control Systems for Grade-Crossing Protection ■ Vehicle Warning System Development
Reduce the transit crimes against patrons, employees and transit property – base year is 1996.	Number of transit crimes against patrons, employees and transit property.	■ Anti-Terrorist Chemical and Biological Detection Systems Development & Deployment ■ Computer System Security Assessment
In urbanized areas over 200,000, increase the number of transit properties with security plans - base year is 1998.	Number of transit properties in urbanized areas over 200,000 with transit security plans.	■ Emergency Management Planning Assistance

Table 3.2. Performance Goals and Measures for Safety and Security Activities

Major elements for this program area are:

- **Railroad Safety**
- **Information Systems Security**
- **Crime Prevention & Anti-Terrorism**
- **Bus Vehicle Safety**

FTA has participated in Departmental efforts to develop safety and security strategies that will promote national transportation interests. Recent efforts highlighting future investments in transit safety and security include the President's Commission on Critical Infrastructure Protection, the USDOT Grade Crossing Safety Task Force, and the TCRP Mobility for the 21st Century project.

Human factors impact every aspect of transit operation and passenger safety. As such, it is an important subject for FTA. As a third party to the actual transit operating agencies, FTA does not get involved in the day-to-day operation of the transit systems, or with passengers. Therefore, human factors research in practice is conducted by individual operators and improvements are made locally for their

operations. Through the National Transit Institute (NTI), safety courses, including human factors, are offered collectively for the nation's transit operators.

Furthermore, FTA is working closely with the Federal Highway Administration (FHWA) and the National Highway Transit Safety Administration (NHTSA) on human factors research related to vehicle safety. Work is also underway through the Transit Cooperative Research Program particularly dealing with operator workstations and assign issues. Rather than initiate a separate human factors research effort, FTA will continue to collaborate with NHTSA and FHWA under a One DOT approach.

The need for enhanced patron and transit agency employee security is unquestioned. While crime prevention is primarily a local responsibility, potential transit riders are deterred unless they perceive the entire trip, including waiting areas, to be safe and secure. Advanced technologies must be tested and evaluated in the transit environment to determine whether they reduce crime and counter terrorism. National security concerns have heightened the need for an effective, innovative anti-terrorism system coupled with appropriate response measures. Measurable safety and security improvements are needed in many environments, including facilities, vehicles, parking lots, shelters, and stations.

3.1.1 Railroad Safety

Many rail transit systems operate in railroad rights of way with intercity passenger and freight traffic. Expanding light rail and commuter rail systems provides new and better transit services, but adding these services to the existing rights of way creates safety vulnerability at highway-rail grade crossings (see Figure 3.1) and along the rights of way. Since 1994, the USDOT has initiated a number of cross-modal efforts to improve grade crossing safety, including the development of ITS technologies in highway-rail interactions, and demonstration of new signs, signals, and train control systems. In addition, FTA and the Federal Railroad Administration are working together on mixed rail corridor operations, which are addressed in this Five-Year Plan under the Fleet Operations Program. There are new technologies that have applicability for use on the nation's roadways that will be demonstrated, evaluated, and integrated for rail-transit system safety application. This pro-

Figure 3.1 Surface Rail Grade Crossing

gram area will benefit the transit industry by supporting new activities that will use technology to meet safety goals for rail transit with respect to grade crossings and control centers.

3.1.1.1 Railroad Grade Crossing Safety

The FTA, as an active partner in this safety improvement effort, will continue to initiate demonstrations, evaluations, and deployment of innovative grade crossings technologies and strategies. These technologies and strategies will: integrate highway-rail traffic control systems and roadway traffic management systems; provide information warnings of trains to motorists and pedestrians; improve passive and active warning signs and signals for light rail and commuter rail transit; develop cost-effective off-track train presence detection systems; and assess safety data to determine target areas for technology enhancements.

One type of traffic signal operation is the use of preemptive signaling to speed transit vehicle travel. Preemption is the transfer from normal operations of signals to a special control mode. Light rail traffic preemption often occurs when trains approach highway-rail grade crossings. Preemption of traffic signals is typically done when vehicles stopped for a red traffic signal are queuing across the adjacent set of tracks. The objective of a successful preemption is to take control of the intersection traffic signal displays and provide for the passage of a train, no matter where in the normal traffic signal operation the preemption occurs. According to National Cooperative Highway Research Program (NCHRP) Synthesis 280-12, *Traffic Signal Operations Near Highway-Rail Grade Crossings,* practices relative to traffic signal operations near highway-rail grade crossings vary throughout North America and coordination between the transit agency and highway authority also varies.

Future directions for light rail preemption include the use of advanced train detection systems, such as Global Positioning Systems (GPS), deployment of positioning responders, and train-to-train wayside communication links to provide more accurate train information. Traffic signal systems at the crossings can be equipped to handle more detailed data about train position, speed, and estimated time to crossing. The traffic signal controller can then accommodate train movements without the abrupt preemption process, improving safety.

The Institute of Transportation Engineers (ITE) Recommended Practice on the "Preemption of Traffic Signals at or Near Railroad Grade Crossings with Active Warning Devices" includes information on traffic signal preemption timing. However, for light rail crossings, further research needs to be conducted to develop a consistent set of preemption sequences.

Activities under this program include:

Health Monitoring of Grade Crossings:

In order to provide a safe environment for crossing users, the light rail vehicle, highway-rail grade crossing, and nearby signalized intersection operations need to be coordinated among relevant parties. If a change is made to the system at the highway-rail grade crossing or signalized intersection that affects the other party and the other is not consulted, tragedy can result. Motorists may not be provided time to clear their vehicles off the tracks prior to train arrival. An integrated health monitoring system will be developed to include city traffic interface with light-rail train detection systems. This includes both direct and parallel street traffic signals. The health monitoring system per-

mits monitoring of preemption features of vehicular and pedestrian movements. An alarm will be sounded at the light rail control center and at the highway traffic management center, alerting personnel of changes made in either signal system, preventing an accident at the grade crossing.

Constant Warning Time at Highway-Rail Grade Crossing for Electrified Rail Operations:

Develop, demonstrate, and evaluate technologies designed to provide constant warning time to users of highway-rail grade crossings with active warning devices, such as flashing light signals and/or automatic gates. Current constant warning time-controlled track circuits are not compatible with electrified rail operations. Providing an approximately constant warning time is important to overall crossing safety. The new light rail transit system in Salt Lake City, Utah is being built in a corridor where different types of rail traffic operate at various speeds. Other new light rail systems are being planned along similar corridors. Consideration will be given to low-cost methods to achieve constant warning time at highway-rail grade crossings, including use of the Global Positioning System and other train-to-wayside communications-based systems.

Traffic Signals for Highway-Rail Transit Grade Crossings:

Evaluate the effectiveness of traffic signals at highway-rail grade crossings, both those that are isolated and those located near signalized highway-highway intersections. This project will examine the use of standard traffic signals in conjunction with flashing light signals as well as in lieu of flashing light signals.

Sight Distance at Highway-Rail Grade Crossings:

Develop sight distance requirements for highway-rail grade crossings, especially those with significant pedestrian demand, such as those associated with light rail and commuter rail. Design guidelines for new systems will be developed.

Power Swing Gates:

Demonstrate and evaluate the use of train-activated swing gates. Swing gates close the crossing to pedestrians when a light rail or commuter rail train approaches. Train-activated swing gates will lock when a train approaches. To prevent pedestrians from being trapped on the track, emergency push bars can be tested or designated safe areas can be installed.

Oversight of Grade Crossing Safety Innovations for Rail Transit:

The FTA will provide oversight and related work to determine the effectiveness of grade safety crossing technology applications for light rail and commuter rail transit. This project will develop criteria for assessing the FTA's investment in grade crossing technologies including the cost, benefits, and possible long-term impact on highway-rail crossing safety.

3.1.1.2 Train Control Centers Safety

This activity area involves assessments of the adequacy of rail control centers and rail transit systems operating in rights of ways with freight and inter-city passenger services. It will be initiated by a joint meeting of FTA, Federal Railroad Administration (FRA), and public/private sector representatives responsible for the

safe, reliable, and expeditious movement of commuter rail traffic. Control centers' equipment and personnel will be evaluated with particular attention to the density of peak period train traffic and the number of routing operations. A five-year record of incidents and accidents of trains will be analyzed, as well as the training and experience records of the centers' staffs. Human factors specialists will assess the appropriateness of the work place environment to effectively accomplish assigned tasks.

Safety, schedule reliability, and expeditious train movement in a commuter rail system or commuter/freight system rely on factors such as human resources, track condition, number of routes operated, number of interlocking, and peak number of trains operated. Train control technology (signals/communications) may be based on equipment designed at any time between 1928 and 1998. Train control center equipment is undergoing quantum changes. The issue of initiating commuter train service on existing freight railroads as well as the issue of expanding commuter service already operating on freight railroads will add to the operating burden of the control centers of freight railroads. Emphasis will be placed on reviewing human factor (fitness for duty) concerns such as fatigue and training, and recommendations will be made to improve the safety of the passengers and employees of mixed use railroads.

Human Factors: As a result of the 1995 New York City Transit accident on the Williamsburg Bridge, and based on a recommendation by the National Transportation Safety Board in February 1998, the Office of Safety and Security, in conjunction with the American Public Transit Association, sponsored a Fatigue Symposium. This symposium brought together fatigue experts from around the country as well as those in the transit industry who are responsible for fatigue awareness programs and training. One of the recommendations from this symposium was that a follow-on symposium be conducted in two years. This symposium is an outgrowth of the recommendations of the 1998 conference and will include a more extensive cross section of fatigue experts and others with a concern for fatigue and its effects on the transit industry.

FTA will host a workshop to discuss issues of signals/communications control centers for rail transit and commuter train control. Control centers around the country are being upgraded with the latest technology available and should, therefore, be manned with the best personnel available. This issue involves human factors and issues of alertness, challenge, and boredom in the control center. This workshop will bring together medical and scientific (human factors) specialists to present the latest thinking in this area and discuss the matter with industry personnel. A baseline for this will be the status of control centers of the Long Island Railroad, Amtrak at Penn Station, and New York City Transit and the outlook for the months and years ahead. This conference will assist in improving the level of operating reliability and safety in rail transit operations. The status of equipment, personnel, and housing for control centers is vital to the safety of any rail transit organization. These issues are on the cutting edge of rail transit safety.

3.1.1.3 Rail Vehicle Materials Safety

As a result of the February 16, 1996, MARC commuter train accident, NTSB recommended that DOT review the testing protocols within various modal administrations regarding the flammability and the smoke emissions characteristics of interior materials and coordinate the development and implementation of standards

for materials performance and testing with the FRA and FTA. There is a need to utilize the latest fire safety technology to validate uniform guidelines for fire performance of materials for use by government agencies. Use of these guidelines in selection of materials for vehicles will reduce fire incidents and their attendant costly property damage and casualties.

This activity will enable FTA to participate with various modal administrations within DOT in developing and implementing fire safety standards for performance and testing of interior materials for rail vehicles. It also supports the objective of the Interagency Fire and Materials Working Group of the Federal Government to produce uniform guidelines for fire performance of materials for consideration by government agencies. Fire safety testing of new composites with improved characteristics, a part of this effort, is important because new railcars and buses are likely to be designed and build using such materials. This testing will help determine how to use the latest fire safety technology in testing to improve fire safety standards for composite materials which comply with government regulations and standards and FTA fire safety guidelines.

3.1.2 Information Systems Security

Transit systems increasingly rely on electronic information systems to collect, transmit, and store information about all aspects of transit operation and management. Access to this information is important for effective management, operator efficiency, and customer service and convenience. The need to make this information accessible also creates a need to maintain information security. This project will focus on electronic fare payment systems and telecommunications.

Many transit systems are beginning to implement fare payment systems using recent advances in communications and information technology and central accounting. These systems increase efficiencies and financial accountability and handling for the transit operators. They also increase the traveler's convenience of using the transit service. Smart cards are now being operationally tested for use with multiple transit agencies. It is anticipated that additional use, such as retail sales, will soon be made available to the public. Cash handling tasks may be removed from the transit operators and given to banking institutions. Security measures to be considered to prevent abuse will include issues related to software tampering and mishandling of funds through the banking institutions.

Although many industry and government groups are dedicated to ensuring the technical performance of the next generation of telecommunications networks, there has been no cohesive effort for protecting infrastructure against the emerging threat of electronic attack. Future efforts will include a system of surveillance, assessment, early warning, and response mechanisms to mitigate these potential threats. Conceptually, a successful electronic attack warning and response system will include a means for near real-time monitoring of the telecommunications infrastructure; the ability to recognize, collect, and profile system anomalies associated with attacks, and the capability to trace, re-route, and isolate electronic signals that are determined to be associated with an attack.

3.1.3 Crime Prevention & Anti-Terrorism

The vulnerability of transit systems to domestic terrorism or criminal activity has been highlighted by recent domestic and international

events. Transit systems must continue to enhance their security systems, facilities, and vehicle designs to ensure the safety and security of the riding public. This involves creating and maintaining an environment that will not tolerate criminal activity. By designing the physical environment in a way that deters criminal behavior, transit agencies improve the quality of life on their systems by reducing both the fear and incidence of crime, including the vulnerability of the system to an act of terrorism. Through this program, FTA will demonstrate innovative security technologies, system design, and rail and bus vehicle security enhancements. This program area will benefit the riding public through technical demonstrations and evaluations that will lead to common practices which enhance the personal security of the riding public.

Consistent with the recommendations of the President's Commission on Critical Infrastructure Protection, the FTA will identify possible key terrorist targets in transit and evaluate the economic consequences of disruption to transit service in those markets. Core systems that may be vulnerable to terrorist acts will need to develop fail-safe interventions.

The FTA will explore other options to improve transit security. Specific actions will include accessing transit vulnerabilities, examining current transit systems, terrorism prevention programs, identifying technologies, developing procedures, and providing appropriate recommendations to enhance transit security. Of particular importance will be a risk assessment of the range of transportation services at airports served by rapid transit lines. The FTA will also develop a computer model for application in field operations that simulates the transit environment, including medical triage, contingency transit, emergency evacuation routes, and vulnerable locations points, which will aid security personnel in responding to catastrophic transit events.

Activities under this program include:

Development of an Advanced Multi-sensor System Which Incorporates Full data Fusion:

The goal of this program will be to tie together ten or fewer Urban Chemical Release Detector (UCRD) multi-sensor detector instruments that will be installed in a variety of locations within a subway station. The use of this system will result in a significant reduction in the false alarm rate without a concurrent degradation of high probability of detection. The proposed fully integrated system will use a flexible modular architecture so that other instruments and detector types can be included, such as meteorological, fire, smoke, and biological agents. The design focus will be on ease of system deployment in any location without introducing interference with the existing system infrastructure.

Detailed Validation of the Subway Environmental Simulation Chemical and Biological (SESCB) Numerical Modeling Code:

A fully validated code can be used to confidently predict the possibility of identifying and quantifying the threat created from the release of a variety of chemical and biological agents. Sensor instruments as described above can be used to validate the code predictions in a subway station during simulated chemical and biological releases. This effort will also employ the SESCB model to access and define consequence assessment and crisis management tools.

Incorporation of Additional Sensor Types to Improve the Performance of Both the Fully Integrated System and Modeling Codes:

Through the use of additional environmental sensor information, such as temperature, relative humidity, air pressure, and wind speed and direction, the fully integrated system, as well as the SESCB modeling code, will have the capability of providing improved performance. The detector system can provide improved results because the additional sensor data provided to the data fusion algorithms better describe the parameters that influence the operations of the detectors. In a similar manner, these additional data will help improve the accuracy and precision of the numerical modeling code by providing refined data on parameters which influence the kinematics of agent release and how vapors move and disperse with time.

Expansion of Background/Interferant Measurements:

The focus of this project will be to acquire and analyze background data using the UCRD system hardware in a variety of subway stations in wide ranging environmental conditions. The results of these tests will provide additional insight into the range of interferant types and concentrations that are present in the background gases and vapor in these unique facilities. The results will be used to improve interferant rejection in present and future chemical and biological agent detectors. The result of improved interferant rejection will be an overall improvement in false alarm rates and an enhanced reliance on chemical agent detectors in real-world use.

Security Survey:

Public Perception: Collection and analysis of data on safety and security concerns provides FTA with a basis for identifying key safety and security issues. The security survey will: (1) determine concerns of citizens regarding public transit in and around their neighborhoods and (2) assess and evaluate these concerns in conjunction with and relation to transit designs for livable communities. This information will be invaluable for more effectively meeting transportation needs of diverse communities throughout the nation.

Safety/No Tolerance Conference:

At transit agencies where the no tolerance has been in effect, the record indicates that crime is considerably lower than on those systems where minor infractions are tolerated. This conference would explore enforcement of a no tolerance policy to discourage minor infractions in public transit which impact the level of criminal activity in transit as well as the public perception of the security of the transit system. The comfort level of transit riders is increased with the awareness that a no tolerance policy for minor infractions is imposed and seriously enforced. Transit sites are visibly cleaner and safer for the traveling public. This invariably affects the goal of keeping transit a valuable and useful means of transporting people.

3.1.4 Bus Vehicle Safety

As well as the previously described safety benefits of the Intelligent Vehicle Initiative (IVI) program, the IVI program will also provide a unique opportunity to improve transit operations and efficiency. Precision docking systems will allow buses to be automatically ma-

neuvered into a loading zone or maintenance area, allowing easier access for passengers, or more efficient maintenance operations. Transit operating costs will also be reduced through decreased maintenance costs and less damage to the breaking and steering systems. Collision warning systems will help the bus driver and surrounding vehicle drivers more efficiently operate their vehicles. Human factors issues will be addressed to control the driver workload based on additional information processing requirements.

In 1997, the Department of Transportation began merging all vehicle-focused ITS activities into a multi-agency research and development program, entitled the Intelligent Vehicle Initiative. The IVI emphasizes the significant and continuing role of vehicle operators in highway safety. The IVI is aimed at accelerating the development, availability, and use of driving assistance and control intervention systems to reduce motor vehicle crashes. The IVI also will increase traffic efficiency and will be addressed in this Five-Year Plan in the Safety & Security Program area. By integrating driving assistance and motorist information functions, IVI systems will help drivers process information, make decisions, and operate vehicles more safely and effectively.

The Departmental IVI Program is organized around four specific vehicle types: cars, transit buses, commercial trucks, and special vehicles such as snow plows. FTA is lead coordinator for the development of the IVI transit bus. Recognizing that Transit IVI will need to address a variety of transportation environments and modal mixtures, this initiative will examine a range of transit configurations, ranging from purely mass transit IVI to the transit characteristics of an integrated intermodal system. Key areas of development in Transit IVI will consist of research and operational tests related to rear collision avoidance, lane change and merge collision avoidance, road departure warning, pedestrian/passenger sensing, precise docking, tight maneuvering, maintenance automation, and vehicle diagnostics.

Over the next five years, in the Transit IVI program, FTA will move forward from needs-assessment, to operational tests and evaluation, and on to product development with the industry. Initially, a needs assessment will be carried out to synthesize existing information and experience, and to identify and prioritize transit industry requirements and problems which lend themselves to solutions involving IVI technologies. This will form the basis for identifying the most critical IVI services, and how they can be integrated into packages for implementation within transit vehicles. Integrated system design, development and testing will then be carried out followed by product development. Throughout, the Transit IVI program will support the transit industry, and act as a catalyst for industry activities.

3.2 Equipment & Infrastructure

The Equipment and Infrastructure program area supports three FTA strategic goals: Mobility and Accessibility, Economic Growth and Trade and Human and Natural Environment. The program area activities are tailored to achieve the highest level of passenger service and comfort by applying technology to increase the capacity and quality of transit service. The performance goals, performance measures and related program activities for this program area are shown in Table 3.3 on the next page.

Performance Goals & Measures for Equipment & Infrastructure Activities

Performance Goals	Performance Measures	Performance Activities
Increase the percentage of bus facilities and rail infrastructure (track, power systems, stations, structures and maintenance facilities and yards) in good or excellent condition, as a means of improving operation and efficiency – base year is 1995.	The number of bus and rail facilities in good or excellent condition compared to all facilities.	■ Turnkey Deployments ■ Tunnel Design and Construction Assessment ■ Advanced Simulation Demonstration
Reduce bus and light rail dwell travel times by 20% by FY 2002 through deployment of new technology and other innovations - base year is FY 1995.	Reduction in dwell times for transit agencies deploying low-floor buses and light rail vehicles.	■ Advanced Technology Bus Deployments ■ Research in Lightweight Rail Vehicles
Reduce by one percent per year annual service interruptions per 100,000 vehicle hours – base year is 1996.	Rate of revenue service interruptions per 100,000 vehicle hours.	■ Bus Testing Program ■ BART Advanced Automated Train Control System Deployment ■ Advanced Simulation Demonstration
Safeguard the Federal investment in the nation's public transit systems through effective Federal oversight.	Increase construction savings due to value engineering on major capital projects.	■ Turnkey Deployments

Table 3.3 Performance Goals and Measures for Equipment and Infrastructure Activities: **Part 1**

Performance Goals & Measures for Equipment & Infrastructure Activities

Performance Goals	Performance Measures	Performance Activities
Increase FTA participation in private and public partnerships supporting the development, adaptation, deployment and testing of advanced technology vehicles and components.	Total number of joint partnerships projects selected.	■ BART Advanced Automated Train Control System Deployment ■ Joint Partnership Program Implementation
Increase the dollar volume of exports of domestically produced transit equipment and services.	Dollar volume of exports of domestically produced equipment and services.	■ CBTC Technical Assistance (New York and Philadelphia)
Increase ridership and revenue from joint development projects associated with New Starts.	Ridership and revenue generated from joint development projects.	■ Innovative Financing Technical Assistance ■ Deployment of Smart Growth Initiatives
Increase by 2% per year the deployment of energy efficient and low emission technology vehicles in the transit industry.	Number of alternative fueled vehicles in the fleet.	■ Fuel Cell Bus Deployment ■ Hybrid-Electric Bus Deployment ■ Clean Fuels Program Assistance

Table 3.3 Performance Goals and Measures for Equipment and Infrastructure Activities: **Part 2**

Major elements of this program area are:

- **Bus Equipment**
- **Rail Equipment and Systems**
- **Civil Infrastructure**
- **Advanced Simulation**
- **Innovative Financing**

The President's budget for FY 1999 proposes that $850 million be made available for FTA's major capital investment program and $3.6 billion for routine capital acquisitions such as new bus and rail equipment. Other Federal and non-Federal funds provide additional support for new bus and rail vehicles, facility modernization, and other capital items to renew the nation's transit infrastructure. In addition, there is well over $40 billion in major capital investments in the project development and implementation phases. The equipment and

infrastructure area seeks to introduce new reliable and cost-effective vehicle, system, and facility technology.

At present, buses powered by alternative fuels, such as compressed natural gas, propane, and methane, have been incorporated into transit fleets. The principal goals have been to lower emissions and reduce reliance on a single fuel source. Operation, maintenance, and repair of these vehicles require specialized training for the transit staff. The Research and Technology Program will assist in implementing the Clean Fuels Formula Grant Program, which was authorized in the Transportation Equity Act 1998 for the 21st Century.

Work will be initiated in construction technology, and FTA will continue to monitor, provide technical assistance, and document best practices in innovative finance and turnkey delivery methods. Specialized activities will focus on technological advancement in buses and component systems needed for the 2002 Winter Olympics in Salt Lake City; adaptations of radio-based communication systems; advancements in bus propulsion systems; advancements in bus testing; continuous dialogue with the bus and rail industry through workshops and peer panels on major site-specific projects; and deployment of proven cost-effective technology. The following sections describe activities in more detail.

3.2.1 Bus Equipment

The Bus Equipment Program addresses a number of research and technology needs related to the future design, safety, and operation of the next generation of transit buses and associated components. These needs have been identified in consultation with the transit community. Over the next five years, this program will work on advanced transit vehicle technologies including Advanced Technology Subsystems, a Small Durable Transit Bus, advancements in Bus Testing, and deployment of clean fuels.

3.2.1.1 Advanced Technology Buses

The transit bus remains the workhorse for transit agencies across the Nation. FTA will continue to apply advanced technology to improve the performance of this critical transit vehicle. Advanced technology propulsion systems offer significant benefits not only in terms of emissions reductions, but also savings in operating and maintenance costs. Advanced lightweight materials help to lower the overall vehicle weight for improvements in system efficiency. FTA's focus is to apply those technology developments that are also underway for other vehicle markets to ensure commercial viability in transit given transit's limited market volume. As critical components of the transit bus change from the introduction of new technologies, a systems approach to the total vehicle design is necessary to ensure the smooth and efficient integration of all sub-systems and components.

3.2.1.1.1 Advanced Technology Transit Bus

The research, development and testing phases of the Advanced Technology Transit Bus (see Figure 3.2) project, which started in 1992, are near completion. Six prototypes were produced by Northrop Grumman Corporation under contract to the Los Angeles County Metropolitan Transportation Authority. Under this Five-Year Plan, emphasis will be placed on documenting the test results and providing technical assistance in the use of

Figure 3.2 Advanced Technology Transit Bus

the ATTB technical data sets in deploying the ATTB or ATTB subsystem technologies. In addition, FTA will initiate other technology deployments using the ATTB platform. For example, under the Houston Metro Element of the ATTB program, one of the ATTB prototypes may be modified with a set of new wheel motors, electro-mechanical suspension system, and integration of a flywheel energy storage system. The ATTB may also serve as a test platform for an advanced fuel cell propulsion system.

3.2.1.1.2 Small Durable Bus

Numerous factors are causing communities and transit agencies to consider small durable buses as an alternative to 40-foot standard heavy-duty buses. Most small buses on the market are designed for light-duty use and have a useful life of only four to seven years which is considerably shorter than the current 12-year expected life of heavy duty 40-foot buses. Transit agency mechanics and supervisors continue to raise concerns about maintenance problems associated with smaller buses built with a truck chassis.

Central city neighborhoods, low-density suburban areas and rural communities fail, in many instances, to produce sufficient demand for 40-foot standard buses. Communities across America are implementing traffic circles, humps, and narrowing of local arterial streets as traffic calming devices. These devices, while reducing auto and truck speeds, also create maneuverability problems for 40-foot buses. The demand for more express bus service operating on freeways will require more rapid accelerating buses. A small heavy-duty, durable bus will address these needs. Small buses (30 feet or less) can be more maneuverable, lighter, and

blend better into the community landscape. The Federal Transit Administration is working with the National Highway Traffic and Safety Administration and the Department of Health and Human Services to issue guidelines on a durable multi-purpose Community Transit Vehicle (CTV). The CTV will address the needs of parents who wish to ride with their children on Head Start vehicles.

Under this program, FTA will continue to work with and build upon the Defense Advance Research Projects Agency's (DARPA) effort and the ATTB platform to develop, test, and deploy a small, light-weight, heavy-duty advanced technology bus through a partnership with a transit agency. This bus will be designed for durability and an expected life of ten years or more. It will also be low-floor, more maneuverable than a 40-foot bus, rapid accelerating, and employ a variety of propulsion systems and clean fuels. The development of these buses will be accomplished through a consortium of one or more local transit agencies with cooperation from bus manufacturers and suppliers. The consortium will lead the development of common performance requirements, which will be developed into procurement specifications and technical standards.

Many of the transit agencies that need this type of equipment have a need for so few buses that they cannot benefit from the cost reductions created by large purchases. Common procurement specifications are a first step towards addressing this issue. A second, but more difficult step, will be for members of the consortium on a regional or state basis to consolidate their purchases into a single bid. This will allow manufacturers to write off the developmental costs over a larger known market. FTA will provide technical advice and financial support addressing both of these issues and, if needed, will fund special costs associated with forming and procuring vehicles through a consortium arrangement.

3.2.1.1.3 Fuel Cell Transit Bus

The transit industry is faced with meeting stringent bus emission standards that are increasingly more difficult to meet with diesel technology. Fuel cells offer near zero emissions and significant reductions in greenhouse gas emissions, as well as potentially more efficient power generation, improved reliability, and lower maintenance costs. The Fuel Cell Transit Bus Program is developing one of the leading candidates for fuel cell applications and is critical to the nation's economic competitiveness in this emerging technology area.

The Fuel Cell Transit Bus Program builds upon the joint FTA/USDOE test bed fuel cell bus program. Three 30-foot test bed fuel cell buses were completed under that program. Emission testing confirmed that a methanol-fueled test bed fuel cell bus produces nearly non-measurable nitrogen oxide (NOx), no particulate matter (PM), low levels of hydrocarbons (HC), and acceptable levels of carbon monoxide (CO). In a congressionally mandated program with Georgetown University, two types of fuel cell technologies are currently being evaluated as the propulsion system for transit buses: phosphoric acid fuel cell (PAFC) and proton-exchange-membrane-fuel cell (PEMFC). Under this program, one PAFC 40-foot transit bus and one PEMFC 40-foot transit bus will be assembled and evaluated. It is expected that emissions testing will measure emissions from the 40-foot transit bus at levels that are similar to the results from testing the 30-foot transit bus. Significant reductions are expected in CO emissions.

Based on the tests performed on the PAFC and PEMFC 40-foot buses, an assessment will be made of whether sufficient data is available for the selection of fuel cell technologies for transit bus applications related to operations and maintenance. Factors to be considered include availability of fuel cell suppliers, durability of the fuel cell system under transit duty cycle, compatibility with transit operating and maintenance practices, potential life cycle costs, and choice of fuel cell technology in other heavy-duty transportation applications. The selected fuel cell technology or technologies will be demonstrated in additional transit buses in partnership with interested transit agencies. More than one U.S. fuel cell supplier will be selected to ensure commercial competition. A range of vehicle configurations and transit bus platforms (including the ATTB) will be evaluated, from fuel cell hybrids to pure fuel cells, as well as a range of fueling options from on-board hydrogen to reformed methanol. Safety issues associated with fuel cells and the range of fuels that may be used will be evaluated from both a vehicle and infrastructure perspective. These activities will complete the FTA fuel cell program as envisioned.

As the testing, demonstration, and evaluation of fuel cell transit buses begins at various transit agencies and national parks, a Joint Partnership Program effort will be initiated as a development for a next generation advanced fuel cell propulsion system for transit buses. Advances in increased energy density, fuel cell system efficiency, improved transient-load following, quick start-up operation, ease of maintenance and durability, and other improvements will be developed. Fuel cell technology under development for other transportation applications will be evaluated for adaptation to transit bus applications.

The program will monitor the technical progress and safety use of on-board hydrogen-fueled fuel cell transit buses at the Chicago Transit Authority (CTA) and at British Columbia (BC) Transit in Vancouver, BC. The technical progress of ongoing research and development efforts into direct-methanol fuel cells and fuel cells using reformed diesel and gasoline fuel will also be monitored for performance and safety. Developments in advanced solid-oxide fuel cells as well as molten carbonate fuel cell technologies will also be evaluated for transit bus applications.

3.2.1.2 Hybrid-Electric & Electric Vehicle Technology

Hybrid-electric and electric vehicles provide another opportunity for the transportation industry to reduce vehicle emissions. Electric drive systems enable transit buses to exceed current and anticipated emissions standards. Their low emissions characteristics may enable transit buses to operate in areas that are off-limits to diesel buses. Hybrid electric transit buses offer significant emissions reductions without costly infrastructure changes and offer significant improvements in fuel efficiency, lowering transit operating costs. Preliminary tests have shown a 50 percent reduction in emissions and a 25-30 percent improvement in fuel efficiency. Figure 3.3 shows a hybrid-electric vehicle in service in Chattanooga, TN and a zero emission electric bus demonstrated in Washington, DC.

Figure 3.3 Fuel Cell and Electric Transit Buses

3.2.1.2.1 Energy Storage

The objectives of this program are to foster the development and deployment of electric drive propulsion systems that can be used in a wide range of transit applications to improve air quality, reduce greenhouse gas emissions, reduce the transportation sector's consumption of petroleum, reduce transit operating and maintenance costs, and encourage the creation of new jobs through the continued development of an emerging electric vehicle industry. FTA will document the safety, cost-effectiveness, and environmental benefits of using electric drive propulsion systems.

Key components and subsystems for electric drive propulsion systems will continue to be developed and refined. One critical subsystem is a compact, lightweight energy storage system. Significant improvements in current hybrid-electric bus operating performance and efficiency will be possible with an affordable, small, and lightweight energy storage system to replace battery packs currently in use. Efforts will continue in the development and testing of flywheel technology. New efforts will be initiated to support the development of ultra-capacitors and spiral-wound thin-film advanced batteries as possible energy storage systems for hybrid-electric transit bus applications.

3.2.1.2.2 Demonstration of Universal Electric Transportation Subsystems

This program will complete the Demonstration of Universal Electric Transportation Subsystems (DUETS) program (see Figure 3.4) that has been developed using DARPA funding under FTA management. Efforts will continue to provide technical assistance in advanced transit technology alternatives to the National Park Service in support of the joint memorandum of understanding between USDOT and the U.S. Department of the Interior (USDOI). With the transition of the DARPA Electric and Hybrid-Electric Vehicle Program to an intermodal Advanced Vehicle Program within USDOT, an active role will be undertaken in defining technology focus areas, reviewing and approving project proposals, and managing and monitoring projects selected for funding.

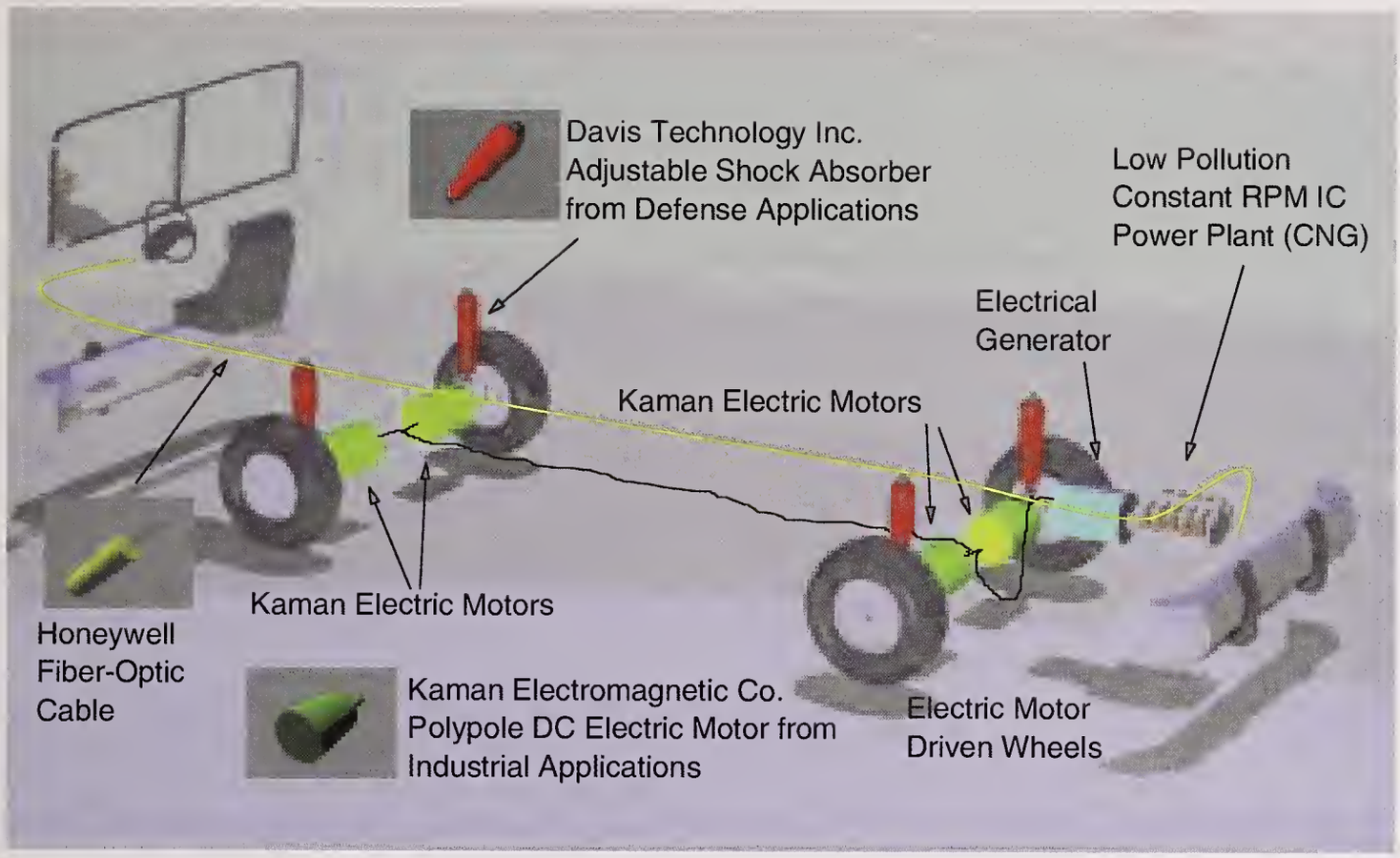


Figure 3.4 Demonstration of Universal Electric Transportation Sub-Systems (DUETS) Equipment

FTA is currently testing, demonstrating, and evaluating zinc air batteries for transit bus applications. Many organizations and institutions are conducting research into advanced battery technologies appropriate for Electric Vehicles. FTA will consider the use of these advanced battery technologies for use in transit applications. Prototype development, testing, demonstration, and evaluation of advanced batteries in transit vehicles will be conducted.

Generally in pursuing the advancement of alternative fueled vehicles, the FTA research and technology program is benefited by the new Clean Fuels Formula Grant Program, Section 3008 of TEA-21. Based on this provision, a substantial amount of funding will be set aside every year for the purchase of clean fuel buses including Fuel Cell, Electric and Hybrid-Electric Buses as dictated by the needs of locales. Most of the purchases will probably be CNG and other types of alternative fuel buses. For non-attainment areas, electrical based vehicles will be their choice. FTA is expecting that the above-described research and demonstration tasks, Sections 3.2.1.3 and 3.2.1.2 will be closely coordinated with the formula program to achieve customer-oriented results.

3.2.1.2.3 Advanced Battery Technology

Battery powered buses offer zero emissions, and have been successfully used in transit applications in Santa Barbara and Chattanooga. The use of electric buses in these two cities has generated community benefits that far sur-

pass the emissions reductions realized. The Chattanooga electric shuttle has been a critical factor in the revitalization of the downtown area, and to the change in the community attitude toward transit. Similarly, in Santa Barbara, the electric buses are viewed as a means to accommodating smart growth and development. FTA's focus is not on the development of basic battery chemistry as there are a number of efforts in both the government and private sectors. FTA's focus is on the application of battery technology to transit bus operations and providing guidance to transit agencies on their successful operations and maintenance. Given the constraints of current battery technology, battery powered buses have limited applications. FTA will evaluate means to extend their applicability through rapid recharging.

3.2.1.3 Bus Testing

Bus Testing was first required by the Surface Transportation and Uniform Relocation Assistance Act (STURAA) of 1987. The 1998 Transportation Equity Act for the 21st Century reauthorized the New Model Bus Testing Program. Congress, through the ISTEA legislation of 1991, expanded this testing mandate and the vehicle categories covered. Testing is required on all new model buses before they can be purchased with Federal funds. Testing of the first 96 new bus models identified 27 failures that had the potential for serious accidents. The Testing Program provides bus manufacturers and transit agencies invaluable information that is used to improve the quality and safety of transit buses. It saves operators and taxpayers millions of dollars in operating and maintenance costs over the life of each bus model.

The testing program is administered by the Vehicle Systems and Safety Program staff at the Altoona Bus Research and Testing Center in Altoona, Pennsylvania, and at the Pennsylvania Transportation Institute (PTI) in State College, Pennsylvania. The facility currently handles up to eight buses at one time. Since its start in 1990, the Bus Testing Program has completed testing 115 different new model buses. Currently, the Center tests buses for safety, structural integrity, durability, performance, maintainability, noise, and fuel economy. Test results are compiled into a comprehensive report available to the industry and the public. Testing to date has resulted in more than 4,100 reported malfunctions ranging from minor problems to serious design deficiencies and safety-related failures. By identifying serious design problems before the buses are placed in revenue service, many costly fleet failures and serious safety problems have been averted. Braking and emissions testing will soon be added to the testing program. Studies will be performed to determine the benefits of using computer simulations as a supplement to the testing program.

Efforts will be made to upgrade the capabilities of the Testing Center. The PTI is acquiring from the Federal Highway Administration a heavy vehicle shaker, known as DYNTRAC, which will be installed at the New Model Bus Testing facility in Altoona, PA. The PTI staff is undertaking a review of how best to use and integrate the DYNTRAC in its bus testing efforts and the role it will play in the Bus Testing Program. Simulation systems will be considered for assisting manufacturers and transit agencies in designing and pre-testing new bus models before they are actually built.

In consultation with the industry, FTA will prepare a Final Rule regulation with regard to the Bus Testing Program. This regulation will also include the requirements for testing buses with

hybrid-electric, fuel cell, and battery-powered propulsion systems and with other advanced electronics. The modifications that are needed in both facilities and procedures to conduct the testing of advanced technology buses will be determined and implemented.

3.2.2 Rail Equipment & Systems

Improving rail transit capacity by building new infrastructure is prohibitively expensive. Standard approaches include extending tracks and enlarging station platforms to accommodate longer trains. An affordable solution requires better use of the existing infrastructure to the best possible degree, consistent with safety and reliability. Rail rapid transit agencies are facing the problem of improving passenger-carrying capacity of their systems at affordable cost and without expensive additions to existing infrastructure. Concurrently, significant improvements in overcoming train control operational problems and safety are warranted. Major elements of the Rail Equipment and Systems program include demonstration of Communication-Based Train Control (CBTC) systems and examining the future of lightweight rail vehicles. Furthermore, some investigations will also be conducted on specialty guided technologies such as urban maglev and suspended monorail systems.

3.2.2.1 Communication-Based Train Control Systems

Communication-Based Train Control systems employ modern computing systems, communications, and control technologies to overcome the limitations placed by fixed block train control technology that safeguards train operations but limits train throughput. These systems may pave the way for eventual introduction of total automation of train operations. CBTC benefits transit users in a number of ways. It allows for more trains to be run on the existing system; increased safety and flexibility in operations to facilitate fast recovery from unforeseen circumstances; faster trips; greater reliability; and better and more timely availability of information. CBTC systems reduce the need for major investments in infrastructure. The Bay Area Rapid Transit District (BART) is considering using CBTC as an alternative to investing $3 billion for a new Transbay Tube to accommodate future system expansion. Other advantages of CBTC include requiring fewer vehicles to meet the same demand for service and energy efficiency, smart grade-crossing protection, and the ability to coordinate with intelligent road systems.

Over the next five years, FTA will demonstrate this technology at two or more locations. FTA will continue to work with BART in the testing of the advanced automated train control system, which is partially funded by DARPA. Other candidate testing sites are New York City, NY and Philadelphia, PA. Capabilities to be demonstrated and tested include positioning, command and control features. Once CBTC is more widely deployed, FTA will cooperate with industry partners to establish national CBTC standards. This program also includes dissemination of CBTC information, assistance to transit agencies to deploy the appropriate technology through ongoing capital programs, and development of training courses and other training media.

3.2.2.2 Lightweight Rail Transit Vehicles

Railcar purchase, operation, and maintenance costs continue to rise. This affects the ability of transit systems to add or improve services. Furthermore, urban rail systems as a whole deteriorate from wear and tear resulting from regular use. One important element is that systems with steel-wheels on steel-rails provide constant impact on total structures. This is a major problem in areas with large amounts of rail trackage that provide service over an enormous area such as New York/New Jersey. Development of a lightweight railcar can address both the individual railcar cost problem and its impact on the infrastructure. Experimental light rail cars based on composite materials have been recently produced for Sheffield ,UK for verification of benefit in revenue service.

Lightweight composite materials have been in use in aerospace applications for years and are used in the body of the ATTB. These materials provide greater strength and greater life without corrosion, and significantly reduce wear on wheels and the running rail. Composites are also used to build car trucks for similar benefits. This activity may have considerable advantages for the U.S. as it is the world leader in the composite materials industry. FTA will initiate studies to investigate the advances in lightweight materials, propulsion and electronics, and manufacturing techniques to advance railcar technology while improving reliability, availability, and maintainability.

3.2.2.3 Specialty Guided Technologies

FTA has historically supported research, development, and deployment of new advanced and specialty fixed guideway systems. Under this Five-Year Plan, FTA will identify new technologies that may support future guided transit systems. Magnetically levitated, linear-induction motor-powered vehicles, which use recently developed superconductive coils, have been tested for high-speed intercity rail service. This type of system requires expensive investments in control systems and infrastructure in order to maintain stable and safe operation at very high speeds. However, the levitation technology may very well have applications for low speed urban systems where precision requirements are not stringent as in the high-speed application. Furthermore, low speed maglev technologies can result in driverless shuttle systems for major urban activity centers.

Another promising use of technology is the application of newly developed lightweight materials for structure columns and viaducts in a conventional transit system. Structure materials using epoxy mixtures have been successfully tested by FHWA in bridge designs. This may allow for significant cost savings versus tunneling or viaduct-type construction for the basic guideway. FTA is investigating the monobeam concept that has an existing quarter-scaled operative model and is being considered for a full system design.

3.2.3 Civil Infrastructure

Hundreds of millions of dollars are spent annually on construction and rehabilitation of the nation's heavy rail, light rail, commuter rail, automated guideway, and dedicated busway systems. The costs to build and expand these systems continue to rise, with a

major cost component being civil infrastructure. This infrastructure has many components including tunnels, stations, and bridges. This research will focus on reducing the life-cycle costs for these systems, including design, construction, operations, and maintenance costs. Research under this program will address the planning, design, and construction of components of fixed-guideway systems, including tunnels and stations. Minimizing operating and maintenance costs through better planning, design, and construction will also be part of this research, as will reducing the overall cost of building these systems.

One method that may be investigated under research into each component is the use of "virtual engineering" as applied to civil infrastructure systems and components. Application of computer-simulated integrated design and testing may result in better-designed projects at lower costs. Advanced technologies promise to reduce the inconsistencies and flaws in project designs that are often not caught using traditional design tools. Other subjects of research will include major civil engineering actual working topics such as Turnkey Project Delivery, Tunnel Design and Construction, and Transit Station Design. These are supportive of the broader National Science and Technology Center (NSTC) partnership work on Monitoring, Maintenance and Rapid Renewal of the Physical Infrastructure.

3.2.3.1 Turnkey Project Delivery

Change orders are a significant factor in cost overruns of transit projects. Better design and estimating techniques, improved understanding of the geologic impacts of tunneling, greater attention to risk management, and better methods for scheduling project construction can reduce the need for these changes. Lack of understanding about changes that may occur has historically been a basis for low-bidding a project. The low bidder attempts to recover actual costs through change orders. Creating incentives that reduce the financial advantage of change orders, while maintaining the integrity of the project, will reduce cost overruns. FTA is already researching and demonstrating the usefulness of one method, turnkey project delivery. Partnering agreements and fast track scheduling are other methods being tested by transit agencies. FTA will document best practices among these other project delivery innovations as well as turnkey. Further research will identify other ways to reduce the need for change orders and resulting cost and schedule overruns.

Section 3019 of ISTEA established the FTA Turnkey Demonstration Program, which was modified by Section 3023(a) of TEA-21. FTA was authorized to select two or more transit projects that would participate in the Turnkey Demonstration Program. The projects selected are: Baltimore Central Light Rail Extensions, Los Angeles Union Station Gateway, San Francisco Bay Area Rapid Transit Airport Extension, New Jersey Hudson-Bergen Light Rail, and San Juan, Puerto Rico Tren Urbano. The Baltimore and Los Angeles projects were completed on time and within budget. The Baltimore project's contingency fund was still intact when service was inaugurated in September 1996. Turnkey is a promising project delivery system to help expedite schedules, control costs, and better allocate and manage implementation risks and the introduction of new technology for major fixed-guideway systems. Other potential benefits of turnkey deployment are more effective cash flow management, project control, partnering of small-, medium-, and large-sized firms, attraction of new sources of funding, and

fostering use of innovative technology. There are many variations on how turnkey project delivery can occur. Some of the most common methods include the following:

Design/Build is where a public agency owner contracts with a private entity for delivery of a complete and operational project. The contractor, or developer, is given overall responsibility for project implementation, including design and construction. After certification of project completion, the developer "turns the keys" over to the agency staff, as an indication that the project is ready for immediate use.

Design-Build-Operate-Maintain (DBOM) is where a private entity is given authority to design, build, operate and maintain a facility for a period of time, after which responsibility reverts over to the public owner.

Design-Build-Transfer-Operate (DBTO) is a variation of DBOM described above, which allows private entities to reduce their liability exposure. After design, financing, and construction, ownership is transferred to a public agency and the contractor is allowed to exclusively operate the project over a pre-set time period.

Super Turnkey is where, in addition to the provisions of turnkey projects mentioned previously, the private entity receives real estate development rights along the project right-of-way, at station areas, and potentially at off-corridor locations. In exchange for these rights, the super turnkey contractor is expected to provide partial project funding, thus reducing the need for public investment.

There is a wide range of options being tested under the Turnkey Demonstration program, as shown in Figure 3.5. These options will help the transit industry adapt the fundamental principles of turnkey implementation to the unique circumstances of individual agencies and projects.

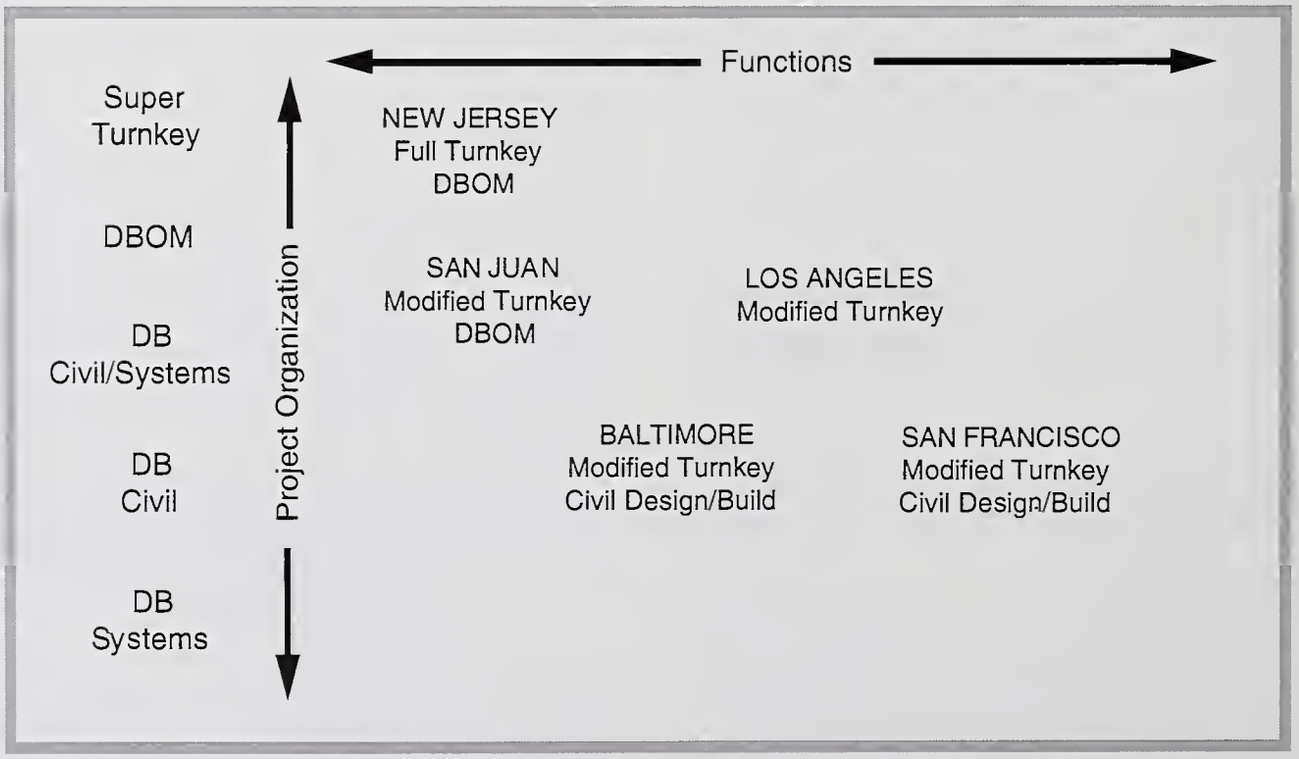


Figure 3.5 Turnkey Continuum

FTA prepared a report to Congress on the progress of the turnkey demonstration program and as required will develop guidelines on the use of the turnkey method as part of the Major Investment project development process. Other specific future activities will involve monitoring, reviewing, and reporting on the selected demonstration projects in all phases. This includes procurement, finance, value engineering, project management, systems acquisition, construction system testing, operations, and maintenance. In addition, the turnkey demonstration projects will be compared to projects delivered on a conventional basis, and technical assistance and training will be provided to transit agencies that are implementing projects with the turnkey approach. The lessons learned from this effort will be made available to Congress, design and construction firms, transit agencies considering the turnkey approach, universities, and other interested parties.

3.2.3.2 Tunnel Design & Construction

Tunneling for transit projects is as much an art as a science. Variables affecting the design and construction of a project include predicting the behavior of ground mass during construction and the vagaries of ground-water hydrology. Predictive models are only of some use because no two projects are the same. The process of tunnel design and construction involves evaluation of geologic conditions, identifying and acquiring the appropriate tunnel boring equipment, ground modification techniques, environmental impact mitigation, utility and traffic protection, contractor selection and payment, and risk management. Research is needed in all of these areas.

Many innovations have been made in tunnel technology. This information needs to be collected and reviewed to identify the range of options available to minimize the problems an initiator of a subway project may face. Lessons have been learned from projects completed in the U.S. and in other countries that should help identify ways to achieve greater efficiency in the design and construction of subway tunnels. The strong and weak aspects of tunneling methods, such as two-pass, single-pass, and the New Austrian Tunneling Method (NATM), must be identified as they relate to geological conditions, scheduling, budgeting, and functional constraints.

FTA research will analyze and catalogue lessons learned and make this information available to the transportation industry in a usable format. This is a starting point for devising better design and construction processes and for developing effective risk mitigation techniques. Other research topics to be considered include assessment of tunnel infrastructure conditions and evaluation of non-destructive testing methods. Advances in thermal scanning, high resolution ultrasonic, scanning, and radar detection may have the potential to address this problem.

3.2.3.3 Transit Station Design

Subway stations have a variety of components including platforms, air and elevator shafts, escalator wellways, normal and emergency egresses, structures and enclosures for electrical and mechanical equipment. Each component can require different construction methods and different configurations. Understanding how these components fit together is a critical point for identifying the construction sequence, and the budget and schedule. These factors will be studied in the FTA's research effort from establishing documentation of best practice,

feasibility study for advanced computerized design methods and knowledge transfer for complex station designs from locale to locale.

Impact on neighboring communities must be considered when determining the most efficient and cost-effective way to build a station. Limited space for storing materials combined with the need to reduce impact as much as possible on the adjacent community may increase costs, but may be necessary for the community to accept the project. The design of effective, attractive, and efficient transit stations is made more complex when the facility serves multiple modes. Designing multimodal and community sensitive facilities is a complex undertaking requiring cooperation from different organizations and individuals from different fields with different capabilities. Research will develop better functional architectural and transportation design guidance to aid in site planning and design of multimodal facilities.

Safety is an important consideration in the design of transit stations. Research will be conducted on designs which provide for quick and safe evacuation of passengers from a station in an emergency. Concern that existing transit stations are vulnerable to terrorist attacks using biological or toxic agents is discussed in Section 3.1, Safety and Security. New transit station design research will also address this issue. FTA research will utilize the results from the Total Terminal Security research partnership promoted by NSTC.

3.2.4 Advanced Simulation

Virtual Reality (VR) simulation is a proven and potent tool for planning, designing, training, and testing. For example, the Navy has used this tool for submarine design and transit agencies are deploying these systems in the analysis and design of transit corridors. It has been used to improve products and ensure that they meet customer needs. This technology can reduce the time needed to design, evaluate, and test a product. It can also help in training people to use the finished product.

Railcar costs have escalated significantly and time cycles of specification, design, manufacturing, and placement in service have grown, making it difficult to react to customer demand for greater service at reasonable cost and within reasonable time frames. Railcar development will be enhanced by allowing partners, including transit users, railcar builders, subsystem suppliers, and consultants, to participate at each step of the design process. An on-line network, coupled with VR, offers this opportunity. This technology can also help move design to manufacturing. Drawings can be produced by Computer-Aided-Design packages if systems are made compatible. This should reduce the amount of time between designing and manufacturing products.

Reliability of complex systems depends heavily on tools such as health-monitoring systems, self-diagnostic systems and expert systems, and equally, if not more, upon the quality of the work force. VR systems make enhancement of quality possible by making real life training possible without real life incidents. The program envisages demonstration of new VR technologies for simulation and design at two or more rail car suppliers, demonstration of use of VR for emergency management and associated training of operators, and development of training courses and other training media to understand VR issues.

3.2.4.1 Design

Design is the process of giving physical shape to conceptual expressions. The large engineering idea is broken into details so that it

can be integrated into the finished product. In design, the materials are determined, shaped, fitted and a system is put into enclosure. Modern design emphasizes products which are efficient and error free during manufacture and which require as little maintenance as possible once in service.

One of the cost drives and also an obstacle to timely final products is the design process that is largely human based. Computer integrated design creates the manufactured products in the three-dimensional world of virtual reality. If an object resembles a similar object from an earlier product, that earlier object and its specifications can be used and modified for the current application, although the current designer had no prior knowledge of the predecessor. Materials can be changed and manufacturing processes specified automatically based on historic databases covering the properties and specifications of tens of thousands of more or less similar objects and components. With computer integrated design, products are designed and developed much faster and more perfectly than was thought possible just twenty years ago. The FTA research program encourages the advancement in integration of designs and simulations.

3.2.4.2 Testing

The conventional product development process follows design with development of a prototype and redesign leading up to product testing. Prototype development and testing are expensive. With advanced virtual engineering, the prototype is an electronic virtual image, complete with the properties and characteristics implicit in the yet un-built actual product. This virtual product can be placed into a simulated duty cycle and tested under real world conditions that are expected to be experienced. Using computer simulated testing, an entire new rapid transit product can be tested, including all aspects of its operation prior to actually producing any prototype.

Product development and testing costs are the major items prohibiting manufacturers from venturing into innovations today. Simulated testing requires only a small fraction of the post-manufacturing and construction modification and adjustments of conventionally designed and tested products. It is notable that in areas such as vehicle safety and occupant protection, virtual simulated testing has made it possible to crash test thousands of simulated vehicles and crash conditions unhampered by the cost of damaging a full cost fully manufactured model. The benefits in improved product safety are beyond the scale of pre-simulation testing. FTA research programs will investigate the scope of simulated testing that can be beneficial to transit product and service improvements.

3.2.4.3 Training

In most occupations, developing skill and judgment comes with experience. Sometimes the same event followed by the same response elicits very different results. With practice, the differences in apparently similar events can be distinguished, as can the almost imperceptibly different responses. Where training events, responses or outcomes can be fatal or dangerous, the tendency is to minimize the training exposure but this comes at the risk of ill preparedness or high risk.

In training situations not involving health and safety, but including operational performance, training costs can be substantially reduced and the exposure to training increased with the use of training simulations and simulators. Simulators are generally expansive to purchase. FTA plans to explore the feasibility of

regional joint-use of simulators for a number of operating agencies.

3.2.5 Innovative Financing

Innovative financing is an effort to apply newly emerging or established financing techniques from other sectors of the economy to transit. Reducing the cost of capital, or accessing new sources of capital reduces the costs of transit infrastructure and thus reduces the overall costs of providing transit service and improving the level of transit service provided for each dollar invested. FTA will provide technical assistance and document results of innovative financing pilot projects and produce best practice manuals, evaluation reports, workshops, and conferences. The subject of studies will include:

Transit Finance Corporation–which is a centralized entity that purchases rolling stock in quantity and provides the vehicles to multiple transit providers;

Lease/Leaseback Transactions–where an investor leases rolling stock or a facility from the owner then leases them back to the transit agency, potentially accruing certain tax advantages;

Joint Development–to explore the easing of obstacles to partnerships between transit systems and private developers and helping to establish benefit assessment districts, tax increment financing districts, and similar mechanisms;

State Infrastructure Banks–that receive grant funds from the Federal highway and transit programs and use the money to make loans and credit enhancements in support of highway and transit projects. Demonstration projects will be documented and training will be offered.

Other areas for research include categorizing interest expense and preventive maintenance as capital costs, which could allow for more transit grant funding, and promotion of cross-border leases.

Innovative financing methods present new risks and new opportunities for transit systems and private-sector firms wishing to forge new partnerships for infrastructure investment. FTA studies will provide a central information bank for such practice. In addition, the *Transportation Infrastructure Finance and Innovation Act* (TIFIA) under TEA-21 provides an opportunity to demonstrate a number of innovative public-private financing methods.

The Transportation Infrastructure Finance and Innovation Act established a new program under which the USDOT is authorized to provide Federal credit assistance (secured loans, loan guarantees, and lines of credit) to large-scale surface transportation projects of regional or national significance. The goal of TIFIA is to leverage Federal funds with private capital through the provision of targeted credit assistance to revenue-generating projects.

3.3 Fleet Operations

The Fleet Operations Program area supports two FTA strategic goals–Mobility and Accessibility and Economic Growth and Trade. Fleet operations research and technology advances America's economic growth and competitiveness domestically and internationally through efficient and flexible transportation. The performance goals, performance measures and related program activities are shown in Table 3.4.

Performance Goals & Measures for Fleet Operations Activities

Performance Goals	Performance Measures	Performance Activities
Increase the percentage of bus facilities and rail infrastructure (track, power systems, stations, structures and maintenance facilities and yards) in good or excellent condition, as a means of improving operation and efficiency – base year is 1995.	The number of bus and rail facilities in good or excellent condition compared to all facilities.	■ Transit Capacity and Quality of Service Deployment ■ Bus Rapid Transit Demonstrations ■ Deployment of Transit ITS
Increase the number of deployed Intelligent Transportation Systems (ITS) – base year is FY 1995.	The number of inter-modal ITS projects that relate to connectivity.	■ Mixed Rail Corridor Operations ■ Deployment of Transit ITS ■ Transit Capacity and Quality of Service Deployment
Reduce bus and light rail dwell times by 20% by FY 2002 through deployment of new technology and other innovations – base year is FY 1995.	Reduction in dwell times for transit agencies deploying low-floor buses and light rail vehicles, pre-paid fare collection methods, or contactless fare payment systems.	■ Bus Rapid Transit Demonstrations ■ Update Highway Capacity Manual ■ Transit Capacity and Quality of Service Manual ■ Integrated Electronic Fare Payment
Reduce door- to- door travel times within highly congested corridors where FTA investments have been made.	Measure percent of riders with reduced times of 20% or more with Bus Rapid Transit (BRT) service.	■ Bus Rapid Transit Demonstrations ■ Autonomous Dial-A-Ride Rapid Transit Demonstration
Reduce by one percent per year annual service interruptions per 100,000 vehicle hours – base year is 1996.	Rate of revenue service interruptions per 100,000 vehicle hours.	■ Bus Rapid Transit Demonstration ■ Autonomous Dial-A-Ride Rapid Transit
Reduce the number of transit-related pollutants released into the air per revenue vehicle mile.	Amount of pollutants released into the air per vehicle revenue mile.	■ Transit Capacity & Quality of Service ■ Transit Intelligent Transportation Systems ■ Bus Rapid Transit Initiative

Table 3.4 Performance Goals and Measures for Fleet Operations Activities

Major elements of this program area are:

- **Transit Capacity & Quality of Service**
- **Transit Intelligent Transportation Systems**
- **Bus Rapid Transit Initiative**
- **Mixed Rail Corridor Operations**

FTA will target the urban, suburban, and rural travel markets with the aim of introducing technological and other innovations to increase the quality and capacity of all transit modes operating both in mixed traffic and on exclusive rights-of-way. This program area will enhance knowledge of the factors which affect the flow of transit, pedestrian, and other vehicular traffic flow and customer service quality. It will focus on relatively low-cost operational and management solutions, especially when compared to the cost of constructing new infrastructure capacity increases. A key area will include tests, deployment, and promotion of advancements in communication and information technologies.

Customers, operators, and the community at large benefit from improvements in transit fleet operations. Fast and reliable transit vehicles improve the quality of service to transit passengers, and enhance the image of transit compared to other travel modes. In addition, fleet requirements are reduced, resulting in lower capital and operation and maintenance costs. The environmental and travel efficiencies of public transit, in terms of reducing pollution, energy consumption, and vehicle-miles traveled, are well established. Benefits will accrue to the overall transportation system by reducing congestion and accommodating travel growth without the capital investment of major new infrastructure projects. Transit quality improvements, coupled with the efforts to enhance the reality and perception of system safety and security, will lead to transit systems attracting additional ridership.

The Fleet Operations research and technology program will also support FTA's efforts in special events including the 2002 Winter Olympics in Salt Lake City and efforts of the U.S. Department of the Interior and National Park Service (NPS) to reduce auto travel in the parks. Projects under this program will occur in the following areas: Transit Capacity and Quality of Service Measurement, Transit Intelligent Transportation Systems (ITS), Bus Rapid Transit, and Mixed-Rail Corridor Operations.

3.3.1 Transit Capacity & Quality of Service

The industry consultation found that the transit profession needs to develop a consolidated and generally accepted set of transit capacity and quality of service definitions, principles, practices, and procedures for planning, designing, and operating transit vehicles and facilities. This transit situation is in contrast to that of the universally accepted guidance of the Highway Capacity Manual. A significant amount of empirical data gathering and analysis is needed to develop relevant information on transit capacity. FTA plans to provide this information as well as input to the Year 2000 update of the Highway Transportation Capacity Manual which is universally used by transportation and traffic engineers for the analysis and design of urban transit systems. Alternatively, a Transit Capacity and Quality of Service Manual can be established for traffic engineers to base their planing effort on.

Many of the transit data is available internally to FTA through the Section 15 report. FTA plans to conduct the research program to establish the base for such a manual by internal skill and contracted efforts. FTA activities include conducting research, empirical analysis, simulation model development and testing to improve transit operations, providing consensus design standards, and offering demand and supply parameters for transportation planning. Priorities include: development of quality of service measures; updating general bus boarding and alighting times; developing boarding and alighting times for low-floor vehicles and different fare collection systems; developing a model for bus clearance times at bus stops reflecting different stop locations and traffic conditions, and developing procedures for calculating paratransit system capacity. Specific projects in the quality of service area are to develop both quantitative and qualitative measures categorized by system size and mode as appropriate, and to develop a framework for applying these measures with respect to system, corridor, route, on board vehicle, stop/station, and combined door-to-door scenarios. The results will be compiled into the Transit Capacity and Quality of Service Manual. After its development, training will be developed for traffic engineers to fully use the analytical tools in the Transit Capacity and Quality of Service Manual.

3.3.2 Transit Intelligent Transportation Systems

Transit Intelligent Transportation Systems (Transit ITS) is an element of the USDOT's ITS Program. Transit ITS is a comprehensive approach to applying information technologies to transit to improve customer service and reduce system capital and operating costs.

Transit ITS is organized in parallel with the USDOT ITS Program and has three components: Metropolitan, Rural, and Transit Intelligent Vehicle Initiative. (The USDOT ITS Program also includes a commercial vehicle component). The Metropolitan component of Transit ITS focuses on urban and suburban transportation in the areas of traveler information, fleet management, and electronic payment. The Rural component addresses these same areas to improve the effectiveness of transit in rural areas. The Transit Intelligent Vehicle Initiative (IVI) involves automating transit vehicle control and safety systems. Each of these three components is discussed in detail as follows.

Over the five-year period, the Metropolitan component of Transit ITS will continue the evolution of initiatives which have proven successful. Activities in this area are divided into Traveler Information, Fleet Management, and Electronic Payment systems. FTA's effort is also to encourage the local transportation managers to establish, adopt, and integrate the above key components of the ITS systems.

Traveler Information efforts (see Figure 3.6) will focus on the integration of traveler information systems with fleet management systems and other operations-based systems. Anticipated technological advances will improve information kiosk capability and electronic bus stop signs. The integration of these systems will be able to provide improved levels of transit customer service information to the public. Fleet Management systems development will seek to improve integration with subsystems as well as with multiple operator systems and between transit and other modes. Such systems will streamline passenger counting, assist with the flexible routing of vehicles, enable timed-transfer of passengers, facilitate multiple-agency regional fleet management, and enhance automated vehicle diagnostics.

Activities in Electronic Payment will continue to work towards the vision of a single cash-less payment system that may be used for any mode of transportation, as well as for other applications including payment for telephone calls and retail purchasing. Integration with government benefits-transfer systems is also a feasible objective. Major activities include working with the industry to develop integration guidelines and system specifications, as well as highly focused operational tests aimed at solving specific integration issues.

Figure 3.6 Intelligent Transportation System (ITS) User Services

The Rural component of Transit ITS will focus on those unique characteristics of rural transit operations critical to rural communities. These activities will improve rural mobility by dispatch coordination with multiple transportation agencies, fleet maintenance coordination within a fleet and among fleets of different providers, communications including emergency service fleets, geocoding and addressing, coordination of responses to weather-related activities among various fleets (transit, highway maintenance, and emergency services), the development of regional traveler information architecture, and outreach to rural public transportation communities.

A key factor tying the elements of the Metropolitan component of Transit ITS together and also enabling Transit ITS to integrate with other transportation modes is the National Architecture for ITS. The National Architecture provides the framework for integration. The National Architecture for ITS diagram, shown in Figure 3.7, summarizes the nature of the National Architecture in limited detail. The diagram identifies four categories of senders and receivers of information (in rectangular boxes) and four categories of communications channels (in oval boxes). The National Architecture itself identifies the communications relationships between ITS entities in complete detail. While the Architecture does not identify the standards or protocols through which messages are sent, it does identify who must communicate with whom in ITS. As a partner in the development of the National Architecture, FTA's Transit ITS activities strongly encourage and fully support consistency with the National Architecture in all ITS deployments.

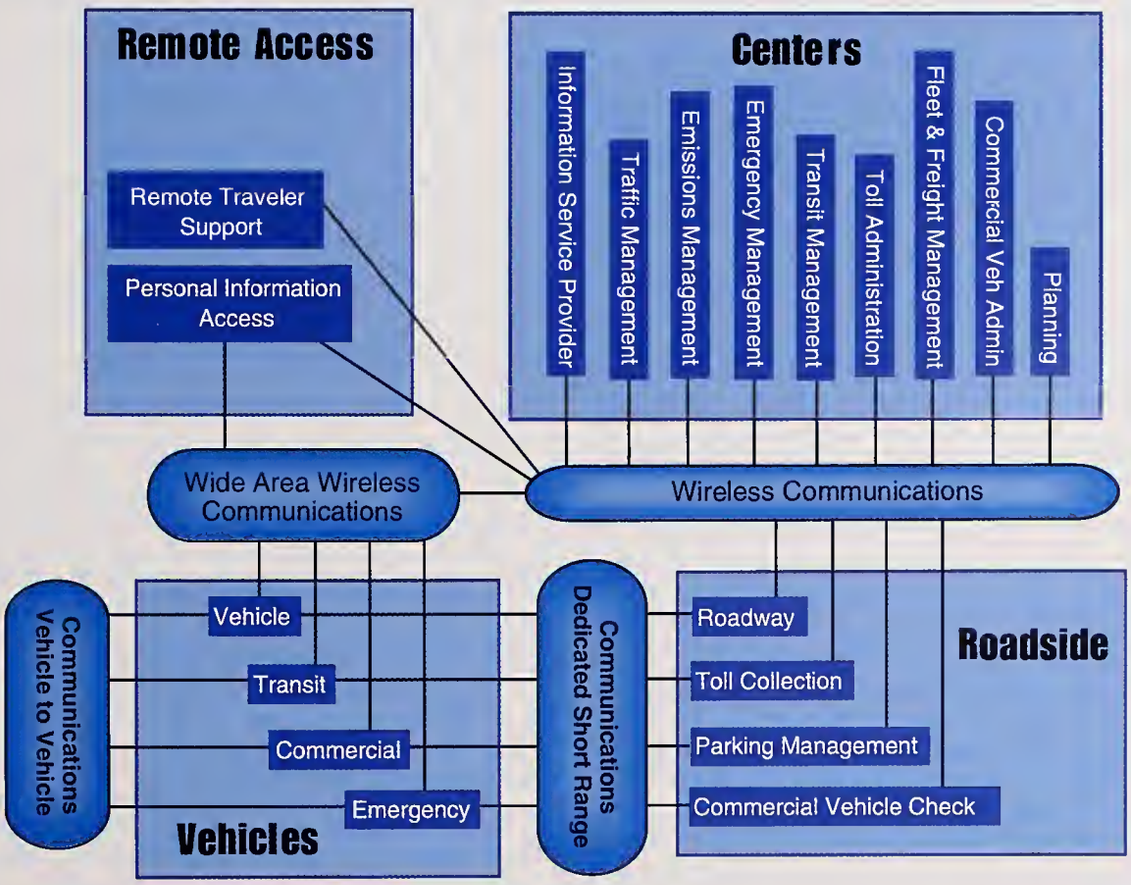


Figure 3.7 National Architecture for ITS

Standards help industry share technologies, improve reliability, reduce the costs of maintaining a qualified and knowledgeable workforce, and may reduce long-term costs. The first round of the Transit Communications Interface Profiles (TCIP) standards development is now complete and as the TCIP is implemented it will be monitored, reviewed and revised if necessary. FTA clearly recognizes that standards are important and that they should come from industry. FTA will act as a catalyst and participate in standards development to support the ITS National Architecture. This includes the development of consistency guidance for the National Architecture, as well as the refinement of the TCIP, and other ITS-related efforts. In the long term, FTA and APTA will be launching the Transit Standards Consortium to serve as a forum for discussing standards issues and prioritizing standards needs. FTA will also assist in the development of international standards, to seek new markets abroad under the same international standards, and enhance U.S. global competitiveness in the long run.

Mainstreaming ITS technologies and providing technical assistance on the National Architecture and how advanced technologies can be used to re-invent transit, also plays a critical role in the departmental Transit ITS program over the next five years. As knowledge from the research areas becomes available, and experience grows, it will be important to disseminate the information as quickly as possible in this rapidly changing area. Professional Capacity Building (PCB) through Training courses and workshops, peer-to-peer scanning tours, sharing of professionals through peer-to-peer networks, and development of standards and best practice guidance will be used to provide support to the transit industry in implementing ITS.

3.3.3 Bus Rapid Transit Initiative

Domestic total transit ridership has experienced growth in recent years with rail transit and paratransit leading the way. This growth has occurred after sizable investments in these two modes. Bus ridership continues to lag behind these other modes. Sustaining this growth, which is the theme for the vision statement of this Five-Year Plan, requires enhancing bus service which continues to be the backbone of public transportation in the U.S.

Some of the problems with U.S. bus services are that buses mostly operate on local arterial streets in mixed traffic and lack the amenities of rail transit or the personal service quality of paratransit. This results in low speeds, long circulatory trips, high operating costs, and more frequent problems with safety and security incidents. Innovations in equipment, infrastructure, and services are available to improve bus services and facilities and make bus ridership more attractive to customers.

FTA is sponsoring the Bus Rapid Transit (BRT) Initiative to encourage integration of these innovations to address the problems of bus service. These innovations and improvements include advanced technology buses, ITS technologies, urban design enhancements, traffic engineering treatments, new service strategies, and supportive land use policies. A real-world model is successfully operating in Curitiba, Brazil (see Figure 3.8) and FTA is promoting this model as an example of BRT for the adaptation in the U.S.

Figure 3.8 Bus Rapid Transit in Curitiba, Brazil

Through this initiative, upgraded bus service will include some or all of the following features: adaptive signal timing; exclusive right-of-ways; queue-jumper intersections; enhanced bus stops/stations; pre-paid fare instruments or electronic fare collection systems; vehicle location systems; buses with low floors, wider doors, and greater maneuverability; on-board passenger information systems; transit-oriented development land use provisions; and multiple bus service strategies including line haul, skip stop, express, neighborhood distributor, line haul feeders, and circumferential routes.

The goal of the BRT program will be increased ridership and reduced operating costs from increased service levels and quality. FTA plans to solicit proposals and select certain BRT projects that best demonstrate various aspects of the concept. These demonstration sites will gain access to administrative flexibility, technology sharing, peer reviews, specialty workshops, and direct on-site technical assistance. FTA will also document best practices and lessons learned, facilitate partnerships with various stakeholders, compare BRT to other transit investment options, update FTA planning and project development guidance accordingly, and disseminate the findings so that the BRT concept is adopted widely by U.S. transit systems. The analysis of BRT deployments will also provide valuable information for the transit chapters of the Highway Capacity Manual to be published by the year 2000 and the Transit Capacity and Quality of Service Manual also under development.

3.3.4 Mixed Rail Corridor Operations

The use of existing freight railroad lines offers the potential of rapidly expanding the scope of high quality passenger transit service, without the lengthy time required to plan, and the high cost of creating fixed-guideway transit systems in entirely new corridors. In a number of areas, existing commuter rail service and potential new rail transit services are subject to increasing conflict between the needs of freight railroads and transit agencies. Demand for commuter rail service is increasing in parallel with increased highway congestion and suburban population growth. The different physical and operational requirements of freight and rail transit traffic present challenges and difficult liability considerations. Train control, monitoring, and signal system design requirements are specialized for each operator, further exacerbating the challenges posed by mixed rail corridor operations.

Activities will involve examining the differing requirements attendant to ensuring the highest levels of safety while operating rail transit service in active freight railroad corridors. The analysis will examine the safety, systems engineering, and informational requirements needed to maintain reliable service. The conditions for systems redundancy, failure mode conflict avoidance, and joint operating rules will be defined. Liability considerations will be described. The potential of advanced train control technologies to address mixed rail corridor operations, such as radio-based signal and train control, will be studied. This project will be coordinated with the Federal Railroad Administration and TCRP Project A-17, *Joint Operation of Light Rail Transit or Diesel Multiple Unit Vehicles with Freight Railroads.*

Completion of work in this area will assist in reducing conflicts and will improve the safety and reliability of freight and passenger service in joint operations territory. Products will include methods for analyzing and defining risk assessment, alternatives for enhancing reliability (minimizing conflict) of joint freight-passenger service in a corridor, and methods of increasing line (passenger) capacity in joint use corridors. Institutional arrangements, standards, procedures, and equipment will be recommended, as appropriate, to permit the safe operation of rail transit on freight railroad corridors.

3.4 Specialized Customer Services

The Specialized Customer Services Program area relates to two FTA strategic goals–Mobility and Accessibility and Economic Growth and Trade. The program area activities are tailored to address the needs of low-income, elderly, and persons with disabilities. Other targeted markets are central city neighborhoods, and low-density rural and suburban areas. The performance goals, performance measures, and related program activities for this program area are shown in Table 3.5.

Performance Goals & Measures for Specialized Customer Services

Performance Goals	Performance Measures	Performance Activities
Increase the urban population within 3/4-mile of transit service-base year in FY 1997. Increase access to jobs for welfare recipients and low-income persons	Urban population within 3/4-mile of transit. Number of employer sites that are made accessible by job access and reverse commute transportation services.	■ Access to Jobs Deployment ■ Elderly Services Demonstration ■ Low Density Services Demonstration
100% accessible bus fleet (lift or wheelchair ramp equipped) by 2002 – baseline: 63% of the bus fleet was wheelchair accessible in FY 1996.	Percent of accessible buses.	■ ADA Project ACTION ■ Mobility Management Deployment
Reduce door-to-door travel times within highly congested corridors where FTA investments have been made.	Travel time in selected highly congested corridors.	■ Access to Jobs Deployment ■ Mobility Management Deployment
Encourage Statewide Access to Jobs Deployment.	Deployment in 50 States.	■ Access to Jobs Program Technical Assistance

Table 3.5 Performance Goals and Measures for Specialized Customer Services Activities

FTA's research in this area will be coordinated with specialized transit service initiatives of other agencies. Specifically, FTA will continue to be an active participant in the USDOT/U.S. Department of Health and Human Services (USDHHS) Coordinating Council for Mobility and Access. The use of Intelligent Transportation Systems technology in the delivery of transportation services has been included in the Council's new strategic planning process.

Major elements of this program are:

- **Access to Jobs**
- **Accessibility for Persons with Disabilities**
- **Elderly Services**
- **Low-Density Transportation Services**
- **Mobility Management**

3.4.1 Access to Jobs

The President has established a national goal for moving two million persons from Welfare to Work by 2002. Since only six percent of welfare families own automobiles, they must depend on public transit and special transportation to get to work and support services like child care. Studies show that more than half of entry level jobs are not readily accessible to transit due to location or because work hours are outside of the traditional work day. Many entry-level jobs are being created in suburban areas that are not served by existing transit routes. Many jobs require working early mornings, evenings, and weekends, times when transit service runs less frequently, if at all. Given the time constraints imposed by welfare reform, the FTA, working with states and other Federal agencies, must undertake a vigorous program of research and planning, financial, and technical assistance to help states and localities meet this challenge. TEA-21 authorized a Job Access and Reverse Commute Program to provide needed transportation services to individuals transitioning from Welfare to Work.

Program activities under the Access to Jobs program include information sharing, interagency coordination, technical assistance, best practice documentation, and demonstrations of innovative services and coordinated planning. FTA will share information with state and local stakeholders about the transportation challenges and successes that must be addressed to meet Access to Jobs goals. This process started with a conference on Access to Jobs and transportation held in 1997 at the Volpe National Transportation Systems Center in Cambridge, Massachusetts and culminated in a November 1998 Federal Register Notice soliciting participation in the program.

Stakeholders will be provided technical assistance as they develop transportation plans and services. FTA will document approaches to address this issue and will work with stakeholder to conduct demonstrations to test new institutional, planning, and operational strategies. ITS technologies may have a role to play in addressing Access to Jobs issues. FTA will also identify and analyze innovative institutional and financial strategies to support Welfare-to-Work transportation.

3.4.2 Accessibility for Persons with Disabilities

The goal of this program is to ensure that all Americans have access to transit to meet basic mobility needs (see Figure 3.9). The passage of the Americans with Disabilities Act in 1990 recognized that persons with disabilities have the same rights as other citizens to access services and facilities that are available to the

Figure 3.9 Americans with Disabilities Act Equipment

public. Congress also recognized that many practical problems had to be solved in reaching the goal of equal accessibility in transit.

Project Action was created to address these issues and to serve as a bridge between the transit and disabilities communities in addressing these issues. Project Action has worked to help translate the ADA transportation regulations into reality. The transportation industry has reached a critical period in addressing ADA requirements. The major issues that must be addressed are service standards, reliability, and cost effectiveness.

Paratransit has proven to be a reliable and useful service for persons with disabilities and usage has grown beyond expectations, resulting in higher than anticipated costs. It remains a priority to address these issues by mainstreaming persons with disabilities onto fixed route transit, and to better coordinate ADA paratransit to reduce trip costs. Additionally, because approximately 70 percent of adults with disabilities are unemployed and receive public assistance, mobility issues related to welfare reform must be addressed along with mobility of persons with disabilities.

Much of the emphasis to date has been on reducing physical barriers to transit use. A growing need is to make transit available to persons whose disabilities are sensory, such as being sight or hearing impaired. Research and technology development in this area goes beyond removal of physical barriers but also must address how information about transit services is made available.

3.4.3 Elderly Services

Under the Older American Accessibility Program, FTA will fund research, technical assistance, and deployment of service innovations to insure accessibility to transportation for elder Americans. A USDOT secretarial task force on "Improving Transportation for a Maturing Society" assigned FTA the leadership role of developing a long-range program of activities benefiting the elderly. Programs to be undertaken include development of service strategies, development of a public awareness program including a Homepage on the World Wide Web, working together with private industry to develop transportation networks (see Figure 3.10) to satisfy elderly needs, and conducting case study evaluations of existing providers around the country for their strengths, weaknesses and gaps in service. The findings will be used to publicize, stimulate, and replicate these efforts.

Figure 3.10 Elderly Using Transit

3.4.4 Low Density Transportation Services

While transit originated in urban communities in the industrial era, it is clear that rural and suburban residents without access to private means of mobility or seeking alternatives to the automobile can benefit from innovative public and private transit services. The challenges of suburban and rural transit are compounded by the absence of sizable numbers of persons to share transit trips, and in rural areas, the large distances that must be traveled for each trip. Among other activities, this program will analyze and support the applications of ITS technology to solve rural transportation problems. Among the issues to be addressed

are providing access to health-care facilities, supporting tourism and travel in rural areas, and providing improved intermodal connections to increase transportation access.

The movement of commercial enterprises and government agencies to suburban locations as well as increased residential construction along with a lack of planning for transit service have brought about congestion, pollution, and other barriers to economic growth. The goal of the low density transit services program is to enhance the economic development and livability of America's suburbs and rural areas.

The low density services program focuses on research, testing, evaluation, deployment, and mainstreaming of innovative transit service and management concepts that are designed to enhance mobility, access, and intermodal connectivity in suburban and rural areas. The program includes the sponsorship of feasibility research, testing of new technologies and concepts, evaluating test outcomes, documenting locally initiated innovations, provision of technical information, and dissemination of program findings to encourage technology transfer. The program also publishes and distributes technical reports and abstracts, provides technical assistance, and conducts workshops and seminars to encourage the widespread adoption of successfully demonstrated practices, techniques, and technologies.

3.4.5 Mobility Management

Responding to the market challenges outlined in this section calls for a new and broader role for transit agencies as mobility managers. Mobility management moves beyond establishing and operating traditional fixed route transit systems to fostering and organizing a network of diverse transportation services and providers to satisfy customer needs. Mobility management involves several functions. The starting point is the identification of transportation needs of a specific community and identifying service options and demand management strategies to respond to those needs. Transit agencies often serve as a travel agent by brokering customer needs with a variety of service providers and providing one-stop customer information on available services.

Attracting adequate financial resources to support these services is usually the responsibility of transit agencies. One way to reduce costs is to coordinate services and providers into a cost-effective transportation network. Transit agencies have an important role in advocating for improved regulatory, traffic management, and land-use policies that support the effective delivery of transportation services. Transit agencies are also responsible for implementing technological innovations to improve network performance.

Mobility management strategies are being pursued vigorously in the coordination of human service transportation coordination activities and in meeting the transportation needs of those making the transition from access to jobs. Individual market segmentation analyses will be undertaken. The USDOT and Department of Health and Human Services Coordinating Council continues their efforts to coordinate. ITS technologies are being supplied to achieve the coordination of multiple service providers, and to provide customers with real-time information. The application of smart card technologies allows customers a seamless fare medium that can be applied to several service providers. Strategies for developing mobility management implementation within the transit industry are being developed in TCRP new paradigm visioning. Finally, FTA will undertake with the transit industry, mobility management demonstrations, and will establish technical assistance and information-sharing activities.

3.5 Policy and Planning

The Policy and Planning Program area supports three FTA strategic goals which are "Mobility and Accessibility", "Economic Growth and Trade", and "Human and Natural Environment." Transportation planning provides transportation decision-makers with information about the options available to address transportation needs and their costs, including fiscal, environmental, and social, and benefits, including

Performance Goals & Measures for Policy & Planning Activities

Performance Goals	Performance Measures	Performance Activities
Improve the responsiveness of the planning process to the local planning needs in the largest metropolitan areas.	Number of large metropolitan areas with improved planning process each year.	■ Implementation of Transportation Institutional Reform ■ Smart Growth Implementation
Increase the number of rail and air terminals with transit connections.	Measure the number of rail and air terminals with transit connections.	■ Intermodal Connectivity ■ Livable Communities Initiative Demonstrations
Eighty-Five Percent of FTA's New Starts funds are allocated to projects that are consistent with the President's Executive Order (E.O.) on cost-effectiveness.	The percentage of New Starts funds allocated to projects that are consistent with the President's E.O.	■ Implementation of Multimodal System Evaluations ■ Implementation Transportation Institutional Reform Deployment
Increase ridership and revenue from joint development projects associated with New Starts – base year is 1998.	Measure ridership and revenue generated from joint development projects approved in cities receiving the Common Grant Rule.	■ Implementation of Multimodal System Evaluations ■ Sustainable Development ■ Innovative Financing Deployments
Increase the number of people having access to high quality transit. High quality transit exists when people live within 1/4 mile of service with a frequency of 15 minutes or less.	Number of people with high quality transit.	■ Livable Communities Initiative Demonstrations ■ Smart Growth Implementation ■ Sustainable Development Implementation

Table 3.6. Performance Goals and Measures for Policy and Planning Activities

mobility, accessibility, environmental, and social, of those options. The strategic goal of this research area is to improve the quality of the information available to decision-makers. The performance goals, performance measures and program activities are shown on the previous page in Table 3.6.

Major elements of this program area are:

- **Policy Research**
- **Transportation Institutional Reform**
- **Multimodal System Evaluation**
- **Planning Technology**
- **Sustainable Development**
- **Intermodal Connectivity**

The need for research in transportation policy and planning development is driven by legislative initiatives, changes in urban form and composition, and the need to address global as well as domestic issues. ISTEA, the major legislative change affecting surface transportation, signaled the end of the interstate highway construction era and the start of a more deliberative, multimodal approach to transportation planning. The implications of these major policy changes in ISTEA were still working their way through the transportation industry at the time of the TEA-21 reauthorization, so it did not substantively alter the new approaches to planning still being developed.

Metropolitan areas have evolved from regions centered on a single core employment and population center to regions where population and employment are spread over large areas. Population density has dropped in many metropolitan areas. A major reason for this is that the size of the areas has grown faster than population growth. Urban transportation systems must be adapted to address these changes.

The now widespread acceptance of the reality and dangers of global warming suggests that new transportation policies are needed, according to the President's Council on Sustainable Development, "to meet the needs of the present without compromising the ability of future generations to meet their own needs." In response to these external forces of change, an aggressive research plan is proposed to continue the adaptation of transportation policy and planning initiatives to our understanding of a changing world.

3.5.1 Policy Research

FTA policy research activities include data collection and analysis to support policy initiatives, strategic planning, and program evaluation. Information is needed to establish agency priorities, assess transit funding needs and benefits, and meet program and regulatory requirements. Policy research supports efforts to meet regulatory requirements and to develop program and policy priorities.

Information developed through policy research activities is used by FTA to meet requirements under the Government Performance and Results Act, including documenting progress to meeting performance goals of FTA's Strategic Plan and for an annual Report to Congress on Surface Transportation Conditions and Performance. Policy research is responsible for the development of models, including the Transit Economic Requirements Model (TERM) and the Transit Performance Monitoring System (TPMS). The policy research activities support continued improvements to FTA's Geographic Information System (GIS) understanding and capabilities, and research into policy strategies such as congestion management.

Under the GPRA, Federal agencies are responsible for establishing performance goals with budget priorities and progress measures. Understanding current conditions is the first step in establishing both goals and priorities. Policy research provides information on existing conditions, as well as identifying and quantifying benefits expected from transit investments and establishing criteria for evaluating benefits of investments. Policy research supports these efforts by providing inputs used to develop the performance goals included in the FTA Strategic Plan, establishing budget priorities and evaluation criteria, and reporting on progress addressing performance goals. Program evaluations will be conducted to assess the impact of several programs identified elsewhere in this Plan, including the Livable Communities Initiatives and State Infrastructure Banks.

One of the most important products of FTA's policy research is the biennial report to Congress on Surface Transportation Conditions and Performance, produced jointly with FHWA. A major effort will be to develop a method for collecting information on vehicle and facility conditions, to supplement information in the National Transit Database. In addition, information is needed on intermodal facilities, especially transit access to airports.

During the next five years, FTA will continue to develop the TERM. It will be a major tool in the development of subsequent *Conditions and Performance Reports to Congress*. TERM will also provide information to support GPRA requirements. This model is being developed to produce estimates of the investments required for maintaining and improving transit conditions and service levels. This will include improved treatment of transit's benefits and the benefits of making transit accessible. FTA will also continue work with FHWA on intermodal investment assessments.

3.5.2 Transportation Institutional Reform

This program has its roots in the recognition that traditional fixed-route transit cannot maintain its efficiency in the face of societal changes, particularly changing locations of employment centers. Basic institutional changes are necessary to address transportation issues as diverse as mobility for the disabled, the elderly, and the very young, access to jobs for low-income workers, and community transit for sustainable development. At an FTA-sponsored workshop on this National Research and Technology Plan, held in Washington, DC in December 1997, the long-range planning breakout group chaired by G.B. Arrington of Portland TriMet concurred in this assessment of research need. That group stated that "long-range research and development should shift its emphasis from transit operations and infrastructure to intermodal, seamless mobility management."

While recognizing the continuing need for traditional transit, the working group questioned whether existing transit operators could provide more flexible and diverse transit service options while maintaining and expanding their traditional transit systems. The working group considered and ranked three major areas for research. The first is research into alternative institutional arrangements to govern, finance, operate, and broker transportation. The second area is market research into the appeal of alternative specialized public transportation services to specific market segments. The last area of research is the evaluation of experiments in alternative institutional concepts and structures. The group felt that a program of demonstration and evaluation of innovative

institutional concepts will be of greatest benefit. FTA will conduct these researches through its multitude program avenues including TCRP and University Centers Programs.

This program will also investigate possible institutional impediments to realization of TEA-21 objectives, such as integration of land-use and transportation planning and cross-jurisdictional implementation of ITS technologies which were impediments in ISTEA. Organizations with regional or statewide jurisdiction, specifically Metropolitan Planning Organizations (MPOs) and State Departments of Transportation (DOT), usually have responsibility for transportation decisions. In most states, land-use and zoning are the responsibility of county, city, or town governments, which lead to political and institutional barriers to coordinating these planning functions. The result is that the integration of land-use and transportation planning is difficult, even given the general acceptance that coordination is not only useful, but necessary.

This program complements work to be done under the Specialized Customer Services Program described in Section 3.4. That program addresses operational issues while this program will study the nature of the institutions themselves, to identify institutional impediments to the use of new technologies and to experiment with alternative institutional structures to deliver the new kinds of services possible with the new technologies. The roles and responsibilities of existing transportation institutions in integrating the new technologies into services that the public will buy, whether through fares or taxes, will be explored. Existing institutions include planning organizations and service providers in all forms, ranging from regional fixed-route transit agencies to social service providers to taxicab companies, and state, county, and city governments.

3.5.3 Multimodal System Evaluation

Despite technological and institutional reforms, the traditional journey-to-work commute will continue to dominate urban travel patterns for the foreseeable future. As urban sprawl continues, roadway congestion increases, and as space for highway expansion diminishes, rail and bus transit will become an increasingly important component of the transportation mix. The number of transit "New Start" projects in the FTA project development pipeline is at an all-time high and continues to grow. These major investment projects must be evaluated by a broad range of local decision-makers and planners, and evaluated at the Federal level for purposes of determining which proposed projects represent a worthy investment of Federal funds.

TEA-21 requires metropolitan areas considering major investments to identify and evaluate multimodal alternatives. This creates a need for tools that can be used to compare alternative investments in highways, rail transit, bus transit, high occupancy vehicle projects, bikeways, and multimodal evaluation methods sensitive to a broad range of objectives.

TEA-21 refines the project evaluation process implemented under ISTEA, and expands the factors that are to be considered when rating projects according to the statutory evaluation criteria. It retains the ISTEA evaluation criteria of mobility improvement, operating efficiency, environmental benefits, local financial commitment, and transit-supportive land-use policies. The implementation of these criteria in the 1998 Report on Funding Levels and Allocations of Funds showed that further refinement of the definitions and measurement techniques for the criteria are needed.

Transit data collection and analysis in support of various periodic reports produced by FTA is another activity that supports system evaluation. *The Annual Status of the Nation's Surface Transportation System Condition and Performance: A Report to Congress* is a prime example. Another example is FTA's decennial participation in the Census Transportation Planning Package, a transportation data source generated by the Census Bureau as a supplement to the census. Other examples are the Characteristics of Urban Transportation Systems, Characteristics of Urban Transportation Demand, and the National Personal Transportation Study. All of these efforts are performed jointly with the FHWA.

New factors to be considered when evaluating transportation systems and alternative system changes are also under study. Research is needed to identify the benefits of transit to businesses, as reflected in commercial property values and the value of other assets located near transit facilities. The approach will examine a variety of new data sources well beyond real estate property values. The analytical tools developed will allow the aggregation of the commercial benefits of transit to local, regional, and national levels for estimating its contribution to economic growth and global competitiveness. This research will continue to expressways and fixed-guideway transit systems operating at, near, or above capacity and an investment in one mode will improve travel times on both. The results of this research will provide information about how FTA investments contribute to economic growth and trade in ways other than the creation of transportation choices for travelers.

3.5.4 Planning Technology

The need for research in planning technology is driven by new requirements and initiatives and by new opportunities created by technological advances. The new requirements include those of the Clean Air Act Amendments of 1990. The CAAA recognizes that although much progress in air quality has been realized since its enactment in 1970, the air in many cities is still far from healthy. Further progress will require greater effort, and the progress already made is threatened by increasing vehicle-miles of travel (VMT) associated with the continued suburbanization of American cities and other factors. Another initiative is the general thrust in ISTEA toward greater integration of transportation planning with other forms of planning, especially those related to the environment and social welfare, such as land-use planning and associated planning for public utilities, parks and recreation, watershed management, and brownfields redevelopment. Advanced planning tools are prerequisite to such comprehensive planning.

There are recent technological advances that create new opportunities for transportation planners. These advances include more powerful computers, more powerful and user-friendly software for processing geographic information, and more automated data collection and data generation technologies such as advanced communications, remote sensing, and the GPS. Three areas of research are proposed in the area of planning technology to fulfill the needs and seize the opportunities. These areas are the travel model improvements, GIS application and support, and ITS data capture. Meanwhile, an intermodal and multipurpose DOT/U.S. Environmental Protection Agency/DOE Travel Model Improvement Program (TMIP) is being developed for general purpose.

More specifically, the ongoing travel model improvement program, funded jointly by FHWA, EPA, and FTA, is developing a new generation of computerized travel models for transportation planning. These models will take advantage of more powerful computer systems now available and simulation techniques originally developed for defense applications. The primary impetus for this effort is the need for more accurate information about emissions of air pollutants from transportation sources. New models will also provide more accurate information in numerous other areas such as safety, noise, fuel consumption, and design detail. Figure 3.11 is a graphical description of the Transportation Analysis and Simulation System model being developed for FHWA and FTA by the Sandia National Laboratory.

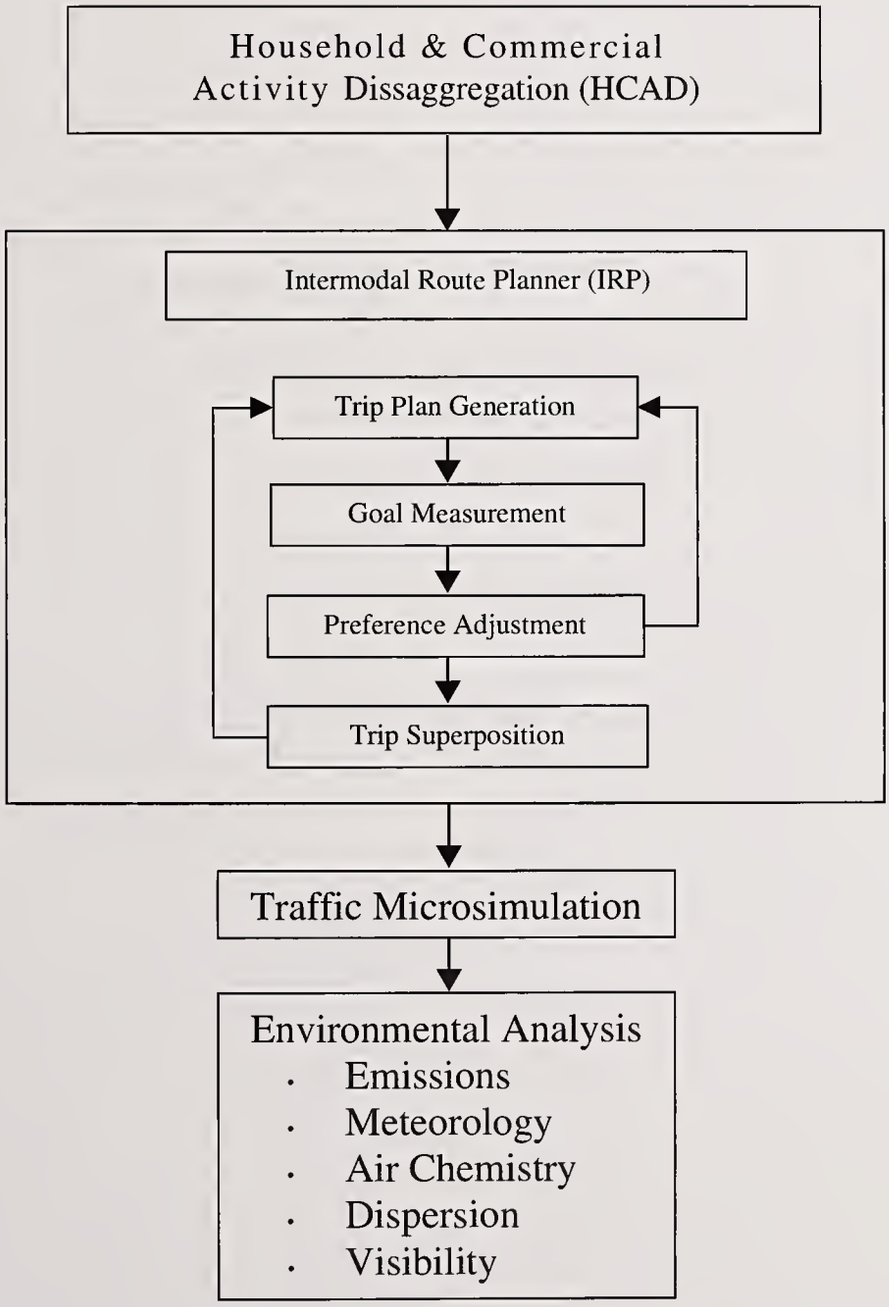


Figure 3.11 TRANSIMS (A planning computer modeling system)

In response to the movement toward more integrated planning, the use of GIS is growing. Much work is needed to determine the kinds of analyses, evaluations, and assessments that GIS can support. For example, overlaying low-income population points and air pollutant concentration maps may show a coincidence of concern that would favor one alternative transportation plan over another. The usefulness of various analyses of this sort will indicate the data collection needs. Work is needed on methods for standardizing geographic data within a metropolitan area so that land-use agencies, transportation agencies, utility companies, environmental agencies, and others can share and use all the data while each agency has responsibility for generating and updating of only that portion of the data within its direct jurisdiction.

The opportunities for transportation data capture presented by ITS implementation are many, but so are the questions that must be answered. The following situations are a few examples of the issues, but numerous other cases will arise as ITS advances. Strategically located video cameras provide information about highway congestion to the operations center, but the same information, in some aggregate form would be useful to the transportation planners responsible for major investment studies of proposed new or expanded facilities. The "smartcards" used at toll booths and transit stations may provide information about individual trips on toll facilities or transit guideways which is of value to planners. A number of issues, including staff resources and privacy, must be addressed when considering what and how information is captured and stored. ITS must be researched not only in its ability to provide operational improvements to the transportation system, but also in its ability to support transportation planning of new and expanded systems.

3.5.5 Sustainable Development

Sustainable development is defined broadly as development that allows people "to meet the needs of the present without compromising the ability of future generations to meet their own needs" (Brundtland Commission, 1987). Sustainable development has been described by the President's Council on Sustainable Development as the integration of the three E's — environment, economy, and equity. Transportation planning practices promote sustainability if they focus on the long-term impacts and consequences of human actions, recognize the interdependence of economic, environmental, and social well-being, and involve decision-making that is inclusive, participatory, and transparent. Three areas of research are proposed to enhance the understanding of transportation's contribution to sustainable communities: an investigation of the impact of urban site design on the livability of communities; Smart Growth, which is the continued study of the integration of land-use planning and transportation planning; and a detailed study of issues of intermodal connectivity, especially land-side access to airports.

3.5.5.1 Livable Communities Initiative

FTA has developed the Livable Communities Initiative to strengthen the linkage between transportation services and the communities served. The LCI is an experiment in the use of sustainable design concepts such as transit-oriented development, community-sensitive transit services, mixed-use development near transit facilities, the provision of safe and secure pedestrian access, and transit-supportive parking management and traffic management techniques. The goal is to increase access to jobs, health care, education, and other social ameni-

ties and to stimulate community participation in the decision-making process that leads to these improvements.

Nationally, interest in the LCI program has increased dramatically, and numerous projects that fall within the LCI rubric have been built across the nation both with and without FTA financial assistance. Through the National Transit Institute, FTA has investigated innovative community involvement methods, such as Visual Preference Surveys, to generate LCI projects. The next phase of the initiative will test and study the results. A rigorous evaluation of the initiative in terms of its long-term effects on mobility, energy consumption, pollutant emissions, job accessibility, social equity, and other measures is needed. Such an evaluation would provide insights to other communities considering the adoption of LCI strategies and provide an empirical basis for analyzing additional linkages of site designs with transit facilities and services.

3.5.5.2 Smart Growth

FTA will support research into the interaction between transportation investments and land-use; decision-making within the context of sustainable development and global climate change will also be studied. Desirable forms of land-use and institutional models that promote sustainability must be identified. For example, further research is needed to determine the impacts of zoning practices on transit ridership and to determine transit-supportive land-use patterns. Some of the answers will be sought through the Smart Growth Initiative, a joint multi-phased project of FTA, the U.S. Department of Housing and Urban Development (USHUD), the U.S. Environmental Protection Agency (USEPA), the Jackson Foundation, and the American Planning Association, designed to update urban and rural development planning and management statutes. The project will produce a guidebook for governors and legislators on the "best" of American planning and land development management law, and establish a clearinghouse on national planning statutes and a corresponding database of legislative materials.

3.5.6 Intermodal Connectivity

Changes from one means of transport to another frequently take place at terminals specifically designed for this purpose. The design of these terminal facilities is very important to ensuring smooth transitions and exchanges. The design of terminal facilities and stations must address many components including: loading and discharging areas, pedestrian walkways and waiting areas, restrooms, lounges, and housekeeping, ventilation and lighting, intermodal drop-off and pick-up facilities, parking and storage areas, fare collection, aesthetics, and traveler information.

The design of modern passenger facilities must consider functionality, convenience, safety, and emergency provisions. The design must recognize the many types of persons who will use the facility while in transit. Accessibility considerations for those with disabilities and the ease of use and comprehension by those unfamiliar with the terminal or the system, and possibly speaking and reading a different language are added requirements.

Increasingly, the design and maintenance of effective and efficient terminals and intermodal exchanges is a complex undertaking involving teams of individuals or organizations with broad ranges of capabilities. While there are architectural and limited transportation functional design guidelines, it is clear that terminals of roughly the same age in different locations

perform very differently with widely variant outcomes in terms of customer satisfaction and success in negotiating the exchange.

Similar to the design of airport ground access systems, research is needed to develop planning, design, and implementation guidance for intermodal terminal facilities. With the recommendations, guidelines, and processes resulting from this research, planners, engineers, and designers will have the tools to build intermodal facilities that meet a wide range of needs.

3.6 Professional Capacity Building

The Professional Capacity Building supports the FTA strategic goal number three Economic Growth and Trade. The PCB program coincides with the strategic goal to build professional capacity and promote the education of individuals in transportation-related fields. The Secretary's Strategic Plan and transportation industry strategic planning recommendations

Performance Goals & Measures for Professional Capacity Building Activities

Performance Goals	Performance Measures	Performance Activities
Increase the number of National Transit Institute (NTI) training courses conducted. Increase the number of participants in NTI training.	Number of NTI training courses conducted. Number of participants in NTI courses.	■ Increase in number and type of courses by NTI. ■ Workplace Safety Training.
Increase the number of University Transportation Centers (UTC) students who enroll in transit-related courses.	Number of UTC students who enroll in transit-related courses.	■ Develop and promote transit-related courses in UTC schools.
Increase the number of UTC graduates working in transit-related agencies or organizations.	Number of UTC graduates employed in transit-related jobs.	■ Promotion of transit intern program. ■ Deploy Technology Transfer programs.
Develop programs that support the Garrett A. Morgan Technology and Transportation Futures Program.	Number of programs developed that support the Garrett A. Morgan Technology and Transportation Futures Program.	■ Develop transit training courses for community colleges ■ Deploy Tren Urbano type technology sharing programs.
Increase by 5% every two years customers service ratings.	Comparison of current survey results.	■ Informational sharing activities.

Table 3.7 Performance Goals and Measures for PCB Activities

both identify the need to attract and maintain an educated workforce to assure economic prosperity in the 21st Century. FTA's program initiatives to build professional capacity in the transportation industry are directly linked to this goal. The Federal government has an appropriate and vital interest in assisting transit agencies to improve performance and increase productivity, and professional capacity building is a means to those ends. The performance goals, performance measures and related program activities for this program area are shown on the previous page in Table 3.7.

Major elements of this program area are:

- **Attracting a Quality Workforce**
- **Training a Quality Workforce**
- **Retaining a Quality Workforce**
- **Technology Sharing**

The intent of a strategic approach to human resource development is to foster the development of an organizational culture and climate that facilitates technological and managerial innovation and encourages individuals to learn new knowledge, attitudes, and behavior. Attracting motivated personnel and providing the tools to learn and do the job right will be reflected in a more positive and rewarding traveling experience for the customer.

Currently, there are programs in place to assist the industry in meeting the strategic human resource development needs for the next five years. Major elements of the Professional Capacity Building Program are the University Transportation Centers (UTC), USDOT Garrett A. Morgan Technology and Transportation Futures Program, the National Transit Institute (NTI), Transit Cooperative Research Program, and FTA's international Program.

The TEA-21 University Transportation Research Program, the continuation of the UTC Program, funded jointly by FTA and FHWA, supports research, education, and technology transfer activities eventually rested in the 26 University Transportation Centers. The University Centers match each Federal dollar to conduct research aimed at addressing regional and national transportation problems. This is the only program in the United States that provides higher education for the next generation of transportation professionals and then connects them to the career opportunities in the industry. It also functions as a research investment, using Federal dollars in conjunction with public and private local funds to solve real transportation problems.

The USDOT Garrett A. Morgan Technology and Transportation Futures Program supports a series of educational and work study experiences at all academic levels to attract young people into transportation careers.

NTI was established through ISTEA and reauthorized by TEA-21, to design, develop, and conduct training in response to the FTA and the industry. Located at Rutgers University in New Jersey, it was established to meet the training and development needs identified by the transportation workforce and plays a major role in supporting skills required in FTA's program goals. NTI offers courses on many FTA requirements such as Program Management, Transit Planning, Civil Rights, and Procurement regulations. NTI also supports a number of FTA's training initiatives in the Office of Research, Demonstration and Innovation, and multi-modal planning courses in cooperation with FHWA. In particular, the workplace safety training that is offered by NTI addresses the needs of transit operators and mechanics.

TCRP will continue to investigate and develop new methods and techniques for increasing transit productivity. This includes research in priority areas of safety, security, planning, service equipment, facilities, operations, human resources, maintenance, policy, and administration. Long-range emphasis will be put on customer service, labor/management cooperation and relations, and building an effective mobility management support base in the community. It also covers such other activities as rapid response studies, development of new transit paradigms, and an international studies program.

The International Program disseminates information and expertise from FTA's research and technology program. International technology-sharing activities focus on the design and conduct of specialty workshops on topics such as New Starts, turnkey delivery, and GIS.

3.6.1 Attracting a Quality Workforce

Strategies to attract skilled workers have an important impact on the composition of the work force. FTA will assist the transportation industry to increase both the quantity and quality of trained professionals entering the transit workforce through links with the academic community through UTC and the Garrett A. Morgan Technology and Transportation Futures Program.

FTA will continue to represent transit's interests in the education and research elements of the UTC. FTA has included long-term goals in its Strategic Plan that will increase the number of students involved in transit-related education and the number of graduates of the UTC entering careers in the transportation industry. During the next five years, the FTA will link UTC student education to transit new starts and major capital investments.

Through the Garrett A. Morgan Program, FTA will promote a transit-related curriculum at the high school level. Linkages will be explored to establish networks connecting all levels of transit-related education and training. Career development and placement, including internships and work-study at the community college and university level will serve as a source of technical training to increase the skill level of entry-level workers and prepare students for future transit careers.

3.6.2 Training a Quality Workforce

After attracting quality employees, it is vital that on-the-job training and purchased training continue to be provided to maintain and increase employee's competence levels. Training must be designed that allows employees to use what they learned in their jobs. The NTI will continue to serve the training and development needs of the transportation industry and assist FTA in carrying out training in support of Federal program responsibilities. Training and training delivery systems will be linked to preparing the existing workforce to operate, maintain, and manage in an environment of changing technology and increasing demands for service and cost containment. FTA will continue to seek opportunities to promote the use of a variety of training resources in support of its capital program as well as other initiatives linked to innovative planning and financing and operations.

Both community colleges and the UTC will play roles in assisting the industry to train a quality workforce. The community colleges are often the last step in the transition from school to work, and the first step in returning to school from work. Community colleges play a supportive role in assisting the transportation in-

dustry in bringing its workforce back to the classroom to update skills and introduce new methods and techniques linked to changing technology. The universities also support training of the existing workforce through workshops and seminars that reflect their research and educational programs. FTA will continue to support the NTI, the UTC, and the community college initiative all linked to training a quality workforce. FTA's ongoing support of the TCRP will be coordinated with the NTI and UTCP to share both research results as well as educational and training materials.

3.6.3 Retaining a Quality Workforce

The third major element of FTA's Professional Capacity Building Program will focus on the need to retain a quality workforce in the transportation industry. Since most of the current expertise in transit is experience-based, efforts must be maintained to keep experienced workers and enhance existing institutional relationships. Through TCRP and FTA's Technology Sharing Program outreach efforts, FTA will continue to support labor/management cooperation, employee assistance, and various other workplace arrangements designed to improve performance and bring about greater efficiencies in the workplace. Both these programs put a premium on resolving near term operational challenges and sharing the results throughout the industry. The intended impact will assist transit in maintaining and strengthening its ability to provide service to the public through the managerial, technical, and professional excellence of its workforce.

The NTI annually selects a group of NTI Fellows from industry practitioners with a variety of expertise to provide workshops and short seminars on industry-related topics. The NTI also sponsors an annual trainer's conference bringing together trainers and human resources specialists from throughout the nation to learn new training techniques and share their experiences. A clearinghouse also has been established by NTI to share innovative training programs for use in-house by industry trainers.

FTA will continue to act as a broker and steward in using its technical assistance resources to promote innovative practices relating to organized labor, partnerships with the private sector, and new and unique links to other programs both within USDOT and elsewhere in the Federal government. FTA will continually explore and evaluate new opportunities to link transit with broader initiatives such as Welfare-to-Work, energy and the environment in an ongoing effort to demonstrate the role transit and its employees play in providing public services.

3.6.4 Technology Sharing

FTA will embark on a more vigorous program of technology sharing in assisting the transportation industry in keeping abreast of the latest technological innovations in systems, management programs, and equipment and infrastructure. Valuable lessons learned from the research and demonstration programs will be documented and shared with the transportation industry. Using as a model the Tren Urbano technology transfer program, which was developed as part of the San Juan Turnkey Demonstration Project, FTA is developing a formal technology-sharing program for other New Starts projects. FTA participation in the statutory Small Business Innovation Research (SBIR) program is included as a technology-sharing activity.

FTA supports its interest in Federal research and development and its continuing commitment to facilitate the dissemination and implementation of innovative transit research and innovative practices to state and local agencies and the private sector through its full-service Transit Research Information Center.

FTA's support of the TRB's activities, including its annual meeting, professional committee activities, and ongoing coordination and research dissemination through Transportation Research Information Services, is a key avenue for technology and information transfer. This is being built through linkages with other information dissemination resources using the Internet and other advanced communications techniques. These sources help inform transit professionals in the U.S. and around the world about FTA's research and technology activities. These resources also provide FTA and U.S. transit professionals with information about other transit technology and research activities.

FTA research and technology office will maintain a strategic approach to program development. This will involve periodic retreats, vigilance in understanding the problems of the transit industry, and industry outreach.

The expertise and products developed through the Bus Rapid Transit initiatives and other research and technology programs will be shared with domestic agencies and developing countries where new trade opportunities exist.

Figure 3.12 University of Virginia, Rotunda

4.0 Schedule & Milestones

In partnership with other Federal agencies, universities, states, transit operators, and the transit industry, FTA has a number of ongoing projects at some stage of the innovation process. A summary of FTA's Fiscal Year 2000 Research and Technology Budget is provided in Appendix A. For the purpose of this Five-Year Plan, Fiscal Year 1998 is a transition period toward the strategic approach embodied in this Plan which starts in Fiscal Year 1999. FTA's objective is to eliminate perpetuation of unproductive programs unrelated to identified problems and strategic goals. A method to accomplish this goal is the use of Full Funding Cooperative Agreements (FFCA) to define program goals and parameters. In fiscal year 1996 funding, the Advanced Technology Transit Bus (ATTB) program was the first to use this approach.

Over the next five years, most of the programs and projects described in Chapter 3 will have moved through the research, testing and evaluation phases of the research and technology continuum. Route maps have been developed to graphically depict the flow of activities planned over the next five years for the various programs. A summary route map for each program area is included in this chapter. The summary route maps identify activities in general terms.

This Five-Year Plan contains both short-term and long-term activities. The first two years or the short-term, FY 1999-2000, is a period for completing worthwhile ongoing projects and for starting strategically selected new activities that are described to move toward achieving the desired outcome goals in the FTA Strategic Plan and certain deployment goals as identified in the program route maps. During FY 2001-2003 or the long-term, some projects started in the first two years will proceed to the full implementation stage and new projects will be initiated. An additional round of industry review and consultation with the transit industry will be conducted in year three to ensure that any changes in the industry's assessment of its needs and priorities are properly identified at this mid-point.

Presenting activities in two periods allows readers to see a timely transition from the current programs to the new ones, deployment of new innovations, checkpoints for redirection, and mainstreaming of proven cost-effective technologies. The major projects and programs for each emphasis area are summarized in Table 4.1 on the following page. Following this table, the key activities of the program areas are described temporally in routemaps.

Program Area/Activities		Short-Term	Long-Term
4.1 SAFETY & SECURITY	**Railroad Safety**	• Four Quadrant Gates Deployment • New Warning Signage • Safety Procedures • Video Detection	• CBTC Adaptation • Signaling Standards • Configurations for Crossings • Improved Safety Data/Records
	Anti-Terrorism	• Traffic Signal Standards • Chemical Detection Test • Air Flow Computer Simulation • Emergency Management • Guidance & Training	• Biological Detection Test • Biological Handbook • Virtual Reality Systems • C/B Detection Technology
	Information Systems Security	• Vulnerability Assessment • Financial Systems Controls • Critical Data Flow Mapping	• Control Systems Deployment • Training & Assistance • Olympics Support
	Bus Vehicle Safety	• Technology Assessment • Systems Integration Analysis • User Services Development • Olympic 2002 Support	• Collision Avoidance System Specs • System Prototyping • Operational Tests
4.2 EQUIPMENT & INFRASTRUCTURE	**Bus Equipment**	• ATTB Field Test Completion • Phosphoric Acid Fuel Cell Bus Completion • Proton Exchange Membrane Fuel Cell Bus Testing • Bus Testing Modeling Upgrade • Zinc Air-Battery Development • Electrical Subsystem Testing Protocols • BART AATC Demonstration • Documentation of BART AATC	• Small Durable Bus • Advance Batteries • Hydrogen Fuel Cell Test • Gasoline Fuel Cell Test • PA & PEM Fuel Cell Evaluations • Bus Testing Final Rule
	Rail Equipment & Systems	• Commuter Rail Radio-Based System Adaptation • Research Rail Innovations (Monorail, Maglev & Light Weight Materials)	• Rail Systems Architecture, Multiplexing & Message Set Standards • Test Commuter Rail Radio-Based System • Document Radio-Based System Applications
	Civil Infrastructure	• Tunneling Technology Assessment • Turnkey Demonstration Project Monitoring & Documentation • Best Practice in Station Design • Innovative Finance Documentation • Finance Workshops • Joint Development Pilot	• Turnkey Technical Guidance • Joint Development Best Practice & Training • Construction Lessons Learned • Innovative Finance Training & Technical Assistance
	Advanced Simulation	• Evaluate & Test Simulation for Transit Systems Design (e.g. Vehicles, etc.) • Expand Simulation Training for Operators & Mechanics • Develop Simulation Models for Structural Durability Testing	• Demonstrate Simulation for Transit Systems Design • Deploy Broader Simulation Training for Operators & Mechanics • Deploy Structural Durability Simulation Models

Table 4.1 Short-Term and Long-Term Product Milestones **Part 1**

Program Area/Activities		Short-Term	Long-Term
4.3 FLEET OPERATIONS	**Transit Capacity & Quality of Service**	• Inputs to the Highway Capacity Manual 2000 • TCQS Manual Production	• ITS Impacts • Model & Simulation Results • TCQS Training • Update TCQS Manual
	Bus Rapid Transit	• Design Parameters • Concept Promotion • Demonstrations • Site Peer Reviews • Scanning Tours	• Best Practice Document • Deployment Assistance • System Simulation Models • Lessons Learned & Training
	Transit ITS **Metropolitan ITS**	• Human Factors Research • Wireless Technology Assessment • Spectrum Impact Assessment • Metro ITS Deployments • Planning Models • ADART Test • Best Practices Documentation • Olympic 2002 Support	• Integrated System Deployment • Simulation Systems • Documentation
	Rural ITS	• User Service Definitions • Demand Response Tests • Fleet Management & Traveler Information Best Practices • Tourists System Tests • "Simple Solutions" Analysis • Integrated Deployments • Revised Architecture	• Integrated Deployments • Test Evaluation • Training & Assistance
	Standards & Architecture	• International MOUs • Communication Lines	• Transit Standards Consortium • TCIP & ISO TC204 Update Communications Bus
	All Programs	• Training & Assistance	• Olympics Showcase Evaluation • Training Update

Table 4.1 Short-Term and Long-Term Product Milestones **Part 2**

Program Area/Activities	Short-Term	Long-Term
4.4 SPECIALIZED CUSTOMER SERVICES	• Complete & Evaluate Research using Geographic Information Systems (GIS) for Job Access • Evaluate & Document Cost & Performance Methods of Providing Former Welfare Recipients with Transportation to Jobs • Deploy GIS, ITS & Smart Card to Managing Welfare to Work • Complete Analysis of Problems in ADA Compliance • Report on Paratransit & Human Services Transportation Coordination	• Document Best Practices in Applying ITS in Welfare to Work Transportation • Provide Technical Assistance & Information Sharing on Welfare to Work Best Practices • Develop Standards for Station & Stop Signage • Produce Report on Evaluation of ADA Transit Service Reliability & Costs • Implement Mobility Management Coordination Demonstration
4.5 PLANNING & POLICY RESEARCH	• Assess Institution Reforms • Determine Ecomomic Benefits of Transit Investments • Report on New Starts(3J) • Document Best Practices in Smart Growth Initiatives • Test TRANSIMS Model • Evaluate Financial Requirements & Policy of Rail Airport Access	• Evaluate & Document Linkages of Site Design & Transit Use • Deploy TRANSIMS • Develop Viable Finance Strategies for Regional Rail Projects • New Starts Guidance
4.6 PROFESSIONAL CAPACITY BUILDING	• Monitor Career Placement of Graduates of University Transportation Centers • Complete & Publish Case Studies Linking Training to Capital Equipment, Labor & Management • Prepare & Publish on FTA Internet Web Site Current Information on New Technology & Innovative Practices	• Develop Transit Training Courses & Materials for Community Colleges & Technical Schools • Modify NTI Curriculum to Adapt Above for use by Colleges & Universities • Develop & Document Transit Job • Integrate Information Management FTA/TCRP/UTCP/NTI into Fully Coordinated Systems

Table 4.1 Short-Term and Long-Term Product Milestones **Part 3**

4.1 Safety and Security

The strategic goal of the FTA Passenger Safety and Security emphasis area is to achieve the highest practical level of passenger safety and security in all modes of transit through a comprehensive program of research, technology deployment, training, and technical assistance information dissemination. While crime prevention is primarily a local responsibility, potential transit riders are deterred unless they perceive the entire trip, including waiting areas to be safe and secure. National security concerns have heightened the need for an effective, innovative anti-terrorism system coupled with appropriate response measures. Advanced technologies must be tested and evaluated in the transit environment to determine whether they reduce crime and counter terrorism. Measurable safety and security improvements are needed in many environments, including facilities, vehicles, parking lots shelters, and stations.

Research, evaluation, and testing will be the short-term focus for the three programs under this emphasis area. Development of standards and mainstreaming will address transferring knowledge gained in previous years through training, information dissemination, and identification of best practices. Delivery of new technologies and approaches developed through research, testing, and evaluation will occur over the long-term. *See the Safety & Security route-map at the end of this chapter.*

Through the Rail Transit Rail Grade Crossing Safety program, FTA will mainstream the usage of full-closure, four-quadrant railroad gates, and graphic warning signals and imaging detection systems for light rail operations in mixed traffic in the short term. Over the long-term, FTA will develop a gate control system that integrates railcar approaches with roadway vehicle warnings through radio communications. Testing and deployment of these systems will occur through the joint partnership programs, including partnerships with the Federal Highway Administration (FHWA) and the Federal Railroad Administration (FRA). Dissemination of joint FTA and FHWA Intelligent Transportation Systems (ITS) rail transit grade-crossing demonstration activities will be conducted. Mainstreaming will occur through the normal equipment grant process.

FTA's Information Security Program will, in the short-term, evaluate the vulnerability of transit Information Systems to intruders and methods to prevent such actions. These findings will be shared with transit authorities to ensure continued operational integrity. Over the long-term, FTA will support general research and testing in the areas of financial systems and default prevention. Additional research and technology development activities will be completed in preparation for the Winter Olympics scheduled for 2002 in Salt Lake City, Utah. Work in this area begins in evaluating the integrity of information and computer networks to be used to deliver public transportation services at the Olympic Games. Deployment and mainstreaming will occur in time for the Olympics in 2002.

Research and technology development in the Anti-Terrorism program will, in the short-term, focus on detection and countermeasure methods for chemical and biological attacks in subway environments. Chemical detection and recovery measures will be tested, with U.S. Department of Defense (USDOD) technical assistance. FTA will provide interim emergency management guidelines and training procedures to the industry. In the long-term, integrated measures against both chemical and bio-

logical attacks will be incorporated into one anti-terrorism module to be standardized for the transit industry and deployed through the regular capital grants program.

4.2 Equipment & Infrastructure

The strategic goal of the Equipment and Infrastructure program is to achieve the highest level of passenger service and comfort by applying technology to increase the capacity and quality of transit service. The FTA has historically supported equipment and infrastructure research and technology development. Some of the projects included in this plan are continuations of earlier work. Other projects use early work as a platform to build on. For example, much of the research and technology work in the Bus Equipment area relies on technology development and information collected as part of the Advanced Technology Transit Bus program. *See the Equipment & Infrastructure route-map at the end of this chapter.*

FTA, through the Bus Equipment program, will support completion of the ATTB program with the Los Angeles County Metropolitan Transportation Authority (LACMTA) in the short-term. The completion calls for the delivery and testing of six prototypes, documentation of test results, and industry deployment workshops. LACMTA has announced its intention to purchase 100 vehicles and the Massachusetts Bay Transportation Authority (MBTA) is pursuing acquisition of ATTB-type dual mode trolley buses. FTA will provide LACMTA, MBTA, and other interested transit agencies with direct technical assistance to deploy advanced technology buses and subsystems. Also in the short-term, FTA will distribute technical data packages to domestic bus suppliers with ATTB field testing data.

In the long-term, FTA will use the ATTB platform for the small durable transit bus, hybrid electrical, and electric trolley buses. The small durable transit bus will be developed through industry partnering with the cooperation of transit operators, in order to ensure uniform bus specifications, and to increase the market size.

Other bus equipment activities include the addition of the DYNTRAC Structural Bus Shaker System to the Altoona, PA Bus Test Facility. Also, the Altoona Bus Testing Management Oversight Report will be produced for review, with the intent to improve future bus operations. Over the long-term, these computer simulation techniques will be developed and deployed for bus prototype simulation. Simulation activities will be conducted in parallel with the other bus development programs, including the small durable transit bus and hybrid-electric bus.

In the short term period, the Georgetown University Fuel Cell program will continue to demonstrate the phosphoric acid fuel cell powered transit bus and evaluation. The proton exchange membrane fuel cell propulsion unit will also be demonstrated and evaluated. Over the long-term, direct use of hydrogen will be tested for use as a fuel cell. Currently, hydrogen is produced by an on-board reformer, which adds system complications and increases the weight of the bus. The hydrogen fuel cell effort will explore more efficient ways to employ this technology, and will be done in collaboration with the Defense Advanced Research Projects Agency and other branches of the military.

FTA will continue research and development activities for hybrid electric and electric buses. In the short-term, tasks will focus on existing hybrid programs like the demonstration of DUETS and the USDOD Hybrid Electric Vehicle for a range of power and drive-train systems suitable for a wide range of transit deployments.

Over the long-term, FTA will look to commercialize hybrid electric and electric buses. Long-term research will occur through joint partnerships with the USDOD and the USDOE.

In the short-term, FTA will focus Rail Equipment and Infrastructure activities on completion of the Advanced Automatic Train Control (AATC) project with the Bay Area Rapid Transit (BART) system. This will include demonstration and testing on an operational segment of the BART rail network. FTA will also monitor AATC deployment on the Canarsie Line of the NewYork City Metropolitan Transit Authority. This locally funded project has potential applications for other similar transit authorities. FTA will work with the transit industry to establish open architecture guidelines for Communication-Based Train Control technology in the short-term. Long-term activities will include deployment of CBTC systems in at least three major subway systems in the U.S., and deployment of wide-spectrum radio technology.

For Civil Infrastructure, in the short-term, FTA will initiate research to document construction methods that can curb escalating construction costs. FTA will specifically address tunnel design approaches, and construction experiences in station excavation. FTA will disseminate this information to the transit agencies through workshops on construction technology. The long-term objective is to use the vast experience in the civil construction communities in transit and other infrastructure projects to introduce project management innovations and to establish standards and orderly procedures for negotiation of change orders. At present, all five of the Turnkey Demonstration Program demonstration projects are either underway or completed. In the short-term, FTA will complete documentation of the Baltimore and Los Angeles demonstration projects and monitoring will continue on the San Juan Tren Urbano, New Jersey Hudson Bergen and San Francisco BART projects. By 2003, all of the demonstration projects are expected to be in revenue service and FTA will disseminate information and prepare guidance on the use of the turnkey method.

In the short-term, FTA will document the best Innovative Financing practices, undertake Infrastructure Finance Workshops, and provide technical assistance to transit systems currently developing project or equipment financing procurements or programs. In the long-term, innovative financing projects will include evaluation of state infrastructure bank performance and joint-development value capture projects.

4.3 Fleet Operations

The Fleet Operations Program Area supports the FTA strategic goals to shape America's future by ensuring a transportation system that is accessible, integrated, efficient, offers flexibility of choices and can advance America's economic growth and competitiveness domestically and internationally through efficient and flexible transportation. All phases of the research and technology projects will be addressed in both the short- and long-term for program and projects in the fleet operations area. Much of the research and development is designed to end with best practices that will be conveyed through technical assistance. The focus of short-term research, testing, and evaluation is identifying and assessing methods developed by transit and other transportation organizations. Work in one project area, such as Mixed Rail Corridor Operation, will provide inputs into other projects, such as the Bus Rapid Transit program. This integration of efforts is a major focus of research and technology development in this area. *See the Fleet Operations route-map at the end of this chapter.*

Short-term Transit Capacity and Quality of Service efforts will include research and analysis into operational quality and capacity of service for surface transit system buses, light rail, and commuter rail. This research will pay particular attention to the impact of signal priority systems. The results of this effort will be used to provide information for updating the Year 2000 Highway Capacity and Quality of Service Manual. Over the long-term, efforts will focus on developing and conducting training and information sharing to encourage use of this Manual.

Activities for the Transit Intelligent Transportation Systems will focus on Metropolitan ITS, Rural ITS, the Intelligent Vehicle Initiative, and National Architecture and Standards. The major short-term Metropolitan ITS activity is the selection of five metropolitan areas for deployment of this system and actual deployment in these metropolitan areas. FTA will also continue to support research of ITS ergonomics, the refinement of individual ITS components, and operational tests on technologies such as Autonomous Dial-A-Ride Transit (ADART) and automatic fare collection systems. For Rural ITS, in the short-term, FTA will conduct operational tests and deployment in selected sites. FTA will conduct workshops on Rural ITS and assist the Transit Standards Consortium. The near-term emphasis for the Intelligent Vehicle Initiative will be defining specific IVI service characteristics that are beneficial to mass transit and ITS users at large. User service requirements and service integration will also occur and demonstration sites will be selected. Over the long-term, IVI will be deployed and mainstreamed.

The National Architecture and Standards will help the transit community achieve ITS systems integration, interoperability, and compatibility with other transportation operators. In the short term, it is anticipated that Congress will require Federally funded ITS projects to be consistent with the ITS National Architecture. In anticipation of this, USDOT is initiating a process to develop policy guidance on consistency with the National Architecture. With support from USDOT, several standards and protocols are being developed by accredited Standards Development Organizations (SDO). FTA has funded the Institute of Transportation Engineers, an SDO, to develop the Transit Communication Interface Profiles. TCIP is a set of standards for transit communications that provide the interfaces among transit applications, and allow data to be shared among transit departments and other operating entities such as emergency response services and regional traffic management centers. To assist in the implementation of standards and protocols, USDOT plans on implementing several policies and processes to adopt certain standards and protocols. In the long term, FTA and APTA will be launching the Transit Standards Consortium to serve as a forum for discussing standards issues and prioritizing standards needs. Also in the long term, international standards will be developed to uniform the system and procurement specifications, seek new markets abroad and enhance U.S. global competitiveness.

In the short term, the Bus Rapid Transit program will focus on operational and design parameters necessary for such a system, promoting the concept through the media and industry-sponsored events, and identifying five or more sites to deploy BRT. Long-term activities include monitoring deployment, documenting lessons learned, and mainstreaming the BRT concept through the planning program. FTA will also update planning and project devel-

opment guidance to acknowledge the benefits of BRT as it relates to ongoing and upcoming major investment studies.

Mixed Rail Corridor Operations activities will, in the short term, address the operation of light rail systems operating on freight corridors. FTA, in partnership with the FRA, will consult on the development of operating standards, guidelines, and requirements to provide adequate operating safety. FTA will work with the industry to develop passenger vehicle safety standards for light rail vehicles to be operated in mixed corridors. This short-term effort will also address adoption of CBTC. Research on the standards and guidelines, operations, equipment and train control, will begin in the short term. Over the long term, joint operating standards and guidelines will be adopted by national standards setting bodies. These standards will address and comply with FRA requirements regarding mixed corridor operations. FTA will work with FRA and the National Transportation Safety Board (NTSB) to implement joint requirements for passenger vehicle crashworthiness and occupant projection. FTA will work with the industry to implement requirements for adoption of CBTC.

4.4 Specialized Customer Services

The strategic goal of the Specialized Customer Services program area is to ensure a transportation system that is accessible, integrated, and efficient and offers flexibility of choices to riders and enhances communities. Activities are tailored to address the needs of low-income, the elderly, and persons with disabilities. Other targeted markets are central city neighborhoods and low-density rural and suburban areas. Short-term efforts in the specialized transportation service area will concentrate on research, testing, and evaluation. Some deployment and mainstreaming will be necessary to address other policy initiatives, the major one being Welfare Reform. In the long-term, guidelines and information will be deployed and mainstreamed. *See the Specialized Customer Services route-map at the end of this chapter.*

Exogenous factors are driving Welfare to Work research and technology development. Federal and state welfare reform requirements have made it necessary for alternatives to be identified to provide transportation options to people who must get jobs and will lose welfare benefits. Short-term work in this area will cover all stages of the research and technology development process, including the use of ITS and Geographic Information System technologies to address this issue. Long-term efforts will focus on mainstreaming lessons learned in the short term through technical assistance.

Providing transit access to persons with disabilities is a focus of FTA and transit industry activities. In the short term, a market analysis of demand for ADA services by categories of disability will be undertaken and completed. A report will be produced and disseminated which describes the extent to which ADA paratransit and human services transportation services are coordinated. Standards will be developed for station and stop signage and other information.

FTA will address Elderly Services in the short term through a market analysis of demand for elderly services. This study will help the transit industry understand better the transportation needs of the elderly and will help determine how transit can address those needs. An evaluation of existing services will be performed in FY 2000 and will be followed up by deploying selected services for the elderly market. Service guidelines will be developed and disseminated in FY 2001 and mainstreaming activities such as information sharing will be undertaken.

Research into the service needs of people in low density areas will be the short-term focus of the Low-Density Transportation Services effort. Different types of services will be tested and evaluated. A major issue will be evaluation of performance costs. In the long-term, services to low-density areas will be deployed and best practices documented.

The first project to be completed under the Mobility Management Program is the New Paradigms Study on Mobility Management that was completed in 1998. FTA will conduct workshops nationwide to discuss the new paradigms of mobility management in the areas of institutional arrangements, service strategies, and financial management. In the short term, FTA will initiate Mobility Management deployments involving Welfare to Work, ADA, Elderly Services, and ITS regional travel management and information services. In the long term, FTA will undertake deployment of a Community Transportation Vehicle to serve a variety of community-based transportation needs and of the ADART system. A Mobility Management Best Practices Guide will also be produced.

4.5 Policy and Planning

The goal of research in Transportation Policy and Planning is to improve the quality and scope of the information given to decision-makers on the various transportation options available and the impacts of those options. Sound investment decisions by Federal, State, and local government officials and policy makers require knowledge of the social, economic, and environmental costs, and the mobility and accessibility benefits, of alternative courses of action. This policy and planning research will: provide information on transit and intermodal performance, conditions, and needs; improve the acceptability of alternative institutional arrangements for providing mobility services; develop better approaches to multimodal system evaluation; explore the transportation implications of sustainable development issues; seek ways to ensure intermodal connectivity; and exploit the latest advancements in planning technologies in providing these and more traditional planning data.

New transportation institutions are being created and new institutional missions are being formulated to support mobility management and service coordination. The new or reinvented transportation service providers constitute an experiment in transportation innovation, the results of which will be evaluated and promulgated by FTA. In the near-term, FTA will study the accessibility of various population segments to jobs and amenities, identify travel markets conducive to servicing through non-traditional mobility providers and the impediments to expansion of the missions of traditional transit agencies. In the long-term, the impact of the new kinds of institutional arrangements on the mobility of targeted customers, and the role of ITS technologies in breaking down institutional barriers will be evaluated. The lessons learned will be communi-

cated through case studies, peer exchanges, and NTI courses. *See the Policy & Planning route-map at the end of this chapter.*

In the near-term, the FTA in cooperation with FHWA, will continue to study and test various approaches to the comparative evaluation of modal and multimodal options. FTA will refine its implementation of the statutory New Start criteria for evaluating New Start projects, in consultation with the transit industry, and develop a standard for New Start evaluation. In support of these research efforts, FTA is developing methods to quantify the economic benefits of transit investments and a new model for estimating transit investment requirements called the Transit Economic Requirements Model. Ongoing, annual activities which will be continued include the assessment of the effects of the FTA program, the analysis of transit industry trends, and the reporting of transit performance, conditions, and needs. Updates of reports on "Characteristics of Urban Transportation Systems" (CUTS) and "Characteristics of Urban Transportation Demand" (CUTD) will be included.

The ultimate goal of these efforts is improved decision support in the multimodal transportation environment created by ISTEA. Therefore, long-term activities will serve to put the products of the earlier research into practice through NTI courses in the development and evaluation of multimodal transportation alternatives and the development of a model college curriculum in multimodal transportation planning.

FTA has been cooperating with the FHWA and EPA in the development of a new approach to travel demand forecasting, the process that supports decision-making about the future expansion of our transportation system. Known as the Transportation Analysis and Simulation System or TRANSIMS, this computerized modeling system is based on techniques developed for defense applications and will provide more detailed information on traffic flows and the resulting impacts, especially air quality. In the near-term, the partners in this effort will be field-testing the computerized system in Portland, Oregon, and other cities will also be selected. These tests will lead to refinements of the models, evaluations of the benefits and challenges in using the new models, and the wider acceptance of the models for use in metropolitan and statewide transportation planning. In the long-term, the models will be mainstreamed into the transportation planning community through additional research into the implementation needs of the models such as integration of advanced computer systems and data capture methods, and courses on applying the new methods.

Intelligent Transportation System elements, such as electronic toll and fare collection devices, will become one of the key methods for generating and capturing the detailed travel data that feed these new transportation models. In the near-term, co-development of ITS feedback loops to provide policy and planning information is essential. In the long-term, standard architectures for these feedback loops will be designed, and implementation of ITS feedback will be initiated through demonstrations and other educational efforts.

Full exploitation of the new geographic information systems which support the merging of transportation planning with land use and environmental planning is the goal of other research activity in this area. In the near-term, an evaluation of existing GIS planning applications will

be conducted and promulgated. In the long-term, a standard approach to the use of GIS in comprehensive community planning will be developed and educational efforts initiated to encourage exploitation of this technology.

In the near-term, FTA plans to evaluate the impacts and effectiveness of past investments in transit-supportive development and other concepts of the Livable Communities Initiative. Case studies of these experiences will be documented. Supporting research into the extent to which transit investments have influenced land use decisions will be continued. Exemplary zoning and transportation system management ordinances and practices that support transit will be documented. In the long-term, FTA will team with FHWA to develop a comprehensive approach to transportation, land use, and environmental planning. Throughout the time frame of the plan, FTA will continue its support of the Urban Consortium, a multi-organizational forum for discussion, education, and outreach on issues of livability and sustainability. Land use courses conducted by the National Transit Institute will also continue to stimulate thinking and learning about these issues.

4.6 Professional Capacity Building

The Secretary's Strategic Plan and transportation industry strategic planning recommendations both identify the need to attract and maintain an educated workforce to assure economic prosperity in the 21st Century. FTA's program initiatives to build professional capacity in the transportation industry are directly linked to this goal. The Federal government has an appropriate and vital interest in assisting transit agencies to improve performance and increase productivity, and professional capacity building is a means to those ends. In the short-term, the focus of activities in this area will be training and re-training existing employees. Ongoing programs are supported in cooperation with the National Transit Institute, the Transportation Research Board, and national associations such as the American Public Transit Association, the Community Transportation Association of America, and organized labor.

Professional Capacity Building activities will focus on upgrading existing skills, strengthening organizational relationships, and exploring short-term solutions and innovative human resource practices designed to meet performance and productivity demands. In the long term, FTA will put emphasis in attracting new and diverse professionals to the industry while changing institutional relationships necessary to respond to the needs and interests of the next generation of transit professionals. NTI, TCRP and the University Transportation Centers Program (UTCP) will focus on using common resources to promote training, education, and practical research. *See the Professional Capacity Building route-map at the end of this chapter.*

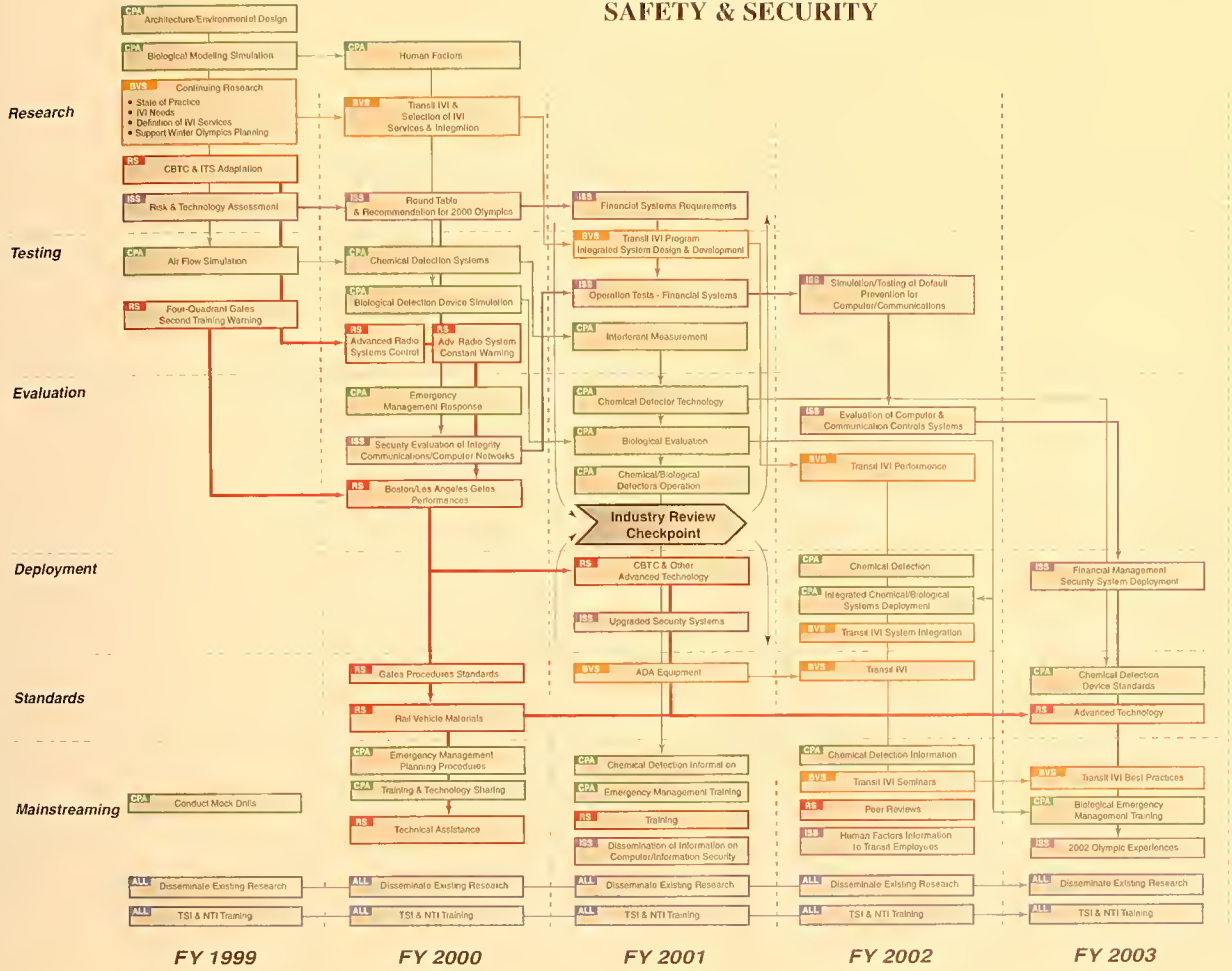
To attract a quality workforce, FTA has established the National Transit Internship program in partnership with APTA and universities that have supported research into the Turnkey Demonstration Program and other major capital investment projects. FTA will contribute to the education and research elements of the University Transportation Centers Program (UTCP) with the intent of attracting UTCP graduates to careers in transit. In the long term, the National Transit Internship Program will be fully tested and institutionalized into transit. Job standards efforts will produce training in the community

colleges and technical schools producing a fully integrated apprenticeship program.

The Training a Quality Workforce Program will, in the short term, focus on NTI working closely with FTA program offices to develop a curriculum linked to new authorization requirements and standards. Results of UTCP and TCRP research will be linked to NTI training in terms of courses, workshops and seminars. International experts will start to be used in both NTI and UTCP. In the long term, NTI will explore distance-based learning using the Internet and CD-ROM applications. NTI and the National Highway Institute (NHI) will work together to support ITS and other new technology initiatives. Training standards will be fully documented and tested in major capital acquisitions along with performance standards geared to increase productivity.

In the short term, FTA will support efforts to retain a quality workforce through Labor/Management Cooperative Workshops developed by TCRP. These regional workshops will draw on experience from transit and the private sector. A skills inventory will be undertaken in line with the TCRP New Paradigm efforts. Institutional changes dealing with worker effectiveness will be examined for future application and mainstreaming. Workplace violence and worker safety programs will be mainstreamed through NTI and in-house training. In the long term, labor/management work site teams and other innovative practices will reflect a new relationship with organized labor.

SAFETY & SECURITY



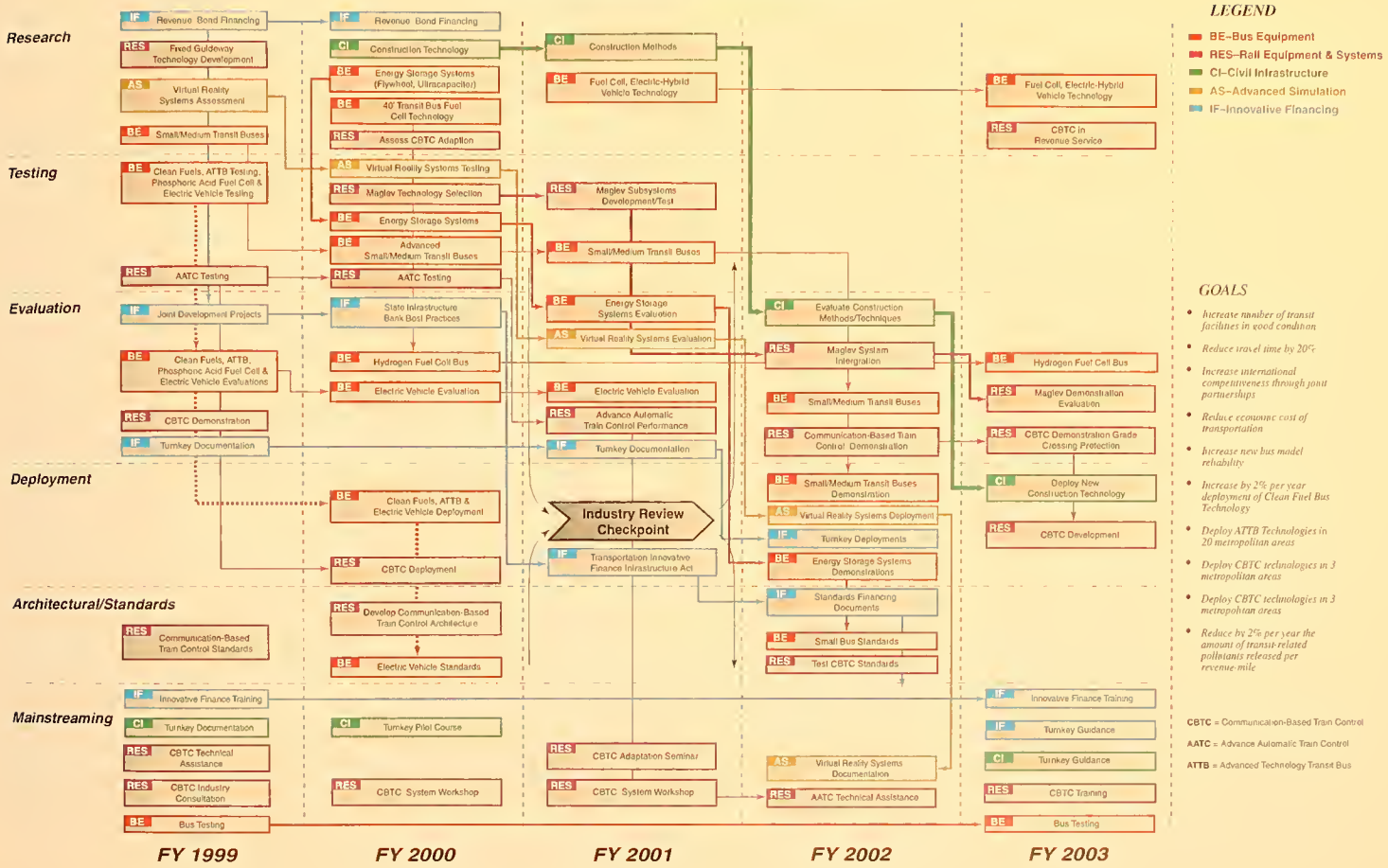
LEGEND

- CPA–Crime Prevention & Anti-Terrorism
- RS–Railroad Safety
- ISS–Information Systems Security
- BVS–Bus Vehicle Safety
- ALL

GOALS

- *Increase the number of transit properties with security plans*
- *Reduce transit injuries and fatalities*
- *Reduce transit crimes against patrons, employees and property*
- *Deployment of safety technology applications*

EQUIPMENT & INFRASTRUCTURE



LEGEND

- BE–Bus Equipment
- RES–Rail Equipment & Systems
- CI–Civil Infrastructure
- AS–Advanced Simulation
- IF–Innovative Financing

GOALS

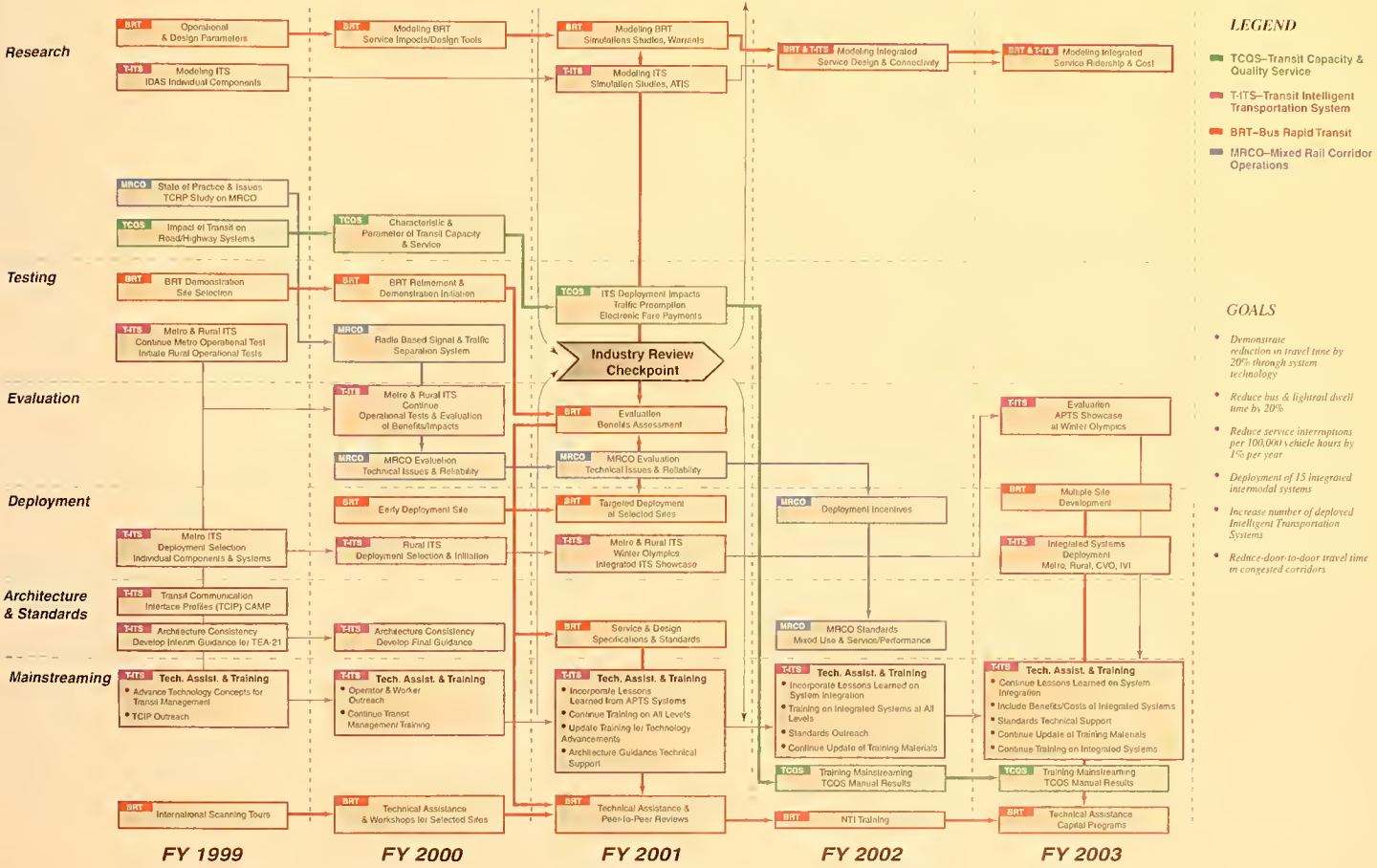
- *Increase number of transit facilities in good condition*
- *Reduce travel time by 20%*
- *Increase international competitiveness through joint partnerships*
- *Reduce economic cost of transportation*
- *Increase new bus model reliability*
- *Increase by 2% per year deployment of Clean Fuel Bus Technology*
- *Deploy ATTB Technologies in 20 metropolitan areas*
- *Deploy CBTC technologies in 3 metropolitan areas*
- *Deploy CBTC technologies in 3 metropolitan areas*
- *Reduce by 2% per year the amount of transit-related pollutants released per revenue-mile*

CBTC = Communication-Based Train Control

AATC = Advance Automatic Train Control

ATTB = Advanced Technology Transit Bus

FLEET OPERATIONS



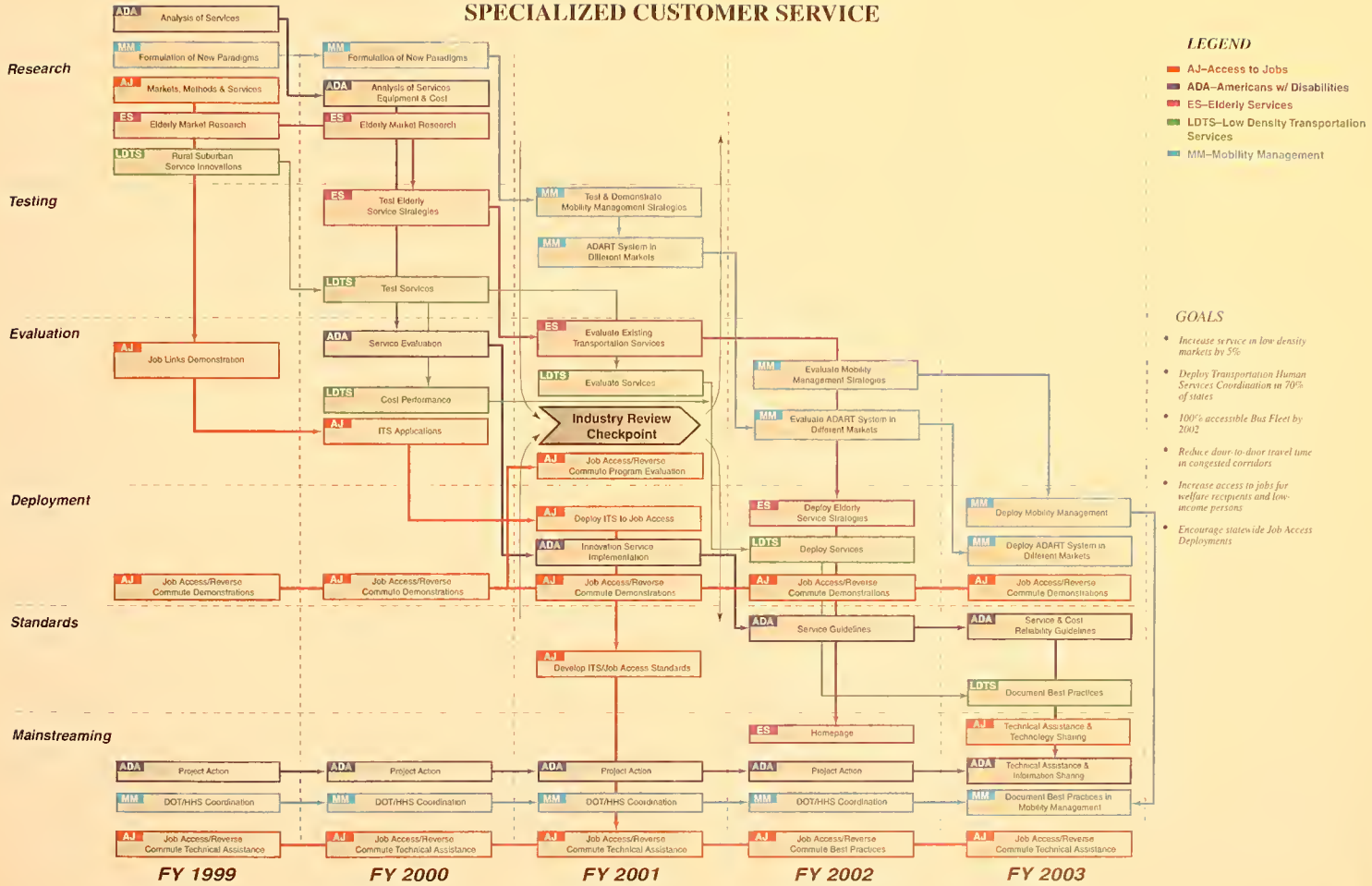
LEGEND

- TCOS–Transit Capacity & Quality Service
- T-ITS–Transit Intelligent Transportation System
- BRT–Bus Rapid Transit
- MRCO–Mixed Rail Corridor Operations

GOALS

- *Demonstrate reduction in travel time by 20% through system technology*
- *Reduce bus & light rail dwell time by 20%*
- *Reduce service interruptions per 100,000 vehicle hours by 1% per year*
- *Deployment of 15 integrated intermodal systems*
- *Increase number of deployed Intelligent Transportation Systems*
- *Reduce door-to-door travel time in congested corridors*

SPECIALIZED CUSTOMER SERVICE

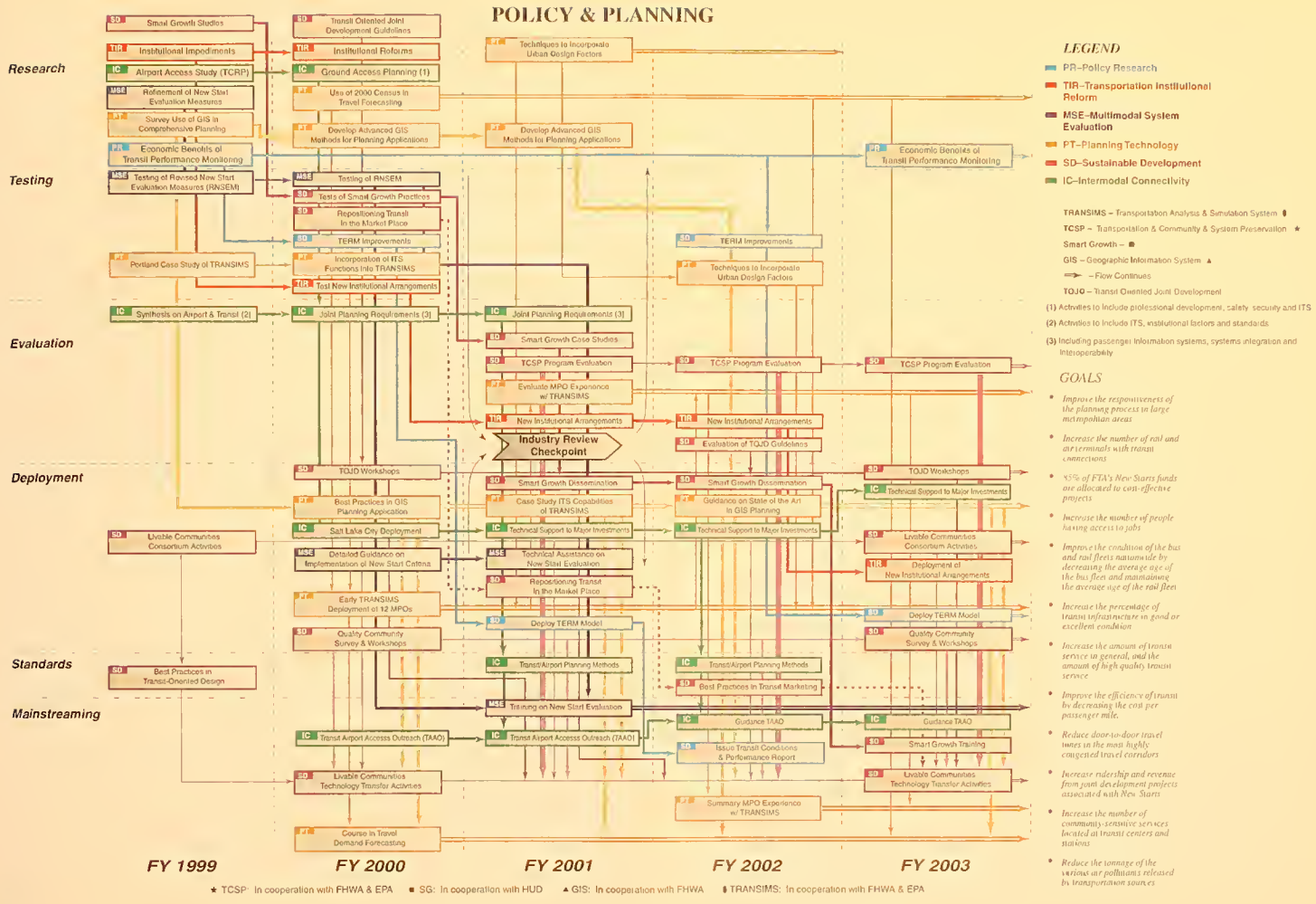


LEGEND

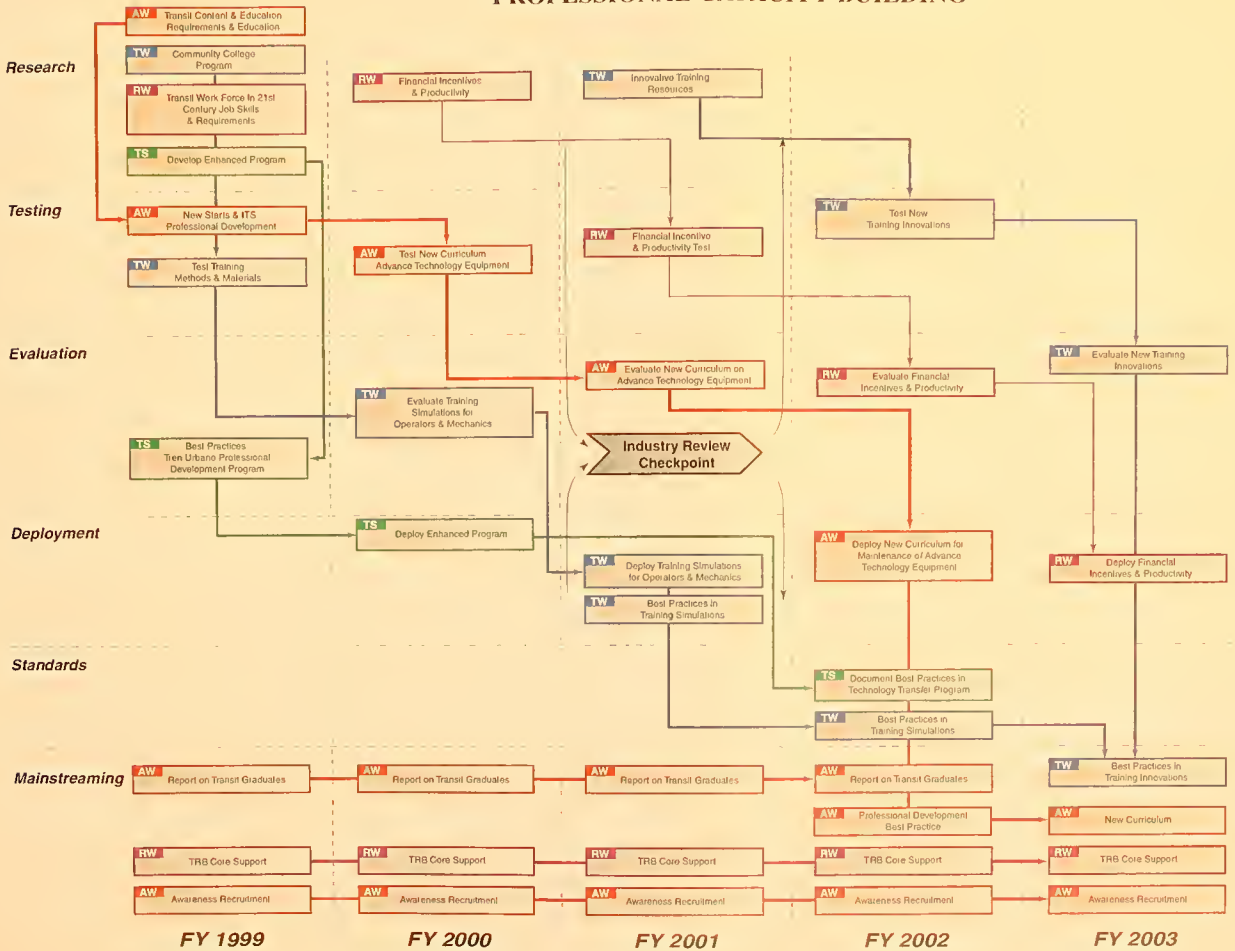
- AJ–Access to Jobs
- ADA–Americans w/ Disabilities
- ES–Elderly Services
- LDTS–Low Density Transportation Services
- MM–Mobility Management

GOALS

- *Increase service in low density markets by 5%*
- *Deploy Transportation Human Services Coordination in 70% of states*
- *100% accessible Bus Fleet by 2002*
- *Reduce door-to-door travel time in congested corridors*
- *Increase access to jobs for welfare recipients and low-income persons*
- *Encourage statewide Job Access Deployments*


POLICY & PLANNING
Research
Testing
Evaluation
Deployment
Standards
Mainstreaming
Smart Growth Studies
Institutional Impediments
Airport Access Study (TCRP)
Refinement of New Start Evaluation Measures
Survey Use of GIS in Comprehensive Planning
Economic Benefits of Transit Performance Monitoring
Testing of Revised New Start Evaluation Measures (RNSEM)
Portland Case Study of TRANSIMS
Synthesis on Airport & Transit (2)
Livable Communities Consortium Activities
Best Practices in Transit-Oriented Design
Transit Oriented Joint Development Guidelines
Institutional Reforms
Ground Access Planning (1)
Use of 2000 Census in Travel Forecasting
Develop Advanced GIS Methods for Planning Applications
Testing of RNSEM
Tests of Smart Growth Practices
Repositioning Transit in the Market Place
TERM Improvements
Incorporation of ITS Functions into TRANSIMS
Test New Institutional Arrangements
Joint Planning Requirements (3)
TOJD Workshops
Best Practices in GIS Planning Application
Salt Lake City Deployment
Detailed Guidance on Implementation of New Start Criteria
Early TRANSIMS Deployment of 12 MPOs
Quality Community Survey & Workshops
Transit Airport Access Outreach (TAAO)
Livable Communities Technology Transfer Activities
Course in Travel Demand Forecasting
Techniques to Incorporate Urban Design Factors
Develop Advanced GIS Methods for Planning Applications
Joint Planning Requirements (3)
Smart Growth Case Studies
TCSP Program Evaluation
Evaluate MPO Experience w/ TRANSIMS
New Institutional Arrangements
Industry Review Checkpoint
Smart Growth Dissemination
Case Study ITS Capabilities of TRANSIMS
Technical Support to Major Investments
Technical Assistance on New Start Evaluation
Repositioning Transit in the Market Place
Deploy TERM Model
Transit/Airport Planning Methods
Training on New Start Evaluation
Transit Airport Accesss Outreach (TAAO)
TERM Improvements
Techniques to Incorporate Urban Design Factors
TCSP Program Evaluation
New Institutional Arrangements
Evaluation of TOJD Guidelines
Smart Growth Dissemination
Guidance on State of the Art in GIS Planning
Technical Support to Major Investments
Transit/Airport Planning Methods
Best Practices in Transit Marketing
Guidance TAAO
Issue Transit Conditions & Performance Report
Summary MPO Experience w/ TRANSIMS
Economic Benefits of Transit Performance Monitoring
TCSP Program Evaluation
TOJD Workshops
Technical Support to Major Investments
Livable Communities Consortium Activities
Deployment of New Institutional Arrangements
Deploy TERM Model
Quality Community Survey & Workshops
Guidance TAAO
Smart Growth Training
Livable Communities Technology Transfer Activities
FY 1999
FY 2000
FY 2001
FY 2002
FY 2003
★ TCSP: In cooperation with FHWA & EPA ■ SG: In cooperation with HUD ▲ GIS: In cooperation with FHWA ▮ TRANSIMS: In cooperation with FHWA & EPA
LEGEND
PR–Policy Research
TIR–Transportation Institutional Reform
MSE–Multimodal System Evaluation
PT–Planning Technology
SD–Sustainable Development
IC–Intermodal Connectivity
TRANSIMS – Transportation Analysis & Simulation System ▮
TCSP – Transportation & Community & System Preservation ★
Smart Growth – ■
GIS – Geographic Information System ▲
– Flow Continues
TOJD – Transit Oriented Joint Development
(1) Activities to include professional development, safety, security and ITS
(2) Activities to include ITS, institutional factors and standards
(3) Including passenger information systems, systems integration and interoperability
GOALS
Improve the responsiveness of the planning process in large metropolitan areas
Increase the number of rail and air terminals with transit connections
95% of FTA's New Starts funds are allocated to cost-effective projects
Increase the number of people having access to jobs
Improve the condition of the bus and rail fleets nationwide by decreasing the average age of the bus fleet and maintaining the average age of the rail fleet
Increase the percentage of transit infrastructure in good or excellent condition
Increase the amount of transit service in general, and the amount of high quality transit service
Improve the efficiency of transit by decreasing the cost per passenger mile
Reduce door-to-door travel times in the most highly congested travel corridors
Increase ridership and revenue from joint development projects associated with New Starts
Increase the number of community-sensitive services located at transit centers and stations
Reduce the tonnage of the various air pollutants released by transportation sources

PROFESSIONAL CAPACITY BUILDING



LEGEND

- AW–Attracting Workforce
- TW–Training Workforce
- RW–Retaining Workforce
- TS–Technology Sharing

GOALS

- *Increase the number of National Transit Institute (NTI) training courses conducted*
- *Increase the number of participants in NTI training*
- *Increase the number of University Transportation Center (UTC) students enroll in transit-related courses*
- *Increase the number of UTC graduates working in transit-related agencies or organizations*
- *Increase customer service ratings by 5% every two years*

TRB = Transportation Research Board

5.0 Implementation Methods

The FTA serves as a partner, sponsor, and funding source of transit research and technology development activities. Its role in implementing the programs and projects identified in Chapter 3 within the time periods identified in Chapter 4 requires working with the transit industry, other private sector organizations, and other government agencies. Implementation can occur through established avenues, such as the National Transit Research and Technology Program, other FTA assistance programs, or through partnerships with other agencies.

Successfully accomplishing the goals of the programs within the next five years, as described in the route maps, will depend upon FTA's ability to form partnerships with public and private sector organizations willing to advance transit innovations and join in leading the innovation process. Many of the activities in this plan will require commitments of staff and funds from these sponsoring partners as well as from FTA and other federal agencies.

Program support is an important activity in effective implementation of the FTA Research and Technology Programs. This would include information and communication activities and project management. The information and communication activity will also include the periodic updating of the FTA Research and Technology Five-Year Plan. The development and preparation of websites, brochures and guides, and project specific publications will be supported by this activity. Other support activities include participation in workshops, seminars, conferences, and other events.

Given the technical complicity of various research and technology activities, project management support is warranted. Systems engineering, electrical engineering, and mechanical engineering contractors may provide this project management support. This management support activity includes contract management, monitoring and commenting on technical direction, reporting on progress, and recommending remedial action if necessary. Project management support will be negotiated with the project sponsors or recipients prior to final approval of grant or contract awards.

Table 5.1, on the next page, shows the phases in the research and technology process and the applicable organization or method for carrying out each phase. Descriptions of these organizations and methods fall into three areas, FTA National Transit Research and Technology Program, Other FTA Programs, and Partnerships.

5.1 National Transit Research & Technology Program

The FTA National Transit Research and Technology Program (National Program) includes several complementary programs authorized by ISTEA and earlier legislation now codified as sections of 49 U.S.C. Chapter 53. As part of its

National Program, FTA participates in the Small Business Innovation Research Program, which is Government-wide and authorized by its own legislation. The FTA National Transit Research and Technology Program consists of the following activities:

- **National Program of Transit Planning and Research**
- **Transit Cooperative Research Program**
- **University Transportation Centers Program**
- **Small Business Innovation Research Program**
- **Joint Partnership Program for Deployment of Innovation**
- **National Transit Institute**
- **Rural Transit Assistance Program**
- **National Transit Database**
- **International Mass Transportation Program**
- **Transportation Safety Institute**

IMPLEMENTATION METHOD	Research	Testing	Deployment	Evaluation	Standards/ Architecture	Mainstreaming
5.1 FTA National Transit Research & Technology Program						
5.1.1 National Program of Transit Planning & Research	■	■	■	■	■	■
5.1.2 Transit Cooperative Research Program	■	■		■	■	■
5.1.3 University Transportation Centers Program	■		■		■	
5.1.4 Small Business Innovation Research Program	■					
5.1.5 Joint Partnership Program for Deployment of Innovation		■	■			■
5.1.6 National Transit Institute						■
5.1.7 Rural Transit Assistance Program				■		■
5.1.8 National Transit Database	■	■	■	■	■	■
5.2 Other FTA Programs						
5.2.1 State Planning & Research	■	■		■		■
5.2.2 Metropolitan Planning				■		■
5.2.3 Capital Assistance			■		■	
5.3 Partnerships						
5.3.1 Partnerships with Federal & State Agencies	■	■	■	■	■	■
5.3.2 Standards Development Organizations	■		■			

Table 5.1 Applicability of Research and Technology Implementation Methods

5.1.1 National Program of Transit Planning & Research

The National Transit Planning and Research (TPR) Program is funded under 49 U.S.C. Section 5314, which authorizes funding of several different types of research, training, education, human resources, and planning activities. The most fundamental of these is 49 U.S.C. Section 5312(a), Research, Development, and Demonstration Projects, successor to a demonstration program first enacted in 1961 and amended in 1964. The TPR provides a highly flexible means of carrying out any or all of the stages of the innovation process: research, testing, evaluation, deployment, standards/architecture development, and mainstreaming.

The National TPR Program is FTA's principal means of carrying out data collection and analysis, much of which is required by statute, and for providing technical assistance to the transit industry. It also provides an effective means for prompt articulation and initiation of FTA's response to new challenges, problems, issues and opportunities. Table 5.2 and 5.2b summarize funding provided for the National TPR Program for the past four fiscal years.

	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000
National Program					
Safety & Security	1,376	725	2,500	2,200	5,450
Equipment & Infrastructure	13,725	15,900	18,729	9,750	11,600
Fleet Operations			550	4,250	3,800
Specialized Customer Services	4,509	3,000	4,950	6,400	4,050
Policy & Planning	2,550	570	2,412	2,550	4,100
Professional Capacity Building	1,182	1,805	3,609	2,550	4,100
Transit Cooperative Research Program	8,250	8,250	4,000	8,250	8,250
University Transportation Centers Program	6,000	6,000	6,000	6,000	6,000
National Transit Institute	3,000	3,000	3,000	4,000	4,000
Subtotals	**40,592**	**39,250**	**45,750**	**45,950**	**51,750**
Job Access/Reverse Commute Program				75,000	150,000
FTA Capital Assistance		15,213	2,672	7,850	13,717
Low-Speed Urban MAGLEV				8,531	5,000
DOT ITS Joint Program Office	2,870	2,517	3,980	12,800	7,500
FHWA	375	200			
NHTSA	35				
DARPA	878		65		
TOTALS	**44,750**	**57,180**	**52,467**	**150,131**	**227,967**

Table 5.2 Funding for FTA Research & Technology Programs

National Transit Planning & Research

(Dollars in thousands)

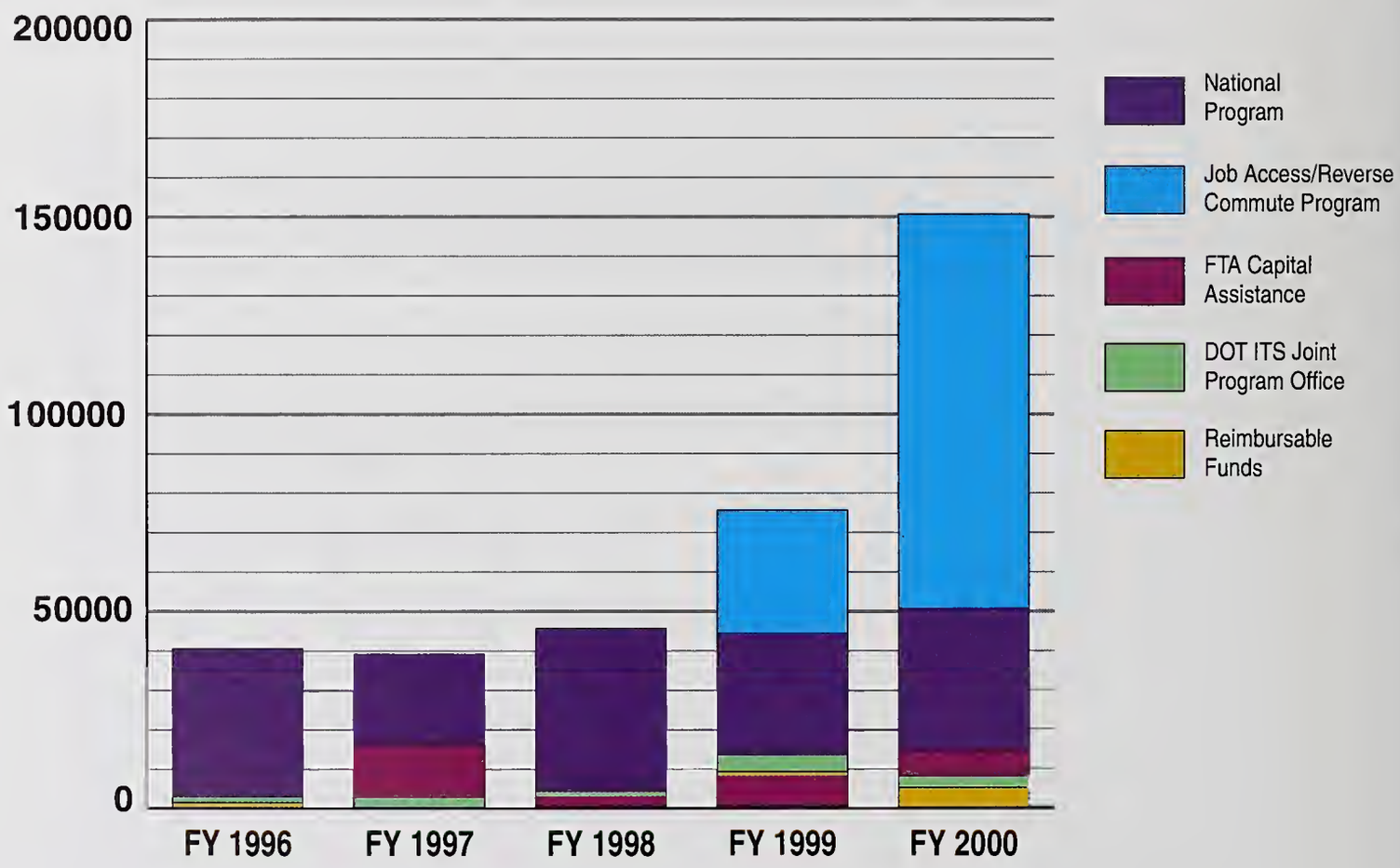


Table 5.2b FTA Research & Technology Program Funding

FTA, under 49 U.S.C. Section 5312(a), may undertake or make grants or contracts for research, development, and demonstration projects related to urban mass transportation that the FTA Administrator decides will help reduce urban transportation needs, improve mass transportation service, or help mass transportation service meet the total urban transportation needs at a minimum cost. 49 U.S.C. Section 5312(a) does not limit the type of entity or organization with which FTA may enter into projects, and it expressly includes agreements with departments, agencies, and instrumentalities of the United States Government. The cost-sharing provision in 49 U.S.C. Section 5314 requires matching funds only when there would be a clear and direct financial benefit to an entity under a grant or contract financed by FTA, in which case FTA establishes a United States Government share consistent with the benefit.

5.1.2 Transit Cooperative Research Program

The Transit Cooperative Research Program is a transit-industry-directed research program, designed to focus on short-term, problem-solving research that is responsive to the ever-changing research needs of transit operating agencies. The TCRP is sponsored by the FTA and carried out under a three-way agreement among the National Academy of Sciences, acting through the Transportation Research Board; the Transit Development Corporation, the educational and research arm of the American Public Transit Association; and the FTA.

Research topics are selected by an independent governing body, the TCRP Oversight and Project Selection (TOPS) Committee, composed of general managers of transit systems, university representatives, suppliers, and the FTA. The TOPS Committee selects projects that support emphasis areas identified in the FTA Five-Year Research and Technology Plan, choosing from research topics submitted directly by the transit industry or developed through special research needs processes. Research topics in a wide variety of functional areas are performed, including operations; services configuration; engineering of fixed facilities, vehicles, and equipment; maintenance; human resources; administration; and policy and planning. In addition, a number of special projects are conducted, including a transit legal studies program, an international transit studies program, and a synthesis program that compiles state of the practice information on a variety of topics of interest to the transit industry.

To ensure quality and balance, and to avoid bias and duplication, a panel composed of transit agency representatives, subject matter experts, and an FTA liaison is formed for each TCRP research project to oversee the project and review its products. The Transportation Research Board provides the overall administration and management of the research, and the American results to the transit industry.

5.1.3 University Transportation Centers Program

Under TEA-21, the University Transportation Centers Program (UTCP) has expanded in the number of universities participating, level of funding, and the addition of education and technology transfer as primary elements of the program. The UTCP is administered by the USDOT's Research and Special Programs Administration (RSPA) and provides the FTA with

a valuable and ongoing resource to complement its overall research efforts on behalf of the transit industry. The mission of the UTCP is to advance U.S. transportation-related technology and expertise through education, research, and technology transfer in University-level Centers of Excellence. The broad-based research goals of the UTCP are designed to address both current and future transportation challenges and issues through interdisciplinary transportation research covering all modes of transportation.

The interdisciplinary research conducted at the university level complements the research, development, and demonstration activities conducted by the FTA and strengthens its overall program of technical assistance on behalf of the transit industry. The collegial relationship established between the FTA and the participating universities offers both a forum for intellectual exchange and an opportunity to focus problem solving from a variety of perspectives.

The UTCP includes Centers of Excellence in each of the ten Federal Regions. This arrangement provides FTA Regional offices with a link to the academic community and a forum to address transit industry issues at a regional level. It also provides FTA Headquarters with an opportunity to target its efforts using UTCP schools to assist in tracking national demonstrations and adding value to FTA major capital investments.

The UTCP assists FTA in meeting its strategic goal of promoting economic growth and trade by promoting the education of individuals in transportation-related fields. Students supported through the program use a combination of experiences gained in both research and education to prepare themselves for careers in the transit industry. This program directly supports the transit industry's efforts to operate, maintain, and manage new technology while building professional capacity in its current and future workforce.

5.1.4 Small Business Innovation Research Program

The Small Business Innovation Research Program is designed to use the nation's small high-technology firms as effectively as possible to meet Federal research and development objectives and to stimulate the commercialization of innovative products and concepts. A primary goal of the program is to stimulate high-technology innovation within the small business community to enhance the nation's productivity and help the U.S. maintain its competitive leadership in the international marketplace. The SBIR Program is administered by the Volpe Transportation Systems Center, RSPA, for USDOT modal administrations.

All Federal agencies with a contracting budget for research and development in excess of $100 million are required to establish an SBIR program. FTA's SBIR Program provides limited funding to small high-tech firms to assist with the start-up and development costs associated with bringing a transit-related innovation to the marketplace. There are three phases within the FTA SBIR program. Projects are selected through a competitive process. The major factors in determining whether a project will be funded are that funding will validate the feasibility of the particular concept or technology and, with further private or public funding, the contract recipient will further develop the concept or technology so it is ready for the commercial marketplace. SBIR Phase II funding is

one public source that can be used to further develop a concept or technology. Phase III projects use private sector investment and support to bridge the gap between product development and commercial sales. No SBIR funds are used in Phase III projects.

FTA's SBIR research topics are selected to reflect its current research needs and may include anything related to the planning, operation, or management of transit service from technological innovations to improved techniques and procedures. Past topic areas have included: Advanced Fare Payment Media Program, Geographic Information Systems (GIS) Transit Applications, Computerized Applications for Transit Operations and Scheduling, Application of Bar Coding Technology to Transit, Transit System Computer Simulation Models, Safety Intrusion Detection Devices - Transit Applications, Improved Maintenance Techniques Linked to Capital Development, and Transit Fare Collection Decision Models for Fare Policy and Cost.

5.1.5 Joint Partnership Program for Deployment of Innovation

Moving an idea from the research stage to the market requires an interim deployment stage where the technology or approach to a problem can be evaluated and improved. This can be done in many ways including development of prototype equipment and pilot programs. FTA usually approaches deployment in partnership with other organizations. This can be done formally through the Joint Partnership Program (JPP) or on an ad hoc basis with partners selected based on the problem being addressed.

A Joint Partnership Program (JPP) for Deployment of Innovation, illustrated in Figure 5.1, will be a primary deployment mechanism for the activities of the FTA National Research and Technology Program. The JPP will seek to deploy innovations in cooperation with transit agencies, system suppliers and other Federal agencies. This program will be made operational through selection of needs-driven innovations. The consortium members will provide 50 percent of costs, while serving as an incentive for deployment. The JPP allows for retention of patent and intellectual rights. Program participation will be based on a competitive selection process, including industry participation in research topic selection.

FTA is increasingly entering into joint sponsorship with Federal, state, and local government agencies, and consortia formed by system suppliers, transit agencies, national laboratories, and universities. The objective of these partnerships is to increase competition and leverage scarce Federal funding. An example of a program involving partnerships is the Advanced Public Transportation Systems (APTS) Program, which is funded through the Departmental Intelligent Transportation System (ITS) Joint Program office. Another example is the FTA Electric Vehicle Program with four consortia competitively selected and funded under ISTEA with a minimum cost shared on a 50/50 basis. Other examples include the Advanced Automatic Train Control (AATC) project, sponsored by the Defense Advanced Research Projects Agency (DARPA) and cost-shared on a 50/50 basis with a consortium comprised of a transit agency and two equipment suppliers. The Demonstration of Universal Electric Transportation Subsystems (DUETS) program is also cost-shared on a 50/50 basis with an industry consortium. A final example is the Fuel Cell Transit Bus Program, which includes substantial DARPA funding.

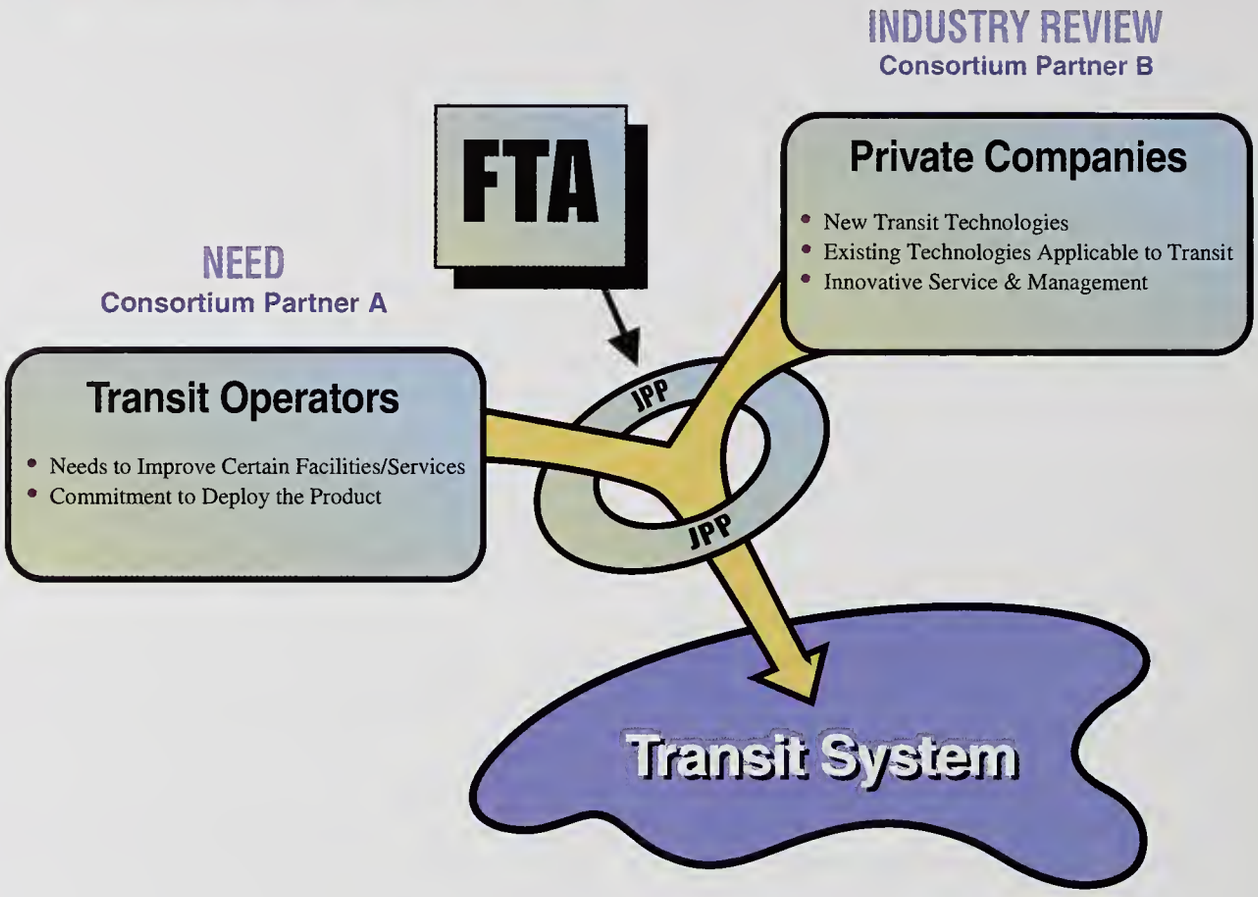


Figure 5.1 Joint Partnership Program

5.1.6 National Transit Institute

The National Transit Institute was established to meet the training and development needs of the transit industry's workforce. The NTI, located at Rutgers University, started operation in 1992. It is modeled on the Federal Highway Administration's National Highway Institute (NHI). The NTI designs, develops, and conducts training in response to the needs of the FTA and the transit industry. It plays a major role in support of FTA's overall program activities, offering courses in a number of FTA offices including; Program Management, Planning, Civil Rights and the Office of Procurement. The NTI also supports a number of FTA training initiatives in the Office of Research, Demonstration and Innovation, and multi-modal planning courses in cooperation with FHWA.

The introduction of new technology and techniques along with the changing nature of the transit workforce requires a continuous effort to train, retain, and develop quality employees. The NTI, through a cooperative agreement with the FTA, will continue to play an

active role assisting the transit industry in its efforts to operate, maintain, and manage all elements of public transportation and continue to provide leadership in transit training and development. As operating deficits continue to mount and demands on budgets build, transit must continue to seek outside support to provide training for its existing workforce. The NTI supports low-cost and no-cost training to assist the industry to develop employees that are technically competent and productive. The NTI will provide a valuable resource to transit in identifying new training opportunities as an active part of ongoing evaluations of training and training audiences.

The NTI has become the major training resource of the transit industry offering a variety of industry-defined courses in management and supervision as well as advanced technology and innovative training techniques. The Institute annually selects a group of NTI Fellows representing industry practitioners with a variety of expertise to provide workshops and short seminars on industry-related topics. The NTI also sponsors an annual trainer's conference bringing together trainers and human resources specialists from throughout the nation to learn new training techniques and share their experiences. A Clearinghouse also has been established by NTI to share innovative training programs for in-house use by industry trainers. These activities meet the Federal Program Trading needs of the FTA and the ongoing training needs of the transit industry.

5.1.7 Rural Transit Assistance Program

The Rural Transit Assistance Program (RTAP) is authorized by 49 U.S.C. Section 5311(b)(2), which establishes a rural transportation assistance program in non-urbanized areas implemented by grants and contracts for transportation research, technical assistance, training, and related support services in non-urbanized areas. The goals of RTAP are to provide training and technical assistance for rural public transportation operators, improve professionalism and safety of rural public transit services, and promote efficiency and effectiveness of rural transit services and support coordination with human service transportation. Most RTAP funds are apportioned to the States on the same basis as formula funds for other than non-urbanized areas. In addition, FTA has allocated a portion of its National Transportation Planning and Research Program funds for a national RTAP program, which serves the common needs of non-urbanized areas in all states.

5.1.8 National Transit Database

Most of the transit statistics in this Five-Year Plan are from the National Transit Database. The NTD industry reporting program is administered by the FTA, as required by 49 U.S.C. Section 5335 and funded under 49 U.S.C. Section 5314. Each year, over 500 transit operators report to the FTA on transit in over 300 urbanized areas. The national total for these transit systems is over 85,000 transit vehicles, over 7,000 miles of rail track, over 2,000 rail stations, and over 1,000 maintenance facilities. Congress, State and local governments, the research community, and the private sector have recognized the importance of and the need for timely and accurate data on which to assess the continued progress of the nation's public transportation systems. The NTD is the major source of public transportation vehicle, capital investment, revenue, operating, and safety data. The NTD was designed to provide information for service planning by public transit systems. Congress, the FTA, and other Federal, State and local governments use the NTD data to make public sector investment decisions involving billions of dollars.

Researchers, transit operators and planners use the NTD data to evaluate performance and service costs. Unique in scope and detail, it has evolved into an essential resource for public transit management, planning, policy-making, and other analytical applications. Validated NTD data is used to apportion FTA funding among the urbanized areas and States, according to our legislative formulas. The NTD is used to evaluate FTA's performance on its strategic plan.

5.1.9 International Mass Transportation Program

Federal investment in transit research and technology programs is vital in promoting technologies critical to the domestic manufacturing base and global competitiveness. Strengthening the domestic transit manufacturing base will ensure stronger local economies and higher quality products. As a result, U.S. transit products will be more competitive in the global marketplace, particularly in the growing markets of Africa, South America and the Pacific Rim nations. In addition, FTA's research and technology program places particular emphasis on information, communication and computer networking systems, areas where the U.S. maintains a globally competitive edge.

International programs of research, technology and demonstration will improve foreign understanding of the American transit industry and its products. These programs will also facilitate a greater understanding of foreign markets and their unique organizational and operational requirements. This understanding will help domestic manufacturers and professional service providers to develop and market appropriate services and products.

The Transportation Equity Act for the 21st Century specifically authorizes the Secretary of Transportation to engage in activities to inform the United States domestic mass transportation community about technological innovations available in the international marketplace and activities that may afford domestic businesses the opportunity to become globally competitive in the export of mass transportation products and services. These activities may include:

- development, monitoring, assessment and dissemination domestically of information about worldwide mass transportation market opportunities;
- cooperation with foreign public sector entities in research, development, demonstration, training and other forms of technology transfer and exchange of experts and information;
- advocacy, in international mass transportation markets, of firms, products and services available from the United States;
- informing the international market about the technical quality of mass transportation products and services through participation in seminars, expositions, and similar activities; and
- offering those Federal Transit Administration technical services which cannot be readily obtained from the United States private sector to foreign public authorities planning or undertaking mass transportation projects if the cost of these services will be recovered under the terms of each project.

The International Mass Transportation Program (IMTP) will aid in achieving American foreign policy objectives and the Department's strategic plan objectives for economic trade and growth. American transit standards and practices complement the introduction of American products and services in foreign markets. Program elements and activities for the International Program will consist primarily of the following:

The IMTP will disseminate information and expertise emanating from FTA's Research and Technology Program. The expertise and products developed through the Bus Rapid Transit initiatives and other research and technology programs will be shared with domestic agencies and foreign countries, especially those underdeveloped countries that are seeking innovative solutions for effective bus and rail system

Program Elements	Activities
Technical/Information Sharing	■ Periodic forums and public notices ■ Provide safety-related training and technical assistance to selected countries ■ Develop a technology sharing program that showcases American research centers, professional expertise, and products in the transit field
U.S. Industry Support	■ Provide peer-to-peer panels in the areas of operations, maintenance, planning, management, finance and other related areas ■ Promote the export of U.S. goods and services
Bilateral Agreements	■ Sharing and exchange of transit knowledge and expertise with undeveloped countries and our trade partners through Memorandums of Understanding
Capacity Building	■ Develop and conduct innovative technology training course in selected foreign countries ■ Develop and conduct infrastructure development training courses to include the areas of project development, project management, and construction management

Table 5.9 International Program Elements and Activities

operations. For example, FTA recently established a Working Group on Africa that will further strengthen its relationship with South Africa, instituted with a Memorandum of Understanding between the Department and the Government of South Africa. This arrangement with South Africa will help facilitate the exchange of information and trade between the U.S. and other countries in Africa.

International technology sharing activities will focus on the design and conduct of specialty workshops on topics such as New Starts, Turnkey delivery and GIS. Peer panels will include presentation of highly specialized expertise from transit agencies addressing such issues as operations, maintenance, planning, finance, safety and security, innovations in technology, and procurement. FTA will continue to support the Transportation Research Board through its annual meeting, professional committee activities, and ongoing coordination and research dissemination through Transportation Research Information Services. Research findings and reports generated from the TRB activities will be shared through the international program.

Funding to carry out the IMTP shall include revenues paid to the Secretary by any cooperating organization or person. Such revenues shall be accounted for separately within the Mass Transit Account of the Highway Trust Fund and shall be available to carry out activities under this program. Cash or in-kind contributions as allowed under the so called Common-Grant Rule applicable to grants and cooperative agreements with State and local governments (49 CFR Part 18) or its companion (49 CFR Part 19) applicable to non-profit, educational institutions are acceptable.

5.1.10 Transportation Safety Institute

FTA provides, through an interagency agreement with the Transportation Safety Institute in Oklahoma City, training in transit safety and security. Over 4000 professionals are trained on subjects that include system safety, accident prevention and investigation, system security, emergency management, industrial safety, alternative fuels, bus operator safety, and fatigue awareness.

Most of the safety and security courses have been developed as part of the FTA integrated approach to training, and many transit safety professionals are involved as associate instructors. The curriculum at TSI supports the FTA mission in an extremely cost-effective way, advancing the state-of-the-practice of safety and security by transit industry professionals.

During FY 2000, TSI will conduct over 200 offerings of 20 courses, including Transit Rail System Safety, Effectively Managing Transit Emergencies, Transit Industrial Safety Management, Transit Rail Accident Investigation, Bus Accident Investigation Seminar, Bus Accident Investigation, Advanced Bus Accident Investigation, Bus Casualty Extrication, Bus Accident Reconstruction, Instructor's Course in Alternative Fuels Safety, Emergency Response to Alternative Fueled Vehicles, Safety Evaluations of Alternative Fueled Facilities and Equipment, Transit System Security, Transit Explosives Incident Management, and Bus Operator Safety. These courses comprise the core cur-

riculum of TSI transit safety and security training, annually attended by over 4,000 transit industry employees.

Over the past decade, FTA has established a unique safety and security resource dedicated to the safety and security of transit patrons, employees, and facilities. This resource consists of a core group of people who assist FTA in providing training to the transit community. This support includes development of new, and revisions to existing FTA sponsored training courses, and the conducting of safety and security workshops. Because of the ever-changing nature of safety and security problems and priorities within the transit industry, it is necessary for FTA to constantly review its safety and security training curriculum, update existing courses, delete courses as the need for them is eliminated, and add new courses as requirements necessitate.

The availability of such a resource is integral to establishing and maintaining the currency and caliber of the safety and security courses conducted by TSI for FTA. New courses are constantly being developed and older courses require ongoing update and refinement. The quality of the safety and security training program at TSI is sustained by FTA support of a pool of professionals each year. Two hundred thousand dollars is requested in FY 2000 for this critical element of the safety and security training program.

5.2 Other FTA Programs

The Federal Government supports transit research and technology development through several funding methods that are not specifically designed as research and development funding mechanisms. The programs described in the previous section have funding components specifically designed for this purpose. Other funding includes using Federal funds available for other purposes, such as planning or capital investments, to support research and technology development. The three major funding sources of this kind for transit research and technology development are:

- **State Planning and Research,**
- **Metropolitan Planning**
- **Capital Assistance**

5.2.1 State Planning & Research

The State Planning and Research Program authorized by 49 U.S.C. Section 5313(b) provides funding, apportioned by a formula based on urban population, directly to the States for planning, research, education, training, and human resources. A State may use these funds to carry out research and professional capacity-building activities that meet State-specific needs or to test or deploy within the State new technologies or innovative practices, including those resulting from the FTA National Research and Technology Program.

The funding amounts available to most States are modest in comparison with the costs of statewide planning required by Federal transit laws, with the result that very little remains for research. For example, in FY 1998, the most populous states, California, New York, Texas and Florida, were apportioned $1.3, $0.7, $0.6 and $0.5 million, respectively, while 26 States received less than $100,000 each (17 of these received only the minimum apportionment of $42,360 each).

5.2.2 Metropolitan Planning

Federal transit laws (49 U.S.C. Sections 5303-5305) also authorize a Metropolitan Planning Program under which planning funds are apportioned to the States by formula, based on urban population. The States in turn allocate these funds to their metropolitan planning organizations under a formula negotiated with the MPOs. The MPO, in cooperation with the State, develops transportation plans and programs for maintaining and expanding the transportation system in the urbanized area. The planning process must consider all modes of transportation and be continuing, cooperative, and comprehensive to the degree appropriate, based on the complexity of the transportation problems.

In developing plans and programs, each MPO must consider certain statutory planning factors including, for example, ways to expand and enhance mass transportation services and to increase usage of those services, and capital investments that will result in increased security in mass transportation systems. These and other planning factors require innovative approaches and new technologies, which can be evaluated through the metropolitan planning process for possible applicability.

5.2.3 Capital Assistance

Mainstreaming new technologies can be funded through the purchase of capital assets with federal capital assistance. Transit operating agencies and state and local governments use FTA capital assistance to acquire vehicles and equipment embodying innovative technologies and use them in every day transit service. Any capital project, including introduction of new technology and maintenance of capital assets, is eligible, and eligible recipients include any public body, typically transit operating agencies, state departments of transportation, other state agencies, municipal governments, and public universities.

In recent years, funds available for FTA Discretionary Grants and Formula Block Grants for urbanized areas have amounted to about $4 billion annually. Congressional earmarks in authorization or appropriation legislation have in recent years allocated FTA Discretionary Grants for buses and bus-related facilities and for new fixed-guideway systems. Discretionary Grants for modernization of fixed-guideway facilities are allocated by a formula that favors large, older rail transit systems. Formula assistance is allocated by formula to urbanized areas, directly for areas with populations greater than 200,000 and through the state's Governor, with authority typically delegated to the state's department of transportation, for areas with a population between 50,000 and 200,000. Capital assistance projects must be included in a regional transportation plan and transportation improvement program and also in a statewide plan and statewide TIP (STIP). Projects must meet all current federal requirements for environmental protection, historic preservation, citizen participation, nondiscrimination, contracting, and project administration.

FTA made extensive use of the Discretionary Grants implementation method in its Alternative Fuels Initiative responding to the requirements of the Clean Air Act for cleaner bus propulsion. The availability of these capital funds provided a market incentive sufficient to induce engine manufacturers to develop, test,

and market a variety of engines fueled by natural gas, methanol, and ethanol. FTA used its National TPR program to provide technical assistance, engineering analysis, and research into the safe handling of these alternative fuels, and also collaborated with the Department of Energy in collecting data for evaluating effectiveness of the new bus engines.

In the future, FTA grantees can be expected to include new technologies emerging from the FTA Research and Technology Program. This will occur once the benefits of these technologies are proven in operational tests and the costs and risks of implementation have been shown to be acceptable through evaluation of pilot deployments.

5.3 Partnerships

Transit partnerships build on historic relationships between FTA, other federal agencies, state and local governments, and the transit industry. The FTA Research and Technology Five-Year Plan was developed in partnership with the transit industry. Partnerships offer FTA the opportunity to stretch resources to meet program and policy goals. The major partnership opportunities available to implement the Research and Technology Five-Year Plan are:

- **Federal and State Agencies**
- **Standards Development Organizations**

5.3.1 Partnerships with Federal & State Agencies

FTA partners with other Federal organizations, including FHWA, Federal Railroad Administration, U.S. Department of Energy, and U.S. Department of Defense, and state agencies, to identify, evaluate, and deploy new approaches to improving the transit system. Historically, this cooperation resulted from the need to address critical national issues jointly, such as reducing traffic congestion or converting military technology to commercial use, minimizing terrorist threats, reducing emissions, and reducing dependence on foreign oil. It can also result from the need of one governmental agency accessing the expertise of another agency.

The FTA research and technology agenda is developed with direct industry participation and reflects, primarily and foremost, the vital, short-term needs of the transit industry at this crucial point in time.

Thus, the research sponsored by FTA is product oriented and focuses on technology and deployment, rather than research and development. However, FTA will continue to partner with other groups, notably the University Research Centers and other research-oriented agencies, to identify and initiate advanced, long-term research activities that would further support and advance transit services. In fact, the Research and Technology Five-Year Plan does contain two areas of high-risk, long-term research. These two areas are the ongoing research with FHWA and the new activities in super conductivity in support of low-speed maglev systems.

FTA has contributed significantly in each of these areas since the authorization of ISTEA. FTA worked closely with FHWA, the Joint Programs Office, other DOT agencies, and the private sector in developing the Intelligent Transportation Systems Initiative. Activities include raising industry awareness, conducting operational tests, evaluating performance, and developing architectural protocols and telecommunications and information system standards.

In the previous years, FTA has received funding from other agencies to conduct research. For example, a $26 million program was established between FTA and DARPA in 1995 for train control and Electric Vehicle technology. Particularly we are looking forward to receiving and deploying anti-terrorism technology transfers from USDOD and the U.S. Department of Justice (USDOJ).

5.3.2 Standards Development Organizations

Section 12 of Public Law 104-113, National Technology and Transfer Act of 1995, sets forth criteria for federal agencies in adopting industry consensus standards, when these standards assist in carrying out policy objectives or activities of the agency. This section provides that Federal agencies should consult and participate with [consensus] standards organizations in the development of technical standards. The context of P.L. 104-113, an amendment to the Stevenson-Wydler Technology Innovation Act of 1980, is that cooperation by government and industry will "speed the development of new products and processes....".

FTA staff is involved in a number of standards development or revision activities. These activities include working with a diverse group of organizations, including the National Fire Protection Association, Engineering Societies, and regulatory agencies including NHTSA, FRA, RSPA, USDOE and the ITS Joint Program Office. Work on standards is initiated outside of FTA, but FTA staff is a vital link between the transit world, private industry, and other groups that use these standards. Transit agencies use agreed upon standards when they build facilities, specify rolling stock, or purchase other equipment. Standards affect procurement, operation, and safety of all transit modes, fixed guideway and bus.

Under the American National Standards Institute (ANSI) process for standards development or revision, standards writing or maintaining organizations must have a balanced group to perform the work. One vital segment of that balance is the public, and usually government represents the public, especially when technical subjects are involved.

6.0 Performance Measurement

The FTA Research and Technology Five-Year Plan must ultimately be measured by its performance relative to the goals established for the program. Former NASA Administrator Robert A. Frosch suggested that the cost-effectiveness of research and development can be estimated only by identifying the value of significant innovation attributable to research and development and dividing by the cost of the entire research and development program over a commensurate time period. Applying this long-term perspective to measuring effectiveness of FTA Research and Technology programs requires that FTA continuously monitor the significant breakthroughs, innovations, and contributions to the knowledge base upon which transit capital investments, operations, regulations, policies, and programs depend.

Performance will be measured by assigning accountability for the success of programs to those responsible for each phase of the programs. Regular reviews of programs will allow for measurement of incremental results. Products and by-products of this process will include technologies as well as different approaches to issues facing transit providers, planners, equipment manufacturers, and other stakeholders. Finally, each program will include methods to assess and evaluate program success.

6.1 Accountability & Incremental Results

Measuring accountability and incremental results requires regular oversight of the research and technology process. Organizations working in partnership with the FTA will regularly provide information about program status. Because programs vary widely in terms of their goals and objectives, involvement, and time frames, it is not prudent to define a single method of measuring accountability and incremental results. Each program will, as it is being designed, include a component for measuring accountability and incremental results.

In some cases, baseline information is available to provide a starting point for establishing performance measures. For example, some of the research into new bus technologies will use results from the completed Advanced Technology Transit Bus program as a starting point. Measuring progress when adapting a method or technology developed in the ATTB program will start with information gained through that program.

6.2 Research & Technology Products & By-Products

Products and by-products of FTA's research and technology program will range from new knowledge about the transit industry, to new transit technologies, to new approaches to transit issues. Performance will be measured by the usefulness of these results in addressing the goals of FTA, USDOT, the Federal Gov-

ernment, and the transit industry. These products and by-products will often be identified in the early stages of research and technology programs. For example, a likely product of the electric bus program is a better battery for storing electricity. A performance measurement will be the time required between charges. An additional measurement will be the potential for other applications and being commercially viable on the world market.

6.3 Program Assessment & Evaluation

This Research and Technology Program supports the development of innovative transit products and practices, and better-informed policies, regulations, and decisions. Monitoring progress of projects and programs is the starting point for assessment and evaluation. This must be done while considering the state of the national transportation system. This will help identify changes or improvements that can be traced, at least in part, to results of previous research and technology programs. The aim is to better define the assessment baseline and to increase the statistic by a significant percentage each year through technology introduction.

To ensure that the outputs of the research and technology development process are integrated with the delivery system, results must be made available promptly to external customers in usable form. The research and deployment process should be evaluated as effective only if there is continuing evidence that these results are being fed into the delivery system and that the delivery system is incorporating some of the results. There should be evidence that customers for research and development are participating in setting research and development priorities and funding levels, and receiving needed outputs.

Research and technology deployment is an iterative process, in the sense that research results inspire development ideas, which when tested may point the way to additional research and development before resulting in usable or cost-effective technologies and products or answers to policy questions. This requires that an effective research and development process should display evidence of a feedback process and continuous interaction with customers.

A research and development manager might be given credit for running an effective research and development program if it produces usable results that are communicated to external customers. However, the agency as a whole should not consider its research and development program effective unless the delivery system for putting those results to work is also well understood and managed.

6.4 Technology Transfer & Baseline Measurement

The final measure of success of the Research and Technology Program is the acceptance of its results in the marketplace. Some of the research and technology efforts implemented under this plan will come to market within the next five years.

Efforts are underway to establish baseline measures of technology benefits to transit. Examples of baseline measures from 1996 include: export of 4,318 public transportation passenger vehicles; operation of 1,091 alternative fuel buses by 64 transit agencies; and, deployment of ITS applications by 264 transit agencies. The aim is to establish a comprehensive assessment baseline in all areas of technology impact and to increase the statistics by a significant percentage each year through technology introduction.

6.5 Performance Measures Related to FTA Strategic Plan

The FTA Strategic Plan and related Performance Plan include specific outcome and performance goals for each strategic goal. The following Table 6.1 relates the activities in this FTA Research & Technology Five-Year Plan to specific goals in the FTA Strategic Plan.

STRATEGIC GOAL # 1	**Safety & Security:** Promote the public health and safety by working toward the elimination of transit-related deaths, injuries, property damage and the improvement of personal security and property protection.		
Strategic Outcome Goal	**Strategic Performance Goal**	**Strategic Performance Measure**	**Related Section of FTA R&T Five-Year Plan**
A. Reduce the number of transit-related fatalities, injuries and incidents	1. Reduce the number of fatalities, injuries and incidents per 100 million transit passenger miles – base year is FY 1996	1. Number of transit fatalities, injuries and incidents per 100 million transit passenger miles	3.1.1.1 Railroad Grade Crossing Safety 3.1.1.2 Train Control Centers Safety 3.1.1.3 Rail Vehicle Materials Safety 3.1.4 Bus Vehicle Safety 3.3.4 Mixed Rail Corridor Operations 3.6.4 Technology Sharing
B. Reduce the vulnerability of transit systems from the consequences of intentional harm to the system, its employees and its users	1. Reduce the number of transit crimes against patrons, employees and transit property – base year is 1996 2. In urbanized areas over 200,000, increase the number of transit properties with security plans – base year is 1998	1. Number of transit crimes against patrons, transit employees, and property 2. Number of transit properties in urbanized areas over 200,000 with transit security plans	3.1.2 Information Security 3.1.3 Crime Prevention and Anti-Terrorism 3.2.3.3 Transit Station Design 3.5.6 Intermodal Connectivity 3.6.4 Technology Sharing

Table 6.1 FTA Research &Technology Five-Year Plan Activities that Support Specific FTA Strategic Plan Goals

STRATEGIC GOAL # 2	Mobility & Accessibility: Shape America's future by ensuring a transportation system that is accessible, integrated, efficient, and offers flexibility of choices.		
Strategic Outcome Goal	**Strategic Performance Goal**	**Strategic Performance Measure**	**Related Section of FTA R&T Five-Year Plan**
A. Maintain, improve and expand the nation's transit infrastructure, and balance new physical capacity with operational efficiency	2. Increase the percentage of bus facilities and rail infrastructure (track, power systems, stations, structures and maintenance facilities and yards) in good or excellent condition, as a means of improving operation and efficiency – base year is 1995	2. The number of bus and rail facilities in good or excellent condition compared to all facilities	3.2.3.1 Turnkey Project Delivery 3.2.3.2 Tunnel Design and Construction 3.2.3.3 Transit Station Design 3.2.4 Advanced Simulation 3.2.5 Innovative Financing 3.3.1 Transit Capacity & Quality of Service 3.3.2 Transit Intelligent Transportation Systems 3.3.3 Bus Rapid Transit Initiative 3.6.2 Training a Quality Workforce 3.6.4 Technology Sharing
B. Increase intermodal physical, informational, and service connectivity	1. Increase the number of rail and air terminals with transit connections 2. Increase the number of deployed Intelligent Transportation Systems (ITS) – base year is FY 1995	1. The number of rail and air terminals with transit connections 2. Number of intermodal ITS projects that relate to connectivity	3.3.1 Transit Capacity & Quality of Service 3.3.2 Transit Intelligent Transportation Systems 3.3.3 Bus Rapid Transit Initiative 3.5.3 Multimodal System Evaluation 3.5.6 Intermodal Connectivity 3.6.2 Training a Quality Workforce 3.6.4 Technology Sharing
C. Ensure that all Americans have access to transit to meet basic mobility needs	1. Increase by one percent per year the urban population within 3/4 mile of transit service – base year is FY 1997	1. Urban population within 3/4 mile of transit	3.3.3 Bus Rapid Transit Initiative 3.4.1 Access to Jobs 3.4.2 Accessibility for Persons with Disabilities 3.4.3 Elderly Services 3.4.4 Low Density Transportation Services 3.4.5 Mobility Management
E. Ensure that all transit systems are accessible	2. 100 percent accessible bus fleet (lift or wheelchair ramp equipped) by 2002 – baseline: 63 percent of the bus fleet was wheelchair accessible in 1996	1. Percent of accessible buses	3.4.2 Accessibility For Persons With Disabilities 3.4.5 Mobility Management

Strategic Outcome Goal	Strategic Performance Goal	Strategic Performance Measure	Related Section of FTA R&T Five-Year Plan
F. The nation's transit systems employ the latest technology to meet the increased needs of mobility and accessibility	1. Reduce bus and light rail dwell times by 20 percent by FY 2002 through deployment of new technology and other innovations - base year is FY 1995 **Annual Goal:** Reduce dwell times by four percent as measured by deployment of low-floor buses and light rail vehicles, pre-paid fare collection methods, or contactless fare payment systems	2. Reduction in dwell times for transit agencies deploying low-floor buses and light rail vehicles, pre-paid fare collection methods, or contactless fare payment systems	3.2.1 Bus Equipment 3.2.2 Rail Equipment & Systems 3.3.1 Transit Capacity & Quality of Service 3.3.2 Transit Intelligent Transportation Systems 3.3.3 Bus Rapid Transit Initiative 3.3.4 Mixed Rail Corridor Operations 3.6.2 Training a Quality Workforce 3.6.4 Technology Sharing
G. Safeguard the Federal investment in the nation's public transit systems through effective financial oversight	8. Improve the responsiveness to local needs of planning processes in the largest metropolitan areas annually - beginning FY 1998	8. The number of large metropolitan areas with improved planning processes each year	3.5.2 Transportation Institutional Reform 3.5.4 Planning Technology 3.5.5.2 Smart Growth 3.5.6 Intermodal Connectivity 3.6.2 Training a Quality Workforce 3.6.4 Technology Sharing
	9. Improve the responsiveness to local needs of planning processes in 10 small and mid-sized metropolitan (non-TMA) areas during FY 1998 and FY 1999. (A Transportation Management Area is an urbanized area with a population over 200,000, or an area so designated	9. The number of small and mid-sized (non-TMA) metropolitan areas with improved planning processes each year	
	10. Disseminate information on planning processes in ways that are accessible simultaneously to TMAs, states and grantees	10. The number of planning newsletters published and distributed	

STRATEGIC GOAL # 3	Economic Growth & Trade: Advance America's economic growth and competitiveness domestically and internationally through efficient and flexible transportation.		
Strategic Outcome Goal	**Strategic Performance Goal**	**Strategic Performance Measure**	**Related Section of FTA R&T Five-Year Plan**
A. Reduce the true economic cost of transportation, taking into account the quality of transit services	1. Improve by one percent per year the condition of the bus, rail and paratransit fleets as indicated by the age of the fleet and other criteria under development (See A1 under Mobility and Accessibility)	1. The condition of the bus and rail fleet and service vehicles for the elderly and persons with disabilities	3.2.1.1 Advanced Technology Buses 3.2.1.1.2 Small Durable Bus 3.2.1.3 Bus Testing 3.2.2.1 Communication-Based Train Control Systems 3.2.2.2 Light Weight Rail Transit Vehicles 3.2.2.3 Specialty Guided Technologies 3.2.3.1 Turnkey Project Delivery 3.2.3.2 Tunnel Design & Construction 3.2.3.3 Transit Station Design 3.2.4 Advanced Simulation 3.2.4.1 Design 3.2.4.2 Testing 3.2.4.3 Training 3.4.5 Mobility Management 3.5.1 Policy Research 3.5.2 Transportation Institutional Reform 3.5.3 Multimodal System Evaluation 3.6.4 Technology Sharing
	2. Increase by one percent per year the number of bus facilities, and rail infrastructure (track, power systems, stations, structures, and maintenance facilities and yards) in good or excellent condition, as a means of improving operation and efficiency - base year is 1995	2. Bus and rail facilities in good or excellent condition compared to all facilities	
	3. Improve the efficiency of service by decreasing, by one percent per year, the cost per passenger mile of transit	3. Passenger miles per dollar	
B. Ensure that improvements in transportation that advance America's economic growth and trade are made in a manner consistent with the President's Executive Order on the cost-effectiveness of infrastructure investment	1. Eighty-five percent of FTA's New Starts funds are allocated to projects that are consistent with the President's Executive Order (E.O.) on cost effectiveness	1. The percentage of New Starts funds allocated to projects that are consistent with President's E.O.	3.2.3.1 Turnkey Project Delivery 3.2.3.2 Tunnel Design & Construction 3.2.3.3 Transit Station Design 3.2.4 Advanced Simulation 3.6.4 Technology Sharing

Strategic Outcome Goal	Strategic Performance Goal	Strategic Performance Measure	Related Section of FTA R&T Five-Year Plan
C. Reduce travel time in the delivery of people, goods, and services to their destinations	1. Reduce door-to-door travel times within highly congested corridors where FTA investments have been made	1. Travel time in selected highly congested corridors	3.2.2.1 Communication-Based Train Control Systems 3.3.1 Transit Capacity & Quality of Service 3.3.2 Transit Intelligent Transportation Systems 3.3.3 Bus Rapid Transit Initiative 3.3.4 Mixed Rail Corridor Operations 3.4.5 Mobility Management 3.5.1 Policy Research 3.5.3 Multimodal System Evaluation 3.5.4 Planning Technology 3.5.6 Intermodal Connectivity 3.6.4 Technology Sharing
	2. Stabilize annual Federal-aid system delay	2. Hours of delay per 1,000 vehicle miles traveled	
D. Improve the reliability of the delivery of people, goods and services to their destinations	1. Reduce by one percent per year annual service interruptions per 100,000 vehicle hours - base year is 1996	1. Rate of revenue service interruptions per 100,000 vehicle hours	3.2.1.3 Bus Testing 3.2.2.1 Communication-Based Train Control Systems 3.2.4 Advanced Simulation 3.2.4.1 Design 3.2.4.2 Testing 3.2.4.3 Training 3.3.3 Bus Rapid Transit Initiative 3.3.4 Mixed Rail Corridor Operations 3.6.2 Training a Quality Workforce 3.6.4 Technology Sharing
E. Improve the U.S. international competitive position by promoting competition in domestic and international markets in transportation-related services, and facilitating the export of domestic transit goods and services	1. Increase FTA participation in private and public partnerships supporting the development, adaptation, deployment and testing of advanced technology vehicles and components	1. Total number of joint partnerships projects selected	3.2.1.1 Advanced Technology Subsystems 3.2.1.2 Small Durable Bus 3.2.1.3 Bus Testing 3.2.4.1 Communication-Based Train Control Systems 3.2.4.2 Light Weight Rail Transit Vehicles 3.2.4.3 Specialty Guided Technologies 3.2.6 Advanced Simulation 3.3.2 Transit Intelligent Transportation Systems 3.5.1 Policy Research 3.6.4 Technology Sharing 5.1.5 Joint Partnership Program for Deployment of Innovation 5.1.9 International Mass Transportation Program
	2. Increase the dollar volume of exported domestic transit equipment and services	2. Dollar volume of exported domestic equipment and services	

Strategic Outcome Goal	Strategic Performance Goal	Strategic Performance Measure	Related Section of FTA R&T Five-Year Plan
F. Encourage regional and local economic development through joint development	1. Increase ridership and revenue from joint development projects associated with New Starts - base year is 1998	1. Ridership and revenue generated from joint development projects approved in cities receiving the Common Grant Rule waivers, i.e., Atlanta, Baltimore, DC and Portland	3.2.7 Innovative Financing 3.5.2 Transportation Institutional Reform 3.5.5 Sustainable Development
G. Build professional capacity and promote the education of individuals in transit-related fields	1. Increase the number of participants in NTI training by five percent per year	1. The number of courses conducted	3.2.6 Advanced Simulation 3.2.6.3 Training 3.6.1 Attracting a Quality Workforce 3.6.2. Training a Quality Workforce 3.6.3 Retaining a Quality Workforce 3.6.4 Technology Sharing
	2. Increase the number of National Transportation Institute (NTI) training courses conducted by two percent per year	2. The number of participants in training	
	3. Increase the number of University Transportation Center (UTC) students who enroll in transit-related courses by two percent per year	3. The number of students enrolled in transit-related courses	
	4. Increase the number of UTC graduates working in transit-related agencies or organizations by two percent per year	4. The number of graduates working in transit-related agencies	
	5. Develop programs that support the Garrett A. Morgan TTFP	5. The number of programs	

STRATEGIC GOAL # 4	Human & Natural Environment: Protect and enhance communities and the natural environment affected by transit.		
Strategic Outcome Goal	**Strategic Performance Goal**	**Strategic Performance Measure**	**Related Section of FTA R&T Five-Year Plan**
A. Improve the sustainability and livability of communities through investments in transportation facilities	1. Increase the number of people having access to high quality transit, which exists when people live within 1/4 mile of service with a frequency of 15 minutes or less	1. The number of people with high quality transit	3.2.4.1 Communication-Based Train Control Systems 3.3.1 Transit Capacity & Quality of Service 3.3.2 Transit Intelligent Transportation Systems 3.3.3 Bus Rapid Transit Initiative 3.4.5 Mobility Management 3.5.1 Policy Research 3.5.4 Planning Technology 3.5.6 Intermodal Connectivity 3.6.4 Technology Sharing
	2. Increase by one percent per year the vehicle revenue hours providing service with a frequency of 15 minutes or less	2. Vehicle revenue hours providing service with a frequency of 15 minutes or less	
B. Reduce the amount of transportation-related pollutants released into the environment	1. Reduce by two percent per year the amount of transit-related pollutants released into the air per revenue vehicle mile - base year is 1995	1. The amount of pollutants released into the air per year per vehicle revenue mile	3.2.2 Fuel Cell Transit Bus 3.2.3 Hybrid-Electric & Electric Vehicle 3.6.4 Technology Sharing
	2. Increase by two percent per year the deployment of energy efficient and low emission technology vehicles in the transit industry	2. The number of alternative fueled vehicles in the fleet	
	3. Reduce by one percent per year the metric tons of hydrocarbons, nitrogen oxides and carbon monoxide released into the environment due to increased transit use and decreased auto use	3. Tons of pollutants	

STRATEGIC GOAL # 5	Quality Organization: Ensure a quality organization that is responsive to employee needs, empowers its employees and provides excellence in customer service.		
Strategic Outcome Goal	**Strategic Performance Goal**	**Strategic Performance Measure**	**Related Section of FTA R&T 5-Year Plan**
A. A diverse and quality workforce	1. Strategic Planning	1. The number of offices that have a Strategic Plan that fosters effective communication, emphasizes a quality workforce, unifies the employees and reflects the DOT and FTA Strategic Plans 2. The number of FTA employees who have outcomes and expectations linked to their office Strategic Plan 3. Periodic retreat and industry outreach	3.6.4 Technology Sharing
B. Deliver the results to customers through an agency that works better, is more practical and costs less	1. Increase by 5% every two years the customer service rating from FTA's external customers	1. Comparison of current biennial survey results with past survey results	3.6.4 Technology Sharing

Footnote: In addition to Chapter 6, these performance goals are derived from the FTA Strategic Plan, and in some cases are listed in Chapter 4 and are noted on the routemaps.

7.0 Conclusion

This Research and Technology Five-Year Plan started with the idea that transit innovation can play an important role in producing a customer-friendly, seamless, accessible, safe, secure, and environmentally sensitive transportation system. By doing so, this plan will address the goals of the FTA and USDOT Strategic Plans called for by the Government Performance and Results Act of 1996. In addition, consultation on the Research and Technology Plan identified the need to address issues in these areas and other areas. Other major areas were advanced customer information systems, simulation systems, cost-effective equipment, worker and customer-oriented equipment ergonomics, standards for new technology, institutional reform, mobility management, welfare to work, livable communities, elderly and disabled travelers, and building capacity for the next generation of transportation professionals.

The six program areas, Safety and Security, Equipment and Infrastructure, Fleet Operations, Specialized Customer Services, Policy and Planning, and Professional Capacity Building were identified from strategic thinking, industry input, and ongoing research and technology programs. Goals and activities for achieving the goals were established around each of these areas. Activities were mapped in priority order over the five-year horizon.

Progression toward the five-year goals occurs in two forms, short-term and long-term efforts. In the short-term, years one to two, FTA will strategically adjust the Research and Technology Program. Ongoing projects are completed, mainstreamed, or phased out. New, more strategically derived projects are put in motion. Some examples in the former category include the ATTB, transit ITS Metropolitan operational tests, turnkey demonstrations, phosphoric acid and proton exchange membrane fuel cell buses, communication-based train control systems, and automated guideway research. New projects will include bus rapid transit, computer system security, advanced railroad grade-crossing protection, advanced fuel cells and other electric vehicle technologies, intelligent transit vehicles, state-of-the-art tunneling technology, training, planning, designing, and testing simulation systems, specialized service for welfare-to-work and elderly customers, institutional reform, support standards development efforts, intermodal access, and mobility management for regional transportation systems.

Years three to five represent the period in which FTA initiates tactics to ensure success in meeting the designated goals. FTA moves beyond chemical detection into assisting transit agencies with developing countermeasures and responses to anti-terrorist threats involving biological agents. Working with vehicle manufacturers and community service agencies, FTA will support development of a community transportation vehicle (CTV) to satisfy human service providers, paratransit operators, school transportation, and line-haul feeder service. The Bus Rapid Transit deployments are expected to show the nation how transit can reduce its travel time. FTA will actively promote partnerships between universities and New Starts sponsors.

Long-term activities will be adjusted in year three through a reassessment process similar to the process used to develop the Five-Year Plan. Advances made in one program may help advance another program or may eliminate the need for a planned program activity. Year three also will give the industry and FTA the opportunity to reassess priorities. Some of the issues that influenced the decisions made in this plan will change by 2001.

An effort is made throughout the five-year period to foster synergy within and between the program areas. The route maps graphically identify some complimentary work within emphasis areas. The reassessment process, along with regular coordination of efforts within FTA and with the industry, will identify other opportunities where progress made or lessons learned in one program or project is useful to another program or project. For example, the Rural ITS program, which is included in the Fleet Operations emphasis area, will provide information useful to the Low-Density Transportation Services program, which is under the Specialized Customer Services emphasis area.

Research and technology development is an ongoing iterative process that must be both forward looking and flexible enough to address new needs. This Five-Year Plan has been developed with industry consultation to meet identified needs of the transit industry. It is flexible enough to address new needs and to take advantage of new opportunities. FTA will work with the industry to make changes when necessary to meet the needs of the Federal government and the transit industry.

No research and technology development can be conducted in isolation and FTA is no exception. Transit research and development is an extension of the larger research activities in this country. Basic research in subjects such as information systems, communications, advanced materials and computer applications are all indirectly supporting the progress of transit research. FTA fully intends to take advantage of the results of the basic system research in which the USA leads the world.

Appendix A

Program Title: Safety and Security
Budget Item No: FTA 1
Amount Requested for FY 2000: $5,450,000

GOALS

Strategic Goals:

Safety & Security

- Promote the public health and safety by working toward the elimination of transit-related deaths, injuries, property damage and the improvement of personal security and property protection
- Reduce the number of transportation related fatalities, injuries and incidents
- Reduce the vulnerability of the transit infrastructure to consequences of intentional harm to the system, its employees and its users

Performance Goals:

Safety & Security

- Reduce the number of transit-related fatalities, injuries and incidents per 100 million transit passenger miles by one percent per year - base year is FY 1996, and
- Reduce the number of transit crimes against patrons, employees and transit properties by one percent per year - base year is 1996

NSTC Strategic Partnership Initiatives:

- Smart Vehicles and Operators
- Total Terminal Security

Safety is an important concern of the Department of Transportation, FTA, transit agencies and transit users. The strategic approach to achieving the highest practical level of passenger safety and security in all modes of transit is through a comprehensive program of research, technology deployment, training, technical assistance, information dissemination, and oversight to support transit agencies in design and operational decisions, practices and programs that will have a direct impact on safety. FTA encourages transit agencies to collect and utilize information on safety and security concepts, identify and implement best practices, and develop and implement comprehensive system safety and security program plans covering passengers, employees, vehicles, and facilities.

The need for enhanced patron and transit agency employee security is unquestioned. While crime prevention is primarily a local responsibility, potential transit riders are deterred unless they perceive the entire trip, including waiting areas, to be safe and secure. National security concerns have heightened the need for an effective, innovative anti-terrorism system coupled with appropriate response measures. Advanced technologies must be tested and evaluated in the transit environment to determine whether they reduce crime and counter terrorism. Measurable safety and security improvements are needed in many environments, including facilities, vehicles, parking lots, shelters, and stations.

FTA has participated in a number of intermodal Departmental efforts to develop safety and security strategies that will promote national transportation interests. The President's Commission on Critical Infrastructure Protection, the USDOT Task Force on Grade Crossing Safety, Human Factors, Drug and Alcohol Testing and Transit Cooperative Research Program (TCRP) project H-15, Mobility for the 21st Century, were recent efforts addressing future investments that enhance transit safety and security.

MAJOR ACTIVITIES & ANTICIPATED FY 1999 ACCOMPLISHMENTS

Technology

- Disseminate design and operational standards for four-quadrant-gate grade crossings from the safety demonstration project on the MBTA New Old Colony Line and deployment for light rail transit systems
- Continue partnership with DOD, DOE, and DOJ to share resources and information that will enhance passenger security

Training & Technical Assistance

- Provide training for over 4,000 transit professionals on a wide variety of technical and management topics, such as system security, rail system safety, emergency management planning, industrial safety, alternative fuels, bus and rail accident investigation, bus operator safety, and fatigue awareness
- Provide assistance to grantees and States to implement Federal requirements for drug and alcohol testing of safety-sensitive employees and for State safety oversight of rail fixed guideway systems through the development and dissemination of training materials and technical guidance
- Provide guidance on emergency preparedness and response and develop model anti-terrorism plans
- Conduct audits of drug and alcohol programs of transit systems and State safety oversight agencies' programs
- Conduct audits of security programs for transit systems seeking to improve the personal security of patrons and employees
- Test materials used in transit vehicles for fire/life safety and update FTA's guidelines
- Support the ongoing management of information contained on the FTA transit safety and security website
- Analyze human factors associated with transit accidents
- Identify, document, and evaluate critical issues associated with safe transportation of school-age children on public transit.

KEY FY 2000 PRODUCTS & MILESTONES

Technology

- Disseminate results of joint FTA and FHWA ITS rail transit grade crossing demonstration projects
- Strengthen partnerships with other Federal, State, and local agencies in developing counter-terrorism measures
- Develop and evaluate analytical tools and simulation models for first responders, e.g., transit personnel.

Training & Technical Assistance

- Provide training for approximately 4,000 professionals through the Transportation Safety Institute training program on subjects that include system safety, accident prevention and investigation, system security, emergency management, managing drug and alcohol testing programs, industrial safety, alternative fuels, bus operator safety, and fatigue awareness
- Update and revise key modules of training courses to reflect advances in the state-of-the-art and state-of-the-practice and add new courses to meet changing training needs
- Test materials used in transit vehicles for fire/life safety and update FTA's guidelines
- Develop architectural and environmental design guidance aimed at improving security of passengers and transit staff

- Conduct anti-terrorism planning events and mock drills
- Provide technical assistance to transit systems seeking to replace traditional security strategies with more proactive and creative approaches
- Conduct security audits to assist systems to enhance their security operations
- Publish a transit security newsletter
- Develop a human factors program and conduct a second fatigue symposium
- Develop a bus safety program to address oversight issues
- Conduct a national transit safety conference
- Provide assistance to grantees and States to implement Federal requirements for state safety oversight and drug and alcohol testing of safety sensitive employees, conduct training and provide technical guidance
- Conduct an annual workshop for Rail Fixed guideway State oversight agency personnel and provide on-going technical assistance
- Enhance the safety and security database (SAMIS) to include collection and analysis of safety and security data on issues such as school children riding transit and causal factors
- Continue development and implementation of the management information system (SAMIS) to monitor compliance and evaluate the drug and alcohol testing programs, and the MIS for the State Rail Safety Oversight program
- Collect, analyze, and publish safety and security data including patron and employee deaths and injuries
- Provide outreach to transit authorities through the dissemination of timely safety and security information and by maintaining a national safety and security clearinghouse and website
- Update the drug and alcohol implementation guidelines based on changes to the regulatory requirements

FY 2000 PROGRAM REQUEST

Technology

1.1 Railroad Grade Crossing Safety

The expansion of light rail and commuter rail systems provides new and better transit services. Adding these services to the existing diverse transportation environment creates safety vulnerability at highway-rail grade crossings. Since 1994, DOT has initiated a number of cross-modal efforts to improve grade crossing safety, including the development of ITS technologies in highway-rail interactions, and the demonstration of new signs, signals, and train control systems. Communication based train control technology presents an opportunity to heighten safety and security at rail grade crossings.

Activities under this program include:

- Traffic signals for highway-rail transit grade crossings,
- Constant warning time at highway-rail grade crossing for electrified rail operations,
- Sight Distance at Highway-Rail Grade Crossings,
- Health Monitoring of Grade Crossings,
- Power Swing Gates,
- Oversight of Grade Crossing Safety Innovations for Rail Transit, and
- Application of communication based train control technology.

FTA, as an active partner in this safety improvement effort, will continue to initiate demonstrations, evaluations, and deployment of innovative grade crossings technologies and strategies. These technologies and strategies will: integrate highway-rail traffic control systems and roadway traffic management systems; provide information warnings of trains to motorists and pedestrians; improve passive and active warning signs and signals for light rail and commuter rail transit; develop cost-effective off-track train presence detection systems; and assess safety data to determine target areas for technology enhancements.

1.1.1 Signalization with Train Pre-emption – $400,000

This project will expand on lessons learned from the Four-Quadrant-Gate Demonstration on MBTA New Old Colony commuter rail in Massachusetts. The proposed location for the traffic signals in Summer Street (Route 3A) is Kingston where the traffic patterns and geometry of the crossing support traffic signals as an effective safety solution. The objective is to use signalization with train pre-emption where there are two trains operating along the railroad. The purpose of this evaluation will be to examine the use of standard traffic signals as a tool for improved system safety at grade crossings.

This is a 24-month project for which $250,000 is estimated for FY 1999 and $400,000 is requested for FY 2000.

1.2 Computer System Security

1.2.1 Research Activities and Engineering Analysis – $50,000

Expert services are required to provide FTA with engineering analyses in this highly technical area. FTA will fund selected interagency research to ensure that transit-related issues are addressed.

This is a new activity for which $50,000 requested for FY 2000.

1.2.2 Assessing Vulnerabilities of Electronic Fare Payment Systems – $50,000

The President's Commission of Critical Infrastructure Protection determined that our growing dependence on computers and integrated information networks has rendered the nation vulnerable to cyber attacks. Transit systems increasingly rely on electronic information systems to collect, transmit, and store information about all aspects of transit operation and management. Access to this information is important for effective management, operator efficiency, and customer service and convenience. The need to make this information accessible also creates a need to maintain information security. This project will focus on assessing the vulnerabilities of electronic fare payment systems. Security measures to be considered to prevent abuse will include issues related to software tampering and mishandling of funds through the banking institutions.

This is a 12-month assessment for which $50,000 is requested for FY 2000.

1.3 Crime Prevention and Anti-Terrorism

The vulnerability of transit systems to domestic terrorism or criminal activity has been highlighted by recent domestic and international events. Transit systems must continue to enhance their security systems, facilities, and vehicle designs to ensure the safety and security of the riding public. This involves creating and maintaining an environment which will not tolerate criminal activity. By designing the physical environment in a way that deters criminal behavior, transit agencies improve the quality of life on their systems by reducing both the fear and incidence of crime, including the vulnerability of the system to an act of terrorism. Through this program,

FTA will demonstrate innovative security technologies, system design, and rail and bus vehicle security enhancements. This program area will benefit the riding public through technical demonstrations and evaluations that will lead to common practices which enhance the personal security of the riding public.

In continuing with the recommendations of the President's Commission on Critical Infrastructure Protection, the FTA will identify possible key terrorist targets in transit and evaluate the economic consequences of disruption to transit service in those markets. Core systems that may be vulnerable to terrorist acts will need to develop fail-safe interventions.

FTA will explore other options to improve transit security. Specific actions will include accessing transit vulnerabilities, examining current transit systems terrorism prevention programs, identifying technologies, developing procedures, and providing appropriate recommendations to enhance transit security. Of particular importance will be a risk assessment of the range of transportation services at airports served by rapid transit lines. FTA will also develop a computer model for application in field operations that simulates the transit environment, including medical triage, contingency transit, emergency evacuation routes, and vulnerable locations points, which will aid security personnel in responding to catastrophic transit events.

Activities under this program include:

- Development of an advanced multi-sensor system which incorporates full data fusion;
- Detailed validation of the Subway Environmental Simulation Chemical and Biological (SESCB) numerical modeling code;
- Incorporation of additional sensor types to improve the performance of both the fully integrated system and modeling codes; and
- Expansion of background/interferant measurements.

The following three programs are aimed at preparing transit systems for the threat of weapons of mass destruction and other terrorist incidents on U.S. transportation systems such as subways, airports, and bus terminals. FTA has responsibility for assisting these transit entities in pre-planning and emergency response preparation.

1.3.1 Chemical/Biological Agent Detection – $450,000

Over the past few years, events here and abroad (such as the 1995 Tokyo sarin incident) have heightened concerns that the United States is vulnerable to terrorists attacks where the terrorists may be willing and able to deploy weapons of mass destruction. The FTA in collaboration with three other federal agencies (DOD, DOE, and DOJ) are currently partnering to advance information sharing and technological advances in the area of chemical detection. The purpose of this project is to provide FTA funding to support the evaluation of chemical and biological detection systems for the special needs of the urban transit environment (subways, airports, and bus terminals). This effort will expand on the lessons learned from the DOD funded Urban Chemical Release Detector Testbed project as well as related research activities underway on general-purpose chemical and biological agent detection at DOE and DOD. This effort is Phase 1 of the three-phase program on chemical and biological detection for the transit environment.

This is a new multi-year project for which $450,000 is requested for FY 2000.

1.3.2 Passenger Security – $200,000

In response to the recommendations of the President's Commission on Critical Infrastructure Protection and recent Presidential Directives 62 and 63, the FTA will identify possible key terrorist targets in transit and evaluate the potential for

loss of life and the economic consequences of disruption to transit service in those markets. Core systems that may be vulnerable to terrorist acts will need to evaluate their security alternatives and means of saving lives. The FTA will explore a variety of pre-planning and emergency response options and recommend the best methods to their transit security specialists. Specific actions will include assessing transit vulnerabilities, examining current transit systems terrorism prevention programs, identifying advanced security technologies, developing prevention and response protocols, and disseminating the appropriate recommendations to the transit community to enhance transit security planning.

One particular interest is a risk assessment concerning the range of transportation services at airports served by rapid transit lines. The FTA will also initiate development of a computer model for training responders to a terrorist incident involving weapons of mass destruction (WMD) that simulates the transit environment, accounting for situation awareness for first responders, identification of clear areas for patrons and responders, medical triage, emergency evacuation routing, and identifying alternative transit options for passengers. The software tool is aimed at aiding security personnel in preparing and responding to catastrophic transit terrorist incidents while reducing the cost of training through use of this tool in conjunction with actual exercises.

This is a new multi-year project for which $200,000 is requested for FY 2000.

1.4.1 Safety and Security Technical Support – $200,000

Technical support to transit agencies by FTA is needed to respond to a variety of industry needs, safety issues, draft regulations and other activities. Technical support may be needed concerning bus emission standards, the useful life of CNG gas cylinders, new grade crossing safety technologies, and in developing standards for WMD preparedness for transit agencies. FTA would like to work with the major transit authorities to determine the minimum requirements for preparedness for WMD incidents. Similar standards exist for preparedness and emergency response for fire and smoke incidents. FTA believes it is very important to provide technical support in these areas. This will be an ongoing project as needs and services are required.

This is a new effort with $200,000 requested for FY 2000.

Training & Technical Support

1.5.1 Transportation Safety Institute Safety and Security Training – $1,200,000

This will sustain support for the Transportation Safety Institute (TSI) for safety and security training. The relationship between TSI and FTA in safety and security training has been a benefit to the transit industry for years. Most of the safety and security courses have been developed as part of the FTA integrated approach to training, and many transit safety professionals serve as associate instructors. The curriculum at TSI supports the FTA mission in an extremely cost-effective way, advancing the state-of-the-practice of safety and security in the transit industry.

During FY 2000, TSI will conduct over 200 offerings of 21 courses, including Transit Rail System Safety, Effectively Managing Transit Emergencies, Transit Industrial Safety Management, Transit Rail Accident Investigation, Bus Accident Investigation Seminar, Bus Accident Investigation, Advanced Bus Accident Investigation, Bus Casualty Extrication, Substance Abuse Management, Instructor's Course in Alternative Fuels Safety, Emergency Response to Alternative fueled Vehicles, Safety Evaluations of Alternative Fueled Facilities and Equipment, Transit System Security, Transit Explosives Incident Management, and

Bus Operator Safety. These courses comprise the core curriculum of TSI transit safety and security training, annually attended by over 4,000 transit industry employees.

1.5.2 Development of Safety/ Security Training – $200,000

Over the past decade, FTA has established a unique safety and security resource dedicated to the safety and security of transit patrons, employees, and facilities. This resource consists of a core group of people who assist FTA in providing technical assistance and training to the transit community. This support includes development of new, and revisions to existing, FTA sponsored training courses, and the conducting of safety and security workshops. Because of the ever-changing nature of safety and security problems and priorities within the transit industry, it is necessary for FTA to constantly review its safety and security training curriculum, update existing courses, delete courses as the need for them is eliminated, and add new courses as requirements necessitate.

The availability of such a resource is integral to establishing and maintaining the currency and caliber of the safety and security courses conducted by TSI for FTA. New courses are constantly being developed and older courses require ongoing update and refinement. The quality of the safety and security training program at TSI is sustained by FTA support of a pool of readily available experts to ensure continual delivery of high quality training for 4,000 transit professionals each year. Two hundred thousand dollars is requested in FY 2000 for this critical element of the safety and security training program.

1.5.3 Drug and Alcohol Testing Updated Guidelines/ Newsletters – $225,000

The complexity of the drug and alcohol rules as well as their costs and operational impacts necessitate updating the implementation guidelines as well as periodic preparation of updates to those guidelines. The Congressionally mandated drug and alcohol requirements are predicated upon ensuring that safety-sensitive employees are drug- and alcohol-free. Substance abuse management programs of grantees are an integral part of their system safety program plans. This project will support revising, developing, and disseminating the technical assistance information necessary to ensure full understanding and compliance by FTA grantees with the FTA drug and alcohol testing rules. There have been numerous changes necessitating revision of the guidelines. Additionally, the rules are frequently amended and interpretations are issued periodically. Transit systems must be made aware of these changes in a timely manner in order to achieve full compliance.

1.5.4 Security Survey: Public Perception – $100,000

Collection and analysis of data on safety and security concerns provide FTA with a basis for identifying key issues. This security survey will: address less quantifiable concerns of citizens regarding public transit in and around their neighborhoods, including the role of transit in promoting livable communities. This information will be invaluable for more effectively meeting transportation needs of diverse communities throughout the nation.

1.5.5.1 Information Data Outreach – $200,000

This new and unique endeavor with two large policing agencies working together in one geographic area will enable them to capture the transit

crime data that currently are unavailable. Without such information, critical analysis and deployment decisions cannot be effectively initiated.

This project will develop a new standard of crime reporting by creating a framework to actively capture vital information. Staffed with crime analysts from both the County of Los Angeles Sheriff's Department (LASD) and the Los Angeles Police Department (LAPD), the project will collect and process information not only from LASD and LAPD, but from other law enforcement agencies in the greater Los Angeles metropolitan area. Analysis of transit crime will cover a variety of issues, including compliance with FTA's National Transit Database transit security reporting, compliance with California Department of Justice and Uniform Crime Reporting requirements, collection of statistical data, terrorist activities, and crime trends. This information will be integrated with gang and tagger tracking systems and shared with the transit industry.

1.5.5.2 Safety Management Information Systems (SAMIS) – $350,000

The Safety Management Information Systems (SAMIS) is a mandatory reporting requirement as part of the National Transit Database. This project funds a separate SAMIS report which analyzes and displays normalized and trend data along with the basic statistical data.

Collection and analysis of safety and security data provide FTA and the industry with the basis for identifying key safety and security problems. In 1994, SAMIS data collection was expended to include highway-rail grade crossing accidents, cost data, and security data. This information is used in reports to Congress, the Office of the Secretary, and the Office of Management and Budget, as well as aiding transit professionals in developing system safety and security plans.

In FY 2000, FTA will undertake a major review of its safety and security data programs as it relates to bus safety. With the cooperation of the transit industry, efforts will be made to identify bus incident causal factors and contributing factors to better assess the state of transit bus safety and to identify safety deficiencies in the transit industry.

1.5.5.3 Drug and Alcohol Testing Information System (DAMIS) – $850,000

The Omnibus Transportation Employee Testing Act of 1991 authorized the Department of Transportation to mandate substance abuse management programs in various transportation industries for safety-sensitive employees. Final drug and alcohol testing regulations for mass transit employers were published by the FTA in February 1994.

These regulations require grantees to submit annual reports through a management information system. These reports serve as a primary tool to evaluate the effectiveness of regulations and support future modification, including adjusting the random testing rates. This project will provide funding to collect, maintain, and analyze reports from grantees summarizing their test results and produce an annual national report on the effectiveness of implementation of these rules by the transit industry. These data are also an important factor in FTA decisions concerning the compliance audits of the drug and alcohol testing programs.

1.5.6 Clearinghouse/ Website – $175,000

The Safety and Security Clearinghouse serves as an ongoing focal point for all requests for written materials and resources currently available on the subject of transit safety and security and related technologies. The clearinghouse function provides FTA with a means for hands-on contact with transit safety and security custom-

ers. This enables FTA to acquire a better understanding of their needs and provides an immediate response mechanism for information dissemination. Customer assistance is provided in the form of guidelines, technical publications, final reports, expert advice through referrals to other industry experts, simulation models, and state-of-the-art information resources.

Safety and security information on all modes of transit is required by planners, managers, and Federal, State, and local officials as they assess safety and capital requirements. The collection and dissemination of information on safety and security help to ensure that transit agencies have the tools to provide their patrons and employees with a safe and secure environment. Requests for information average 400 per month, 75 percent of which are telephone requests and 25 percent are by mail. Eighty-five percent of the telephone inquiries are satisfied instantaneously. The other 15 percent require research; responses are generally provided within two working days.

Funding for the Transit Safety and Security Website/Internet supports the ongoing management (input, edit, update, and deletion) of information on the website. The Website requires constant management to ensure the timeliness and accuracy of the information, such as training opportunities, meetings, DOT/FTA hearings, regulations, and reports. It can be accessed through the FTA Home Page on the Internet. The Website also serves as a communication link for transit systems, emergency response organizations and FTA regional offices.

1.5.7 Bus Safety – $500,000

The National Transportation Safety Board has, through a series of hearings on bus transit safety, concluded that there is a lack of uniformity among the states with regard to safety oversight of bus transit. And, although there is Federal regulation and oversight of commuter rail operations (FRA) and Federally mandated state responsibility for rail fixed guideway transit systems (FTA), there is not any equivalent Federal regulation and oversight of transit bus safety. Absent Federal legislation in this area, there is a distinct need to assist states in developing and overseeing safety programs. Currently, state oversight of bus transit ranges from none whatsoever to highly perfected safety programs supported by state legislation and administered by State-level agencies employing safety-trained professionals.

This project will fund a series of technical assistance projects to States to encourage their adoption of uniform safety regulations and oversight of bus transit systems. Initially, FTA's January 1986 report, "State Regulation and Oversight of Public Transit Safety," will be updated to evaluate the current status of the regulatory oversight of bus transit in various states. A review will be conducted of the Federal role and responsibilities for bus transit by such agencies as the Federal Highway Administration, the National Highway Traffic Safety Administration, and the Federal Transit Administration.

FTA will also cooperate with the American Public Transit Association (APTA), the Community Transportation Association of America and the American Association of State Highway and Transportation Officials (AASHTO) to develop a model state based transit bus safety oversight program that will establish voluntary national standards.

1.5.8 Human Factors: Fatigue Symposium – $150,000

As a result of the 1995 New York City Transit accident on the Williamsburg Bridge, and based on a recommendation for the National Transportation Safety Board, in February 1998 the Office of Safety and Security, in conjunction with the American Public Transit Association, sponsored a Fatigue Symposium. This symposium brought together fatigue experts from around the country as well as those in the transit industry who

are responsible for fitness-for-duty programs and training. One of the recommendations from this symposium was that a follow-on symposium be conducted in two years. This symposium will include a more extensive cross section of fatigue experts and others with a concern for fatigue and its effects on the transit industry.

1.5.9 Fire Materials Testing – $150,000

As a result of the February 16, 1996, MARC commuter train accident, the NTSB recommended that DOT "review the testing protocols within various modal administrations regarding the flammability and the smoke emissions characteristics of interior materials and coordinate the development and implementation of standards for materials performance and testing with the FRA and FTA." There is a need to utilize the latest fire safety technology to validate uniform guidelines for fire performance of materials for use by government agencies. Use of these guidelines in selection of materials for vehicles will reduce fire incidents and their attendant costly property damage and casualties.

This project will enable FTA to participate with various modal administrations within DOT in developing and implementing fire safety standards for performance and testing of interior materials for rail vehicles. It also supports the objective of the Interagency Fire and Materials Working Group of the Federal Government to produce uniform guidelines for fire performance of materials for consideration by government agencies. Fire safety testing of new composites with improved characteristics, a part of this effort, is important because new railcars and buses are likely to be designed and built using such materials. This testing will help determine how to use the latest fire safety technology in testing to improve fire safety standards for composite materials which comply with government regulations and standards and FTA fire safety guidelines.

Program: FTA 1 Safety and Security		
Key Activities and Products	**Program Schedule**	
	FY 1999	**FY 2000**
1. Safety and Security		
A. Technology	**$250**	**$1,350**
1.1 Railroad Grade Crossing Safety		
1.1.1. Signalization with Train Pre-emption	$250	$400
1.2. Computer System Security		
1.2.1 Research activities and engineering analysis		$50
1.2.2. Assessing vulnerabilities of electronic fare payment system.		$50
1.3.1. Chemical/Biological Agent Detection		$450
1.3.2. Passenger Security		$200
1.4.1. Safety and Security Technical Support		$200
B. Training & Technical Assistance	**$1,950**	**$4,100**
1.5.1. Safety & Security Training (includes Transportation Safety Institute)	$1,000	$1,200
1.5.2. Safety & Security Training Course Development		$200
1.5.3. Drug and Alcohol Testing: Updated guidelines/newsletters		$225
1.5.4. Security Survey: Public Perception		$100
1.5.5.1. Information/Data/Outreach (Newsletters, workshops, journals)		$200
1.5.5.2. SAMIS	$100	$350
1.5.5.3. Drug and Alcohol Testing Information System (DAMIS)	$750	$850
1.5.6. Clearinghouse/Website	$100	$175
1.5.7. Bus Safety		$500
1.5.8. Human Factors: Fatigue Symposium		$150
1.5.9. Fire Materials Testing		$150
Total Budget Authority	**$2,200**	**$5,450**

RELATED PROGRAMS: FTA 3. Fleet Operations, FTA 2. Equipment & Infrastructure

RESOURCE SUMMARY/HISTORY ($000)

Budget Authority	FY 1996 Enacted	FY 1997 Enacted	FY 1998 Enacted	FY 1999 Enacted	FY 2000 Program
Contracts, Grants, Cooperative Agreements	**$1,100**	**$725**	**STET**	**STET**	**$5,450**

Contact: FTA Office of Safety & Security, TPM-30, Phone: 202-366-2896

Program Title: Equipment and Infrastructure
Budget Item No: FTA 2
Amount Requested for FY 2000: $11,600,000

GOALS

Strategic Goals:

Economic Growth & Trade

- Advance America's economic growth and competitiveness domestically and internationally through efficient and flexible transportation
- Reduce the true economic cost of transportation, taking into account the quality of transit services
- Ensure that improvements in transportation that advance America's economic growth and trade are made in a manner consistent with the President's Executive Order on the cost-effectiveness of infrastructure investment
- Reduce travel time in delivery of people, goods and services to their destinations.
- Improve the reliability of the delivery of people, goods and services to their destinations
- Improve the U.S. international competitive position by promoting competition in domestic and international markets in transportation-related services and facilitating the export of domestic transit goods and services
- Encourage regional and local economic development through encouraging joint development

Human & Natural Environment

- Protect and enhance communities and the natural environment affected by transit
- Improve the sustainability and livability of communities through investments in transportation facilities
- Reduce the amount of transportation-related pollutants released into the environment

Performance Goals:

Economic Growth & Trade

- Reduce door-to-door travel times within highly congested corridors where FTA investments have been made
- Increase FTA participation in private and public partnerships supporting the development, adaptation, deployment and testing of advanced technology vehicles and components
- Increase the dollar volume of the export of domestically produced transit goods and services

Human & Natural Environment

- Increase the number of people having access to high quality transit
- Increase by one percent per year the vehicle revenue hours providing service with a frequency of 15 minutes or less
- Reduce the number of transit-related pollutants released into the air per revenue vehicle mile

Program Title: Equipment and Infrastructure
Budget Item No: FTA 2
Amount Requested for FY 2000: $11,600,000

GOALS

Strategic Goals:

Economic Growth & Trade

- Advance America's economic growth and competitiveness domestically and internationally through efficient and flexible transportation
- Reduce the true economic cost of transportation, taking into account the quality of transit services
- Ensure that improvements in transportation that advance America's economic growth and trade are made in a manner consistent with the President's Executive Order on the cost-effectiveness of infrastructure investment
- Reduce travel time in delivery of people, goods and services to their destinations.
- Improve the reliability of the delivery of people, goods and services to their destinations
- Improve the U.S. international competitive position by promoting competition in domestic and international markets in transportation-related services and facilitating the export of domestic transit goods and services
- Encourage regional and local economic development through encouraging joint development

Human & Natural Environment

- Protect and enhance communities and the natural environment affected by transit
- Improve the sustainability and livability of communities through investments in transportation facilities
- Reduce the amount of transportation-related pollutants released into the environment

Performance Goals:

Economic Growth & Trade

- Reduce door-to-door travel times within highly congested corridors where FTA investments have been made
- Increase FTA participation in private and public partnerships supporting the development, adaptation, deployment and testing of advanced technology vehicles and components
- Increase the dollar volume of the export of domestically produced transit goods and services

Human & Natural Environment

- Increase the number of people having access to high quality transit
- Increase by one percent per year the vehicle revenue hours providing service with a frequency of 15 minutes or less
- Reduce the number of transit-related pollutants released into the air per revenue vehicle mile

- Increase by two percent per year the deployment of energy efficient and low emission technology vehicles in the transit industry
- Reduce the metric tons of hydrocarbons, nitrogen oxides and carbon monoxide released into the environment due to an increase in transit use and a decrease in auto use

NSTC Strategic Partnership Initiatives:

- Next Generation Motor Vehicles and Ships
- Monitoring, Maintenance and Rapid Renewal of the Physical Infrastructure

This budget request includes $5.8 for major capital investment and routine capital acquisitions such as new bus and rail equipment. State and local funds provide additional support for new bus and rail vehicles, facility modernization, and other capital items to renew the nation's transit infrastructure. In addition, there is well over $90 billion in major capital investments in the project development and implementation phases. FTA's activities in the Equipment and Infrastructure area seek to maximize the payoff from capital investments by introducing new, reliable and cost-effective vehicle, system, and facility technology.

At present, buses powered by alternative fuels, such as compressed and liquefied natural gas have been incorporated into transit fleets. The principal goals have been to lower emissions and reduce reliance on a single fuel source. Operation, maintenance, and repair of these vehicles requires specialized training for the transit staff. The National Research and Technology Program will assist in implementing the Clean Fuels Formula Grant Program, which was authorized in TEA-21.

Work will be initiated in construction technology, and FTA will continue to monitor, provide technical assistance, and document best practices in innovative finance and turnkey delivery methods. Specialized activities will focus on technological advancement in buses and component systems needed for the 2002 Winter Olympic Games in Salt Lake City; adaptations of radio-based communication systems; advancements in bus propulsion systems; advancements in bus testing; continuous dialogue with the bus and rail industry through workshops and peer panels on major site-specific projects; and deployment of proven cost-effective technology.

MAJOR ACTIVITIES & ANTICIPATED FY 1999 ACCOMPLISHMENTS

- Promote the collection, dissemination and exchange of information on bus technology and innovation.
- Assist the U.S. transport industry in achieving global competitiveness
- Demonstrate the effectiveness of an international bus resale program
- Complete demonstration and evaluation of phosphoric acid (PAFC) transit bus. Fuel Cell technology offers one promising method to reduce emissions while maintaining user flexibility to operate long distances
- Complete full-sized, domestically produced, proton-exchange membrane fuel cell (PEMFC) transit bus
- Initiate demonstration and evaluation of hydrogen PEMFC transit bus
- Initiate development of pre-production transit buses with advanced PEMFC propulsion systems with at least two domestic fuel cell manufacturers
- Foster production of "better" transit vehicles and components including use of high-quality tools such as virtual prototyping
- Promote collection, dissemination and exchange of information on research, technology, management practices and innovation

- Provide assistance to domestic transit vehicle manufacturers and technical service industries to enhance U.S. competitive position in global markets
- Support efforts aimed at providing better transit service through use of advanced communications and information infrastructure
- Encourage advanced monitoring and inspection systems for improved state of the physical infrastructure
- Provide technical assistance to transit agencies for the demonstration, testing, and deployment of communication-based train control systems; support peer groups; disseminate results and assist in establishing training programs
- Support development of electrical interface standards for on-board train control information and other major rail car subsystems
- Examine use of advanced composite materials for use in rail vehicles and infrastructure for weight and cost savings
- Examine use of virtual reality systems for improved efficiency and cost savings in rail operations and vehicle design
- Provide technical assistance for the investigation and completion of design of a monobeam rail system with potential for infrastructure cost savings in less dense applications and initiate efforts for an urban maglev system
- Improve delivery and facilitate exchange of information among major transit capital projects through the Transit Construction Roundtable
- Document lessons learned from the Los Angeles, Baltimore and San Juan Turnkey Demonstration projects
- Document best practices in transit joint development and value capture

KEY FY 2000 PRODUCTS AND MILESTONES

- Develop full-sized, domestically produced, advanced (200 kW) PEM fuel cell transit bus
- Initiate development in conjunction with the transit industry and EPA of a hybrid electric transit bus emissions testing protocol
- Develop commercial transaction documents for a bus resale program to stimulate used-bus exports
- Assist U.S. firms in marketing transit-related products for export through product information dissemination, participation in peer panels, trade shows, and conduct of transit planning, project development and project management training as requested by foreign countries
- Promote collection, dissemination and exchange of information on research, technology, management practices and innovation
- Provide assistance to domestic rail transit manufacturers and technical service industries to enhance U.S. competitive position in global markets
- Support efforts aimed at providing better transit service through use of advanced communications and information infrastructure
- Encourage advanced monitoring and inspection systems for improved state of the physical infrastructure
- Complete demonstration of advanced automatic train control system at BART
- Provide technical assistance to transit agencies for the demonstration, testing, and deployment of communication-based train control systems; support peer groups; disseminate results and assist in establishing training programs
- Support development of standards and interface gateways for on-board train control and information systems

- Examine use of advanced composite materials for use in rail vehicles and infrastructure for weight and cost savings
- Examine use of virtual reality systems for improved efficiency and cost savings in rail operations and vehicle design
- Provide technical assistance for the investigation and completion of design of the urban maglev system with potential for infrastructure cost savings in less dense area applications
- Improve infrastructure project delivery, document lessons learned from the BART and Hudson-Bergen LRT Turnkey Demonstration projects, and facilitate exchange of information among major transit capital projects through the Transit Construction Roundtable
- Conduct review of construction technology for transit infrastructure
- Continue administrative and technical support to major capital projects through the Transit Construction Roundtable
- Update the Transit Construction Roundtable Brochure

FY 2000 PROGRAM REQUEST

2.1 Bus Technology

The Bus Technology Program addresses a number of research and technology needs related to the future design, safety, and operation of the next generation of transit buses and associated components. These needs have been identified in consultation with the transit community. Over the next five years, this program will work on advanced transit vehicle technologies including: Advanced Technology Subsystems, a Small Durable Transit Bus, advancements in Bus Testing, and deployment of clean fuels.

2.1.1 Advanced Technology Subsystems

2.1.1.1 Advanced Bus Subsystems – $1,150,000

Work will continue on development and deployment of advanced subsystems for transit buses, electric vehicles, and hybrid-electric vehicles critical to achieving deployment, and eventual market introduction, of advanced vehicle technologies in the transit industry. For electric and hybrid-electric vehicles, improvements are needed in energy storage technologies (such as improved power density and reduced cost), communication/control systems, and overall systems integration in order to increase vehicle range, increase reliability, optimize performance, and reduce subsystem costs. Integration of advanced subsystem technologies, such as composite structural materials, regenerative braking, and onboard computer management, into the design of these vehicles will further enhance their cost-effectiveness.

Under the new partnering mechanism provided by the FTA Joint Partnership Program (JPP), FTA will work with industry and other Government and private research entities, in order to leverage R&D funding and further the state-of-the-art in advanced bus subsystem technologies. Such joint development efforts will accelerate the deployment of innovative technologies in the mass transit industry.

This is a new effort requested at $1,150,000 for FY 2000.

2.2 Fuel Cell Transit Bus

The transit industry is faced with meeting stringent bus emission standards that are increasingly more difficult to meet with diesel technology. Fuel cells offer near zero emissions and significant reductions in greenhouse gas emissions, as well as potentially more efficient power generation, improved reliability, and lower maintenance

costs. Current activities build upon a joint FTA/DOE test-bed fuel cell bus program under which three 30-foot test bed fuel cell buses were completed. Emission testing confirmed that a methanol-fueled fuel cell test bed bus produces nearly non-measurable nitrogen oxide, no particulate matter, low levels of hydrocarbons, and acceptable levels of carbon monoxide.

2.2.1 Fuel Cell Transit Bus Program – $1,500,000

The Fuel Cell Transit Bus Program is the only viable U.S. fuel cell transportation program and is critical to the nation's economic competitiveness in this emerging technology area. In a congressionally mandated program with Georgetown University, two types of fuel cell technologies are currently being evaluated as the propulsion system for transit buses: phosphoric acid fuel cell (PAFC) and proton-exchange-membrane fuel cell (PEMFC). Under this program, one PAFC 40-foot transit bus and one PEMFC 40-foot transit bus will be assembled and evaluated. A full-funding memorandum of understanding is being developed with Georgetown University to establish the maximum Federal funding for the completion of this program to develop commercially viable fuel cell transit buses. The agreement will set forth the scope of effort, mutual understandings, terms and conditions, and rights and obligations of FTA and Georgetown related to implementing and completing the Fuel Cell Transit Bus Program.

Based on the tests performed on the PAFC and PEMFC 40-foot buses, an assessment will be made of whether sufficient data related to operations and maintenance are available to support selection of fuel cell technologies for transit bus applications. Factors to be considered include availability of fuel cell suppliers, durability of the fuel cell system under transit duty cycle, compatibility with transit operating and maintenance practices, potential life cycle costs, and choice of fuel cell technology in other heavy-duty transportation applications. The selected fuel cell technology or technologies will be demonstrated in additional transit buses in partnership with interested transit agencies. More than one U.S. fuel cell supplier will be selected to ensure commercial competition. A range of vehicle configurations and transit bus platforms (including the ATTB) will be evaluated, from fuel cell hybrids to pure fuel cell, as well as a range of fueling options from on-board hydrogen to reformed methanol. Safety issues associated with fuel cells and the range of fuels that may be used will be evaluated from both a vehicle and infrastructure perspective.

The program will monitor the technical progress and safety use of on-board hydrogen-fueled fuel cell transit buses at the Chicago Transit Authority (CTA) and at BC Transit in Vancouver, British Columbia. The technical progress of on-going research and development efforts into direct-methanol fuel cells and fuel cells using reformed diesel and gasoline fuel will also be monitored for performance and safety. Developments in advanced solid-oxide fuel cell as well as molten carbonate fuel cell technologies will also be evaluated for transit bus applications.

This is a continuing multi-year program for which TEA-21 authorized $4.85 million of FTA capital investment funds annually beginning in FY 1998. FTA requested $4.0 million in FY 1999, but earmarking in TEA-21 and the appropriations process made FY 1999 funding infeasible. For FY 2000, $1.5 million is requested in National Research and Technology to conduct research and development of a 200 kW PEMFC bus.

2.2.2 Palm Springs, CA Fuel Cell Buses – $1,000,000

TEA-21 earmarks $1,000,000 in FY 1999 and $1,000,000 in FY 2000 for fuel cell buses for Palm Springs, CA.

2.3 Hybrid-Electric and Electric Vehicles

Hybrid-electric and electric vehicles provide another opportunity for the transportation industry to reduce vehicle emissions. Electric drive systems enable transit buses to exceed current and anticipated emissions standards. Their low emissions characteristic may enable transit buses to operate in areas that are off-limits to diesel buses. Hybrid electric transit buses offer significant emissions reductions without costly infrastructure changes and offer significant improvements in fuel efficiency lowering transit operating costs. Preliminary tests have shown a 50 percent reduction in emissions and a 25-30 percent improvement in fuel efficiency.

This program will complete the Demonstration of Universal Electric Subsystems Transportation (DUETS) program funded jointly by DARPA and FTA and managed by FTA. Efforts will continue to provide technical assistance in advanced transit technology alternatives to the National Park Service in support of the joint memorandum of understanding between DOT and the Department of the Interior (DOI). With the transition of the DARPA Electric and Hybrid-Electric Vehicle Program to an intermodal Advanced Vehicle Program within DOT, an active role will be undertaken in defining technology focus areas, reviewing and approving project proposals, and managing and monitoring projects selected for funding.

The objectives of this program are to foster the development and deployment of electric drive propulsion systems that can be used in a wide range of transit applications to improve air quality; reduce greenhouse gas emissions; reduce the transportation sector's consumption of petroleum; reduce transit operating and maintenance costs; and encourage the creation of new jobs through the continued development of an emerging electric vehicle industry. FTA will document the safety, cost-effectiveness, and environmental benefits of using electric drive propulsion systems.

Key components and subsystems for electric drive propulsion systems will continue to be developed and refined. One critical subsystem is a compact, lightweight energy storage system. Significant improvements in current hybrid-electric bus operating performance and efficiency will be possible with an affordable, small, and lightweight energy storage system to replace battery packs currently in use. Efforts will continue in the development and testing of flywheel technology. New efforts will be initiated to support the development of ultra-capacitors and spiral-wound thin-film advanced batteries as possible energy storage systems for hybrid-electric transit bus applications.

FTA is currently testing, demonstrating, and evaluating zinc air batteries for transit bus applications. Many organizations and institutions are conducting research into advanced battery technologies appropriate for Electric Vehicles. FTA will consider the use of these advanced battery technologies for use in transit applications.

2.3.1 MBTA Advanced Electric Transit Buses & Related Infrastructure – $1,500,000

TEA-21 earmarks $1,500,000 in FY 1999 and $1,500,000 in FY 2000 for this project.

2.4. Rail Equipment and Systems

Improving rail transit capacity by building new infrastructure can be expensive. Standard approaches include extending tracks and enlarging station platforms to accommodate longer trains. An affordable solution requires better use of the existing infrastructure to the best possible degree, consistent with safety and reliability. Rail rapid transit agencies are facing the problem of improving passenger-carrying capacity of their systems at affordable cost and without expensive additions to existing infrastructure. Concurrently, significant improvements in overcoming train control operational problems and safety are warranted. Major elements of the Rail Equipment and Systems program include demonstration of Communication-Based Train Control

(CBTC) systems and examining the future of lightweight rail transit vehicles. Investigations will also be conducted on specialty guided technologies such as suspended monorail systems.

2.4.1 Communication Based Train Control – $1,000,000

Communication-Based Train Control (CBTC) systems employ modern computing systems, communications, and control technologies to overcome the limitations placed by fixed block train control technology that safeguards train operations but limits train throughput. These systems may pave the way for eventual introduction of total automation of train operations. CBTC benefits transit users in a number of ways. It allows for more trains to be run on the existing system, increases safety and flexibility in operations to facilitate fast recovery from unforeseen circumstances, and enables faster trips, greater reliability, and better and more timely availability of customer information. CBTC systems reduce the need for major investments in infrastructure by offering an attractive alternative to transit agencies to increase passenger-carrying capacity and safety without adding more tracks or building longer stations to accommodate longer trains. The Bay Area Rapid Transit District (BART) is considering using CBTC as an alternative to investing $3 billion for a new Transbay Tube to accommodate future system expansion. Other advantages of CBTC include requiring fewer vehicles to meet the same demand for service and energy efficiency, smart grade-crossing protection, and the ability to coordinate with intelligent road systems.

The proposed program supports several activities to promote testing and early deployment of CBTC systems. Typical activities are: demonstrations, peer group meetings, dissemination of results, assistance in establishing training programs, CBTC standards development through industry consensus, commuter rail applications, and inter-operability among different CBTC systems. Extension of CBTC technology to grade-crossing protection minimizes gate down-time that is consistent with performance of the approaching train and safety of both rail and road traffic. CBTC, by virtue of being an intelligent system, is capable of safe optimization of both rail and road traffic at grade-crossings. Over the next five years, FTA will demonstrate this technology at two or more locations. FTA will continue to work with BART in the testing of the advanced automated train control system, partially funded by DARPA. Other candidate testing sites are New York City and Philadelphia. Capabilities to be demonstrated and tested include positioning, command and control features. Once CBTC is more widely deployed, FTA will cooperate with industry partners to establish national CBTC standards. This program also includes dissemination of CBTC information, assistance to transit agencies to deploy the appropriate technology through on-going capital programs, and development of training courses and other training media.

This is a new four-year activity for which $1,000,000 is requested for FY 2000.

2.4.2 SEPTA Advanced Propulsion Control System – $3,000,000

Under the project, the Southeastern Pennsylvania Transportation Authority (SEPTA) will replace existing wheelslip, propulsion, dynamic brake electronics, diagnostics and low voltage power supply with new microprocessor-based equipment on 231 Silverliner commuter railcars manufactured by General Electric in 1974-1977. Traction motors will not be replaced. TEA-21 requires SEPTA to request cost proposals from the four selectees from prior open competition (Alstom, ADTRANZ, Secheron and SPD Technologies).

Prototype development and testing is expected to take two years. Modification of cars will follow. TEA-21 earmarked $2,000,000 for FY 1999 and $3,000,000 for FY 2000 for the project.

2.4.3 Gloucester, MA Intermodal Technology Center – $1,500,000

TEA-21 earmarked $1,500,000 for FY 1999 and $1,500,000 for FY 2000 for this project.

2.5 Civil Infrastructure

Hundreds of millions of dollars are spent annually on construction and rehabilitation of the nation's heavy rail, light rail, commuter rail, automated guideway, and dedicated busway systems. The costs to build and expand these systems continue to rise, with a major cost component being civil infrastructure, including tunnels, stations, and bridges. This research will focus on reducing the life-cycle costs for these systems, including design, construction, operations, and maintenance costs. Research under this program will address the planning, design, and construction of components of fixed-guideway systems, including tunnels and stations. Minimizing operating and maintenance costs through better planning, design, and construction will also be part of this research, as will reducing the overall cost of building these systems.

One method that may be investigated under research into each component is the use of "virtual engineering" as applied to civil infrastructure systems and components. Application of computer-simulated integrated design and testing may result in better designed projects at lower costs. Advanced technologies promise to reduce the inconsistencies and flaws in project designs that are often not caught using traditional design tools.

2.5.1 Infrastructure Project Delivery Innovations

Change orders are a significant factor in cost overruns of transit projects. Better design and estimating techniques, improved understanding of the geologic impacts of tunneling, greater attention to risk management, and better methods for scheduling project construction can reduce the need for these changes. Lack of understanding about changes that may occur has historically been a basis for low-bidding a project. The low bidder attempts to recover actual costs through change orders. Creating incentives that reduce the financial advantage of change orders, while maintaining the integrity of the project, will reduce cost overruns. FTA is already researching and demonstrating the usefulness of one method, turnkey project delivery. Partnering agreements and fast track scheduling are other methods being tested by transit agencies. FTA will document best practices among these other project delivery innovations as well as turnkey. Further research will identify other ways to reduce the need for change orders and resulting cost and schedule overruns.

2.5.1.1 Turnkey Demonstration Program – $500,000

Turnkey is a promising project delivery system to help expedite schedules, control costs, and better allocate and manage implementation risks and the introduction of new technology for fixed guideway systems. Other potential benefits of turnkey deployment are more effective cash flow management, project control, partnering of small, medium, and large-sized firms, attraction of new sources of funding, and fostering use of innovative technology.

Section 3019 of ISTEA authorized the FTA Turnkey Demonstration Program. Projects selected to participate in the program are: Baltimore Central Light Rail Extensions, Los Angeles Union Station Gateway, San Francisco Bay Area Rapid Transit Airport Extension, New Jersey Hudson-Bergen Light Rail, and San Juan, Puerto Rico Tren Urbano. The Baltimore and Los Angeles projects were completed on time and are operational. Initial results for the Baltimore project indicate that the

turnkey procurement resulted in a time saving on the order of one full year, when compared to the conventional procurement process. This was divided about evenly between the duration of the procurement process and the combined design/construction phases. The industry review process was critical in fine-tuning the Maryland Mass Transit Administration's in-house procurement efforts for the project. Another result was that the project's contingency fund was still intact when service was inaugurated in September 1997.

FTA will continue to document experience and lessons learned about the turnkey program and provide this information to other transit agencies considering the benefits of the turnkey method for new major investments.

This is a continuing program for which $500,000 is requested for FY 2000.

2.5.1.2 Tunnel Design and Construction – $370,000

Tunneling for transit projects is as much an art as a science. Variables affecting the design and construction of a project include predicting the behavior of ground mass during construction and the vagaries of ground-water hydrology. Predictive models are only of some use because no two projects are the same. The process of tunnel design and construction involves evaluation of geologic conditions, identifying and acquiring the right equipment for boring the tunnel, ground modification techniques, environmental impact mitigation, utility and traffic protection, contractor selection and payment, and risk management. Research is needed in all of these areas.

Many innovations have been made in tunnel technology. This information needs to be collected and reviewed to identify the range of options available to minimize the problems an initiator of a subway project may face. Lessons have been learned from projects completed in the U.S. and in other countries that should help identify ways to achieve greater efficiency in the design and construction of subway tunnels. The strong and weak aspects of tunneling methods, such as two-pass, single-pass, and the New Austrian Tunneling Method (NATM), must be identified as they relate to geologic conditions, scheduling, budgeting, and functional constraints.

FTA research will analyze and catalogue lessons learned and provide information to the transportation industry. This is a starting point for devising better design and construction processes and for developing effective risk mitigation techniques. Other research topics to be considered include assessment of tunnel infrastructure conditions and evaluation of non-destructive testing methods. Advances in thermal scanning, high resolution ultrasonic, scanning, and radar detection may have potential to address this problem.

This is a new activity for which $370,000 is requested for FY 2000.

2.5.1.3 Transit Construction Roundtable – $80,000

FTA will continue support of the Transit Construction Roundtable, a successful partnership between the Federal government and local public transportation agencies. The Roundtable brings together chief engineers and construction officers from transit agencies with major capital projects to discuss initiatives that will improve the implementation of those projects and save taxpayer dollars. FTA's past support has included administrative and technical facilitation as well as publication of a brochure highlighting the accomplishments of the Roundtable. Plans for FY 2000 include continued administrative and technical support and an update to the brochure.

Program: FTA 2 Equipment and Infrastructure		
Key Activities and Products	**Program Schedule**	
	FY 1999	**FY 2000**
2. Equipment & Infrastructure		
2.1. Bus Technology		
2.1.1.1. Advanced Bus Subsystems		$1,150
2.2. Fuel Cell Transit Bus		
2.2.1. Fuel Cell Bus: 200KW PEM Fuel Cell		$1,500
2.2.2. Palm Springs, CA Fuel Cell Buses	$1,000	$1,000
2.3. Hybrid Electric and Electric Vehicles		
2.3.1. Santa Barbara Electric Transportation Institute	$500	
2.3.2. Advanced Transit Systems & Electric Vehicle Program CALSTART	$1,500	
2.3.3. MBTA Advanced Electric Transit Buses & Related Infrastructure	$1,500	$1,500
2.3.4. Zinc Air Battery Research	$1,500	
2.4. Rail Equipment and Systems		
2.4.1. Communication Based Train Control		$1,000
2.4.2. SEPTA Advanced Propulsion Control	$2,000	$3,000
2.4.3. Bus Technology: Gloucester, MA Intermodal Technology Center	$1,500	$1,500
2.4.4. Vegetation Control on Rail Rights-of-Way Survey	$250	
2.5. Civil Infrastructure		
2.5.1.1. Turnkey Demonstration Program		$500
2.5.1.2. Construction Technology Review		$370
2.5.1.3. Transit Construction Roundtable		$80
Total Budget Authority	**$9,750**	**$11,600**

RELATED PROGRAMS: FTA 1 Safety & Security, FTA 3 Fleet Operations

RESOURCE SUMMARY/HISTORY ($00)

Budget Authority	FY 1996 Enacted	FY 1997 Enacted	FY 1998 Enacted	FY 1999 Enacted	FY 2000 Request
Contracts, Grants, Cooperative Agreements					
Bus Technology & Infrastructure	$5,295	$15,830	$17,305	$6,000	$5,150
Rail Systems & Infrastructure		$70	$1,424	$3,750	$6,450
Total Contracts, Grants, Coop. Agreements	**$5,295**	**$15,900**	**$18,729**	**$9,750**	**$11,600**
Contact: FTA Office of Research and Technology, TRI-1, Phone: 202-366-0184					

Program Title: Fleet Operations
Budget Item No: FTA 3
Amount Requested for FY 2000: $3,800,000

GOALS

Strategic Goals:

Mobility & Accessibility

- Shape America's future by ensuring a transportation system that is accessible, integrated, efficient, and offers flexibility of choices
- Increase intermodal physical, informational, and service connectivity.
- Ensure the nation's transit systems employ the latest technology to meet the increased needs of mobility and accessibility

Economic Growth & Trade

- Advance America's economic growth and competitiveness domestically and internationally through efficient and flexible transportation
- Reduce the true economic cost of transportation, taking into account the quality of transit services
- Ensure that improvements in transportation that advance America's economic growth and trade are made in a manner consistent with the President's Executive Order on the cost-effectiveness of infrastructure investment

Performance Goals:

Mobility & Accessibility

- Increase the number of deployed Intelligent Transportation Systems (ITS)
- Reduce bus and light rail dwell times by 20 percent by FY 2002 through deployment of new technology and other innovations

NSTC Strategic Partnership Initiative:

- National Intelligent Transportation Infrastructure

FTA will target the urban, suburban, and rural travel markets with the aim of introducing technological and other innovations to increase the quality and capacity of all transit modes operating both in mixed traffic and on exclusive rights-of-way. This program area will enhance knowledge of the factors which affect the flow of transit, pedestrian and other vehicular traffic flow and customer service quality. It will focus on relatively low-cost operational and management solutions, especially when compared to the cost of constructing new infrastructure capacity increases. A key area will include tests, deployment, and promotion of advancements in communication and information technologies.

Customers, operators, and the community at large benefit from improvements in transit fleet operations. Fast and reliable transit vehicles improve the quality of service to transit passengers, and enhance the image of transit compared to other travel modes. In addition, fleet requirements are reduced, resulting in lower capital and operation and maintenance costs. The environmental and travel efficiencies of public transit, in terms of reducing pollution, energy consumption, and

vehicle-miles traveled, are well established. Benefits will accrue to the overall transportation system by reducing congestion and accommodating travel growth without the capital investment of major new infrastructure projects. Transit quality improvements, coupled with the efforts to enhance the reality and perception of system safety and security, will lead to transit systems attracting additional ridership.

The Fleet Operations research and technology program will also support FTA's efforts in special events including the 2002 Winter Olympic Games in Salt Lake City and efforts of the US Department of the Interior National Park Service (NPS) to reduce auto travel in the parks.

Projects under this program will be conducted in the following areas:

3.1 Transit Capacity and Quality of Service

3.2 Intelligent Transportation Systems (ITS) Transit

3.3 Bus Rapid Transit

MAJOR ACTIVITIES & ANTICIPATED FY 1999 ACCOMPLISHMENTS

- Improve the ability of U.S. transit operators to deliver increased and more efficient transit services and operations desired by the public at relatively low cost compared to more capital intensive investments
- Ensure that all transit communication, information, and operation systems optimize multimodal integration opportunities
- Assist international partners in improving their bus systems through U.S. Federal agencies in the development of technologies, including ITS, advanced communication systems, and innovative traffic engineering concepts
- Complete the APTS mobile showcase, consisting of a transit bus equipped with hardware and software to demonstrate the current state of the art in transit ITS
- Initiate a peer review and coordinate transit industry involvement on the Computer Integrated Transportation Management Environment (CITME) project in Cleveland
- Complete the first phase of an operational test of the integration of transit fare collection with multi-use card systems
- Complete development of guidelines for the integration of transit fare systems with multi-use card systems
- Complete the second phase of the Autonomous Dial-A-Ride Transit (ADART) project in Corpus Christi, Texas
- Complete Fleet Management Expert System research
- Complete research to develop an improved algorithm for demand responsive transit
- Support ISO TC204 Working Group 8 in the development of international ITS transit standards
- Provide direct assistance to transit operators in the design, installation and operation of ITS
- Identify the priority components of the transit platform of the Department's Intelligent Vehicle Initiative program
- Develop and deliver transit ITS courses on the ITS initiative and the implementation of the Transit Communications Interface Profiles (TCIP)
- Conduct an assessment of the impact on transit operations of radio spectrum refarming
- Continue the evaluations of current APTS operational test projects
- Continue Transit Communications Interface Protocols (TCIP) & Standards work

KEY FY 2000 PRODUCTS & MILESTONES

- Identify future needs involving the transit component of the Intelligent Vehicle Initiative (IVI). Conduct research involving characteristics and parameters of transit capacity and service for input into the Transit Capacity and Quality of Service manual. Continue the assessment of transit radio spectrum refarming. Continue research on utilizing congestion pricing linked to improved transit services in highly congested areas and innovative uses of GIS technology in transit. Conduct research of radio-based signal and traffic controls for mixed rail corridor transit operations
- Continue operational tests of rail grade crossing technology. Begin a demonstration under the Bus Rapid Transit Initiative of increasing service throughput. Continue testing the Rural Transit Regional Fleet Management System. Complete a cross-cutting study of APTS tests. Evaluate the CITME project. Begin operational tests and evaluation of core components of the IVI Transit Platform and Improved Demand Response Algorithm
- Continue efforts to mainstream transit ITS architecture and continue support for transit standards both in national and international arenas. Develop an open architecture for vehicle systems
- Continue efforts on technical assistance, training, information dissemination, outreach and industry cooperation

FY 2000 Program Request

3.1 Transit Capacity and Quality of Service (Funded from TCRP)

In the industry consultation during development of its R&T Five-Year Plan, FTA found that the transit profession lacks a consolidated and generally accepted set of transit capacity and quality of service definitions, principles, practices, and procedures for planning, designing, and operating transit vehicles and facilities. This transit situation is in contrast to that of the universally accepted guidance of the Highway Capacity Manual. A significant amount of empirical data gathering and analysis is needed to develop relevant information on transit capacity. This information will be used as input to the Year 2000 update of the Highway Transportation Capacity Manual which is universally used by transportation and traffic engineers for the analysis and design of transit systems.

This program will conduct research, empirical analysis, simulation model development, and testing activities to improve transit operations, provide consensus design standards, and offer demand and supply parameters for transportation planning. Priorities include: development of quality of service measures; updating general bus boarding and alighting times; developing boarding and alighting times for low-floor vehicles and different fare collection systems; developing a model for bus clearance times at bus stops reflecting different stop locations and traffic conditions, and developing procedures for calculating paratransit system capacity. Specific projects in the quality of service area are to develop both quantitative and qualitative measures categorized by system size and mode as appropriate, and to develop a framework for applying these measures with respect to system, corridor, route, on board vehicle, stop/station, and combined door-to-door scenarios. The results will be compiled into the Transit Capacity and Quality of Service Manual. After its development, training will be developed and conducted to implement the analytical tools contained in the Transit Capacity and Quality of Service Manual.

Research in this area will be pursued through the Transit Cooperative Research Program and University Transportation Research Program.

3.2 Intelligent Transportation Systems (ITS) Transit (Funded from the DOT ITS Program)

Intelligent Transportation Systems (ITS) Transit is an element of the DOT ITS Program. ITS Transit is a comprehensive approach to applying advanced technologies to transit to improve customer service and reduce system capital and operating costs. ITS Transit is organized in parallel with the DOT ITS Program and has three components: Metropolitan, Rural, and Transit Intelligent Vehicle Initiative. (The DOT ITS Program also includes a commercial vehicle component). The Metropolitan component of Transit ITS focuses on urban and suburban transportation in the areas of traveler information, fleet management, and electronic payment. The Rural component addresses these same areas to improve the effectiveness of transit in rural areas. The Transit Intelligent Vehicle Initiative (IVI) involves automating transit vehicle control and safety systems. TEA-21 authorized in Section 3012 the ITS Applications portion of the transit program, with provisions addressing both fixed-guideway and bus technology.

The Metropolitan component activities are divided into Traveler Information, Fleet Management, and Electronic Payment systems.

The Rural component of Transit ITS will focus on those unique characteristics of rural transit operations critical to rural communities. These activities will improve rural mobility by dispatch coordination with multiple transportation agencies, fleet maintenance coordination within a fleet and among fleets of different providers, communications including emergency service fleets, geocoding and addressing, coordination of responses to weather-related activities among various fleets (transit, highway maintenance, and emergency services), the development of regional traveler information architecture, and outreach to rural public transportation communities.

The Intelligent Vehicle Initiative (IVI), a multiagency research and development program of vehicle-focused ITS activities, emphasizes the significant and continuing role of vehicle operators in highway safety. The IVI is aimed at accelerating the development, availability, and use of driving assistance and control intervention systems to reduce motor vehicle crashes. The Departmental IVI Program is organized around four specific vehicle types: cars, transit buses, commercial trucks, and special vehicles such as snow plows. FTA is lead coordinator for the development of the IVI transit bus. Recognizing that Transit IVI will need to address a variety of transportation environments and modal mixtures, this initiative will examine a range of transit configurations, ranging from purely mass transit IVI to the transit characteristics of an integrated intermodal system. Key areas of development in Transit IVI will consist of research and operational tests related to rear collision avoidance, lane change and merge collision avoidance, road departure warning, pedestrian/passenger sensing, precise docking, tight maneuvering, maintenance automation, and vehicle diagnostics. Over the next five years, the Transit IVI program will move forward from needs assessment, through operational tests and evaluation, and on to product development by industry.

A key factor in tying together the elements of the Metropolitan component of ITS Transit and enabling it to integrate with other transportation modes is the National Architecture for ITS, which provides the framework for integration.

Standards help industry share technologies, improve reliability, reduce the costs of maintaining a qualified and knowledgeable workforce, and may reduce long-term costs. The first round of the Transit Communications Interface Profiles (TCIP) standards development is now complete and as the TCIP is implemented it will be monitored, reviewed and revised if necessary. FTA clearly recognizes that standards are important and that they should come from industry. FTA will act as a catalyst and participate in standards development to support the ITS National Architecture. This includes the development of consistency guidance for the National Architecture,

as well as the refinement of the TCIP, and other ITS-related efforts. In the long term, FTA and APTA will be launching the Transit Standards Consortium to serve as a forum for discussing standards issues and prioritizing standards needs. FTA will also assist in the development of international standards to create new markets and enhance U.S. global competitiveness.

Funding for ITS Transit activities in recent years has been through the DOT ITS program, and this is expected to continue through FY 2000. Two projects, one earmarked in TEA-21 and one specifically related to transit vehicles, are included in the FTA request for Fleet Operations funding.

3.2.1 ITS Applications: Washoe County, Nevada, Transit Technology – $1,250,000

This project is a multi-year funded project with the Regional Transportation Commission (RTC) of Washoe County to procure and install a GPS-based AVL system for the bus and paratransit fleet. RTC is responsible for both highways and transit. The AVL project is being coordinated with a Caltrans project to install several dynamic message signs along the Reno freeways (state funded) and also a Nevada DOT/RTC project to upgrade the traffic signal system. The AVL system will be integrated with police, fire, and emergency vehicles. RTC will also conduct a feasibility study of automatic passenger counters (APC), smart cards, computer-aided dispatching (CAD), transit signal priority, real-time traveler information at bus stops, and interactive ridesharing.

This project was funded with $1.875 million of DOT ITS funds in FY 1998 and authorized by TEA-21 for National Research funds in the amounts of $1.25 million for FY 1999 and $1.25 million for FY 2000.

3.2.2 Open Architecture for Vehicle Systems – $200,000

This project will provide for developing standards for transit vehicle systems and will use the approach developed in the ITS Initiative when the ITS National Architecture was developed as well as the approach used in developing standards used for railcar standards work underway through TCRP. Standards development will use the industry-accepted organizations for considering, developing, analyzing and approving the various standards needed in the industry.

Standards help industry share technologies, improve reliability, reduce the costs of maintaining a qualified and knowledgeable workforce, and may reduce long-term costs. The first round of the Transit Communication Interface Profiles (TCIP) standards development is now complete and as the TCIP is implemented it will be monitored, reviewed and revised if necessary. FTA clearly recognizes that standards are important and that they should come from industry. FTA will act as a catalyst and participate in standards development to support the ITS National Architecture. This includes the development of consistency guidance for the National Architecture, as well as the refinement of the TCIP, and other ITS related efforts. In the long term, FTA and APTA will be launching the Transit Standards Consortium to serve as a forum for discussing standards issues and prioritizing standards needs. FTA will also assist in the development of international standards to create new markets and enhance U.S. global competitiveness.

The transit industry clearly called for open vehicle architecture. At the November 1997 Bus Technology and Innovation Symposium, both the Operations and Equipment breakout groups identified as priority items open vehicle architecture for systems integration purposes and standards for interoperability of different technologies. They noted as reasons streamlining procurements and reducing acquisition costs. Open architecture is

particularly needed as advanced vehicle electronics and propulsion systems are introduced into transit vehicle, especially buses. Experience with the ATTB prototypes exemplifies this need.

This new initiative in Vehicle Standards will initiate development of voluntary industry standards for class C safety critical electronics that will allow for open architecture of electronics for transit bus applications, such as those needed for current electric-hybrid vehicle development programs. For example, advanced electric-hybrid buses under development, such as the ATTB (Advanced Transit Technology Bus) and the DUETS (Demonstration of Universal Electric Transportation Subsystems) vehicles employ advanced control electronics for standard bus functions, and for advanced power management and safety functions, which require sophisticated class C electronics. Current electronics standards for transit vehicles, such as SAE J1708 and J1939, are not suitable for class C applications, and no current industry standard exists. In the absence of class C industry standards for transit vehicles, both manufacturers of the control electronics for the ATTB and DUETS vehicles determined that a modified AIRNK 629 would suffice for the hybrid-electric vehicles.

This is a new initiative in FY 2000, for which $200,000 is requested.

3.3 Bus Rapid Transit (BRT)

Domestic total transit ridership has experienced growth in recent years with rail transit and paratransit leading the way. This growth has occurred after sizable investments in these two modes. Bus ridership continues to lag behind these other modes. Sustaining this growth, which is a theme for the vision statement of this Five-Year Plan, requires enhancing bus service which continues to be the backbone of public transportation in the U.S. Some of the problems with U.S. bus services are that buses most often operate on local arterial streets in mixed traffic and lack the amenities of rail transit or the personal service quality of paratransit. This results in low speeds, long circulatory trips, high operating costs, and high incidents of safety and security. Innovations in equipment, infrastructure, and services are available to improve bus services and facilities and make bus ridership more attractive to customers.

FTA is sponsoring the Bus Rapid Transit (BRT) Initiative to encourage integration of these innovations to address the problems of bus service. These innovations and improvements include advanced technology buses, ITS technologies, urban design enhancements, traffic engineering treatments, new service strategies, and supportive land use policies. A real-world model is successfully operating in Curitiba, Brazil, and FTA is promoting this model as an example of BRT for the adaptation in the U.S. Several areas in the U.S. are advancing BRT projects, including the Dulles Corridor in Northern Virginia, the Eugene, Oregon University Corridor, the Cleveland Euclid Avenue Corridor and several corridors in the Los Angeles area. The specific areas of the BRT program are as follows:

3.3.1 BRT Design and Operational Parameters – $300,000

This effort provides for continuing and new research that will assist in BRT design and operations. Few, if any, BRT systems exist in the U.S. There are some existing bus operations that incorporate individual elements of BRT, such as exclusive lanes, signal preference, improved fare collection, etc., and data are available that provide designers knowledge of existing operations. Designers and operators of future BRT systems will need to know what are the combined effects and impacts of BRT systems that surpass existing models. For example, what will be the effects on buses operating in a BRT system with multiple, combined BRT features? Also, what is the effect on other corridor traffic if lanes are reserved for the exclusive use of buses? Does traffic signal preference for buses cause excessive delay for other vehicles? This effort will include research studies, capacity analyses, and computer model simulations that would test real or synthesized corridors and predict reductions in bus delay, increases in other vehicle delay, traffic diversions, etc.

This is a continuing effort in support of BRT deployment, with FY 1999 funding estimated at $150,000 and $300,000 requested for FY 2000.

3.3.2 BRT Data Collection and Analysis – $500,000

This effort will support data collection and analysis of BRT demonstration projects. Results of the demonstration projects are important so that other transit agencies can learn of the benefits of BRT. BRT information obtained in this evaluation will be used in the effort to mainstream the BRT concept at U.S. transit agencies. These funds will go via cooperative agreements to transit agencies involved in BRT demonstration projects. The transit agencies will collect data about operations, ridership, financial and other measures according to a plan developed by a contractor to FTA. The contractor will also analyze the data and prepare a report documenting the events of the demonstration, focusing on changes in bus operations, effects on other traffic, changes in ridership, improvements to bus operating efficiency and other measures. This effort should be able to support about four demonstration projects.

This is a continuing effort in support of BRT deployment, with FY 1999 funding estimated at $250,000 and $500,000 requested for FY 2000.

3.3.3 BRT Systems Integration Workshops – $350,000

This effort will support workshops to assist one or more demonstration sites to plan and coordinate various details of a demonstration project. Experts and peers could offer advice to local implementers on how to integrate project elements, overcome obstacles and achieve optimal results.

This is a continuing effort in support of BRT deployment, with FY 1999 funding estimated at $200,000 and $350,000 requested for FY 2000.

3.3.4 Project Administration – $600,000

This element includes funds that would support local transit agency administrative activities associated with the demonstration project such as dealing with FTA, FTA's evaluation contractor, other agencies' staff, and other aspects of demonstration project management.

This is a continuing effort in support of BRT deployment, with FY 1999 funding estimated at $500,000 and $600,000 requested for FY 2000.

3.3.5 BRT Technology Transfer – $150,000

This effort will consist of activities designed to disseminate information about BRT to prospective implementers in order to overcome skepticism and fear of implementing a new and relatively untried transit system methodology as BRT. Activities will include: (1) publication of a variety of written material such as evaluation reports documenting the experience of demonstration projects, brochures, videos, etc.; (2) support of peer-to-peer exchanges where peers from sites where BRT has been successfully demonstrated visit sites planning to implement BRT; (3) scanning tours where prospective implementers visit active BRT sites to see first-hand actual site preparation or operations and have the opportunity to talk to a wide range of operating agency staff and others about planning, design, operations, effects, problems overcome, what to do or mistakes to avoid, etc.

This is a continuing effort in support of BRT deployment, with FY 1999 funding estimated at $100,000 and $150,000 requested for FY 2000.

3.3.6 BRT Professional Development – $200,000

This effort would assimilate knowledge regarding performance and cost of significant subsystem elements suitable for integration into comprehensive BRT systems and findings from BRT demonstration projects and prepare cross-cutting documentation that compares multiple projects and draws general conclusions. This material could also be formatted to be directly incorporated into the curriculum of a National Transit Institute (NTI) training course.

This is a continuing effort in support of BRT deployment, with FY 1999 funding estimated at $200,000 and $200,000 requested for FY 2000.

3.3.7 BRT Lessons Learned Workshops – $250,000

This information exchange activity covers workshops that will bring together successful implementers of BRT and others interested in implementing BRT to exchange information and ideas about all aspects of BRT systems, design elements and operations. The implementers will relate their own experience, and potential adopters would likely seek out information to solve their own problems of design, etc. A side benefit of this activity will be to form a BRT network.

This is a continuing effort in support of BRT deployment, with FY 1999 funding estimated at $100,000 and $250,000 requested for FY 2000.

Program: FTA 3 Fleet Operations		
Key Activities and Products	**Program Schedule**	
	FY 1999	**FY 2000**
3. Fleet Operations		
3.1. Transit Capacity and Quality of Service		
3.2. Intelligent Transportation Systems-Transit		
3.2.1. ITS Applications: Washoe County, NV Transit Technology	$1,250	$1,250
3.2.2. Fixed Guideway Technology: North Orange-Seminole County, FL	$750	
3.2.3. Fixed Guideway Techn: Galveston, TX Fixed-guideway activities	$750	
3.2.2. Open Architecture for Vehicle systems		$200
3.3. Bus Rapid Transit (BRT) Initiative		
3.3.1. BRT Design & Operational Parameters, Impacts	$150	$300
3.3.2. BRT Data Collection & Analysis	$250	$500
3.3.3. BRT Systems Integration Workshop	$200	$350
3.3.4. BRT Project Administration	$500	$600
3.3.5. BRT: Technology Transfer	$100	$150
3.3.6. BRT: Professional Development Workshops - Design, Vehicle Systems, Services, System	$200	$200
3.3.7. BRT: Lessons Learned Workshop	$100	$250
Total Budget Authority	**$4,250**	**$3,800**

RELATED PROGRAMS: FTA 2. Equipment & Infrastructure

RESOURCE SUMMARY/HISTORY ($000)

Budget Authority	FY 1996 Enacted	FY 1997 Enacted	FY 1998 Enacted	FY 1999 Enacted	FY 2000 Request
Contracts, Grants, Cooperative Agreements	**$0**	**$0**	**$550**	**$4,250**	**$3,800**

Contact: FTA Office of Research and Technology, TRI-1, Phone: 202-366-0184

Program Title: Specialized Customer Services
Budget Item No: FTA 4
Amount Requested for FY 2000: $4,050,000

GOALS

Strategic Goals:

Mobility & Accessibility

- Shape America's future by ensuring a transportation system that is accessible, integrated, efficient, and offers flexibility of choices
- Increase intermodal physical, informational, and service connectivity
- Ensure that all Americans have access to transit to meet basic mobility needs
- Ensure that all transit systems are accessible
- Ensure the nation's transit systems employ the latest technology to meet the increased needs of mobility and accessibility

Economic Growth & Trade

- Advance America's economic growth and competitiveness domestically and internationally through efficient and flexible transportation
- Reduce the true economic cost of transportation, taking into account the quality of transit services

Performance Goals:

Mobility & Accessibility

- Increase the number of rail and air terminals with transit connections
- Increase the amount of transit service
- 100 percent of 690 key rail stations in the 33 rail systems are ADA accessible by 2005
- 100 percent accessible bus fleet by 2002
- Reduce bus and light rail dwell times by 20 percent by FY 2002 through deployment of new technology and other innovations

Economic Growth & Trade

- Improve the condition of the bus, rail and paratransit fleets as indicated by the age of the fleet and other criteria under development

NSTC Strategic Partnership Initiative:

- Accessibility for Aging and Transportation-Disadvantaged Populations

Activities are tailored to address the needs of low-income, elderly, and persons with disabilities. Other targeted markets are central city neighborhoods and low-density rural and suburban areas.

The major elements of this program are:

- Job Access and Reverse Commute,
- Accessibility for Persons with Disabilities (Project Action),
- Elderly Services,
- Low-Density Transportation Services, and
- Mobility Management.

FTA's research in this area will be coordinated with specialized transit service initiatives of other agencies. Specifically, FTA will continue to be an active participant in the DOT/HHS Coordinating Council. Deployment of the autonomous dial-a-ride transit (ADART) system being tested in the ITS Transit Program will be explored as a means of providing improved Specialized Customer Services.

MAJOR ACTIVITIES & ANTICIPATED FY 1999 ACCOMPLISHMENTS

- Support the Access to Jobs program by providing technical assistance and identifying innovative transportation strategies for employment transportation serving the needs of low-income communities
- Foster the coordination of human service and public transit services and resources to more efficiently provide specialized community transportation services
- Support the goals of the Americans With Disabilities Act (ADA) by providing technical assistance to solve practical problems of efficiently providing transit accessibility
- Provide innovative and creative solutions to the many problems that impact the rural areas and groups needing specialized transportation.
- Provide alternative service strategies that will meet the needs of a growing population of older Americans
- Complete state welfare-to-work transportation strategies
- Distribute information on employment transportation strategies and value of transportation in achieving welfare reform objectives to state and local decisionmakers implementing welfare reform
- Implement state plans and actions to promote coordination of human service and public transportation
- Promote transit passes for Medicaid program
- Develop a comprehensive research agenda with activities involving the Rural Transit Assistance Program (RTAP), University Transportation Research Program and the results of the National Conference on Rural Public Transportation and Intercity Bus
- Complete development and documentation of the Independent Transportation Network (ITN)
- Develop a long-range agenda of activities benefiting the elderly as requested by a DOT task force on "Improving Transportation For a Maturing Society" in support of NSTC Strategic Partnership Initiative "Accessibility for Aging and Transportation-Disadvantaged Populations"
- Publish Directory of Rural and Specialized Transit Providers, one of the major products of the national RTAP program. The directory, and other products that will be available from the database used to produce the directory, will help identify unmet rural and specialized mobility needs.

KEY FY 2000 PRODUCTS AND MILESTONES

- Report on Phase 2 Joblinks demonstrations
- Implementation of National Governors Association welfare reform transportation planning pilots in local sites
- Develop technical assistance capabilities to enhance mobility for disabled and low-income transportation passengers
- In collaboration with the Departments of Health and Human Services, Education, Agriculture, and Labor, develop innovative and coordinated transportation strategies for services provided by their programs

- Human service coordination demonstrations, particularly aimed at health service delivery
- Strategies to address problems of Native American transportation by developing service demonstration plans
- Continue to support rural and specialized providers through the National Transit Resource Center and other national RTAP training and technical assistance activities

FY 2000 Program Request

4.1 Job Access Support – $200,000

The President has established a national goal for moving two million persons from welfare to work by 2002. Since only six percent of welfare families own automobiles, they must depend on public transit and special transportation to get to work and support services like child care. Studies show that more than half of entry level jobs are not readily accessible to transit due to location or because work hours are outside of the traditional work day. Many entry-level jobs are being created in suburban areas that are not served by existing transit routes. Many jobs require working early mornings, evenings, and weekends, times when transit service runs less frequently, if at all. Given the time constraints imposed by welfare reform, FTA, working with states and other Federal agencies must undertake a vigorous program of research and planning, financial, and technical assistance to help states and localities meet this challenge.

Program activities under the Job Access Support program include information sharing, interagency coordination, technical assistance, best practice documentation, and demonstrations of innovative services and coordinated planning. FTA will share information with state and local stakeholders about the transportation challenges and successes that must be addressed to meet welfare-to-work goals.

Stakeholders will be provided technical assistance as they develop transportation plans and services. FTA will document approaches to address this issue and will work with stakeholders to conduct demonstrations to test new institutional, planning, and operational strategies. ITS technologies may have a role to play in addressing job access issues. FTA will also identify and analyze innovative institutional and financial strategies to support job access and reverse commute transportation.

FY 2000 funding is requested at $200,000.

4.2 Accessibility for Persons with Disabilities (Project Action) – $3,000,000

The goal of this program is to ensure that all Americans have access to transit to meet basic mobility needs. The passage of the Americans With Disabilities Act (ADA) in 1990 recognized as a civil right that persons with disabilities have the same rights as other citizens to access services and facilities that are available to the public. Congress also recognized that many practical problems had to be solved in reaching the goal of equal accessibility in transit.

Project ACTION was created to address these issues and to serve as a bridge between the transit and disabilities communities in addressing these issues. Project ACTION has worked to help translate the ADA transportation regulations into reality. The transportation industry has reached a critical period in addressing ADA requirements. The major issues that must be addressed are service standards, reliability, and cost effectiveness.

Paratransit has proven to be a reliable and useful service for persons with disabilities and usage has grown beyond expectation. A problem with this service is that it is expensive. It remains a priority to address these issues by mainstreaming persons with disabilities onto fixed route transit, and to better coordinate ADA paratransit to reduce trip costs. Additionally, because approxi-

mately 70 percent of adults with disabilities are unemployed and receive public assistance, mobility issues related to welfare reform must be addressed along with mobility of persons with disabilities.

Much of the emphasis to date has been on reducing physical barriers to transit use. A growing need is to make transit available to persons whose disabilities are sensory, such as being sight or hearing impaired. Research and technology development in this area goes beyond removal of physical barriers and must address how information about transit services is made available.

Project ACTION will continue to execute projects and programs designed to facilitate cooperation between the transit industry and the disabled community in ensuring accessible public transportation systems and compliance with the provisions of the Americans with Disabilities Act. In addition to continuing and expanding its previously developed programs of technical assistance development grants and One Stop Shopping Initiatives (OSSI's), Project ACTION will enhance the operations of its Technical Assistance Resource Center and consumer training activities. Activities will be implemented to work with the transit industry to develop information and signage standards responsive to the needs and requirements of those with sensory and cognitive disabilities.

Project ACTION will conduct a test with a transit agency to demonstrate the design and operation of transit services responsive to the needs of disabled populations as revealed in previously conducted marketing surveys focused on the travel needs of those with disabilities.

Project ACTION will conduct an evaluation of reliability and service performance standards to improve the quality and reliability of accessible transit services and vehicles. The results of this evaluation will be used to refine the accessible service reliability and service performance standards for a broader scale industry deployment in subsequent periods.

This is a continuing activity. FY 1998 funding was $2,000,000; TEA-21 increased Project ACTION funding to $3,000,000 annually, the amount estimated for FY 1999 and requested for FY 2000.

4.7 National Rural Transit Assistance Program – $750,000

This national coordination and technical assistance program complements the Rural Transit Assistance Program (RTAP) administered by each state using formula funds apportioned to other than urbanized areas. The National RTAP will continue to support and assist the entities administering the state RTAP activities by developing and promoting training materials, conducting outreach and coordination with other organizations involved in rural transit, convening national and regional meetings on rural topics, and operating the national RTAP Resource Center. The RTAP Resource Center is a clearinghouse for information on rural and specialized transportation issues via a toll-free hotline.

This is a long-established and continuing program. The Appropriations Conference report earmarked $750,000 for National RTAP in both FY 1998 and FY 1999, and $750,000 is requested for FY 2000.

4.8 Mobility Management – $100,000

Responding to the market challenges outlined in this section calls for a new and broader role for transit agencies as mobility managers. Mobility management moves beyond establishing and operating traditional fixed route transit systems to fostering and organizing a network of diverse

transportation services and providers to satisfy customer needs. Mobility management involves several functions. The starting point is the identification of transportation needs of a specific community and identifying service options and demand management strategies to respond to those needs. Transit agencies often serve as a travel agent by brokering customer needs with a variety of service providers and providing one-stop customer information on available services.

Attracting adequate financial resources to support these services is usually the responsibility of transit agencies. One way to reduce costs is to coordinate services and providers into a cost-effective transportation network. Transit agencies have an important role in advocating for improved regulatory, traffic management, and land-use policies that support the effective delivery of transportation services. Transit agencies are also responsible for implementing technological innovation to improve network performance.

Mobility management strategies are being pursued vigorously in the coordination of human service transportation coordination activities and in meeting the transportation needs of those making the transition from welfare to work. Individual market segmentation analyses will be undertaken. ITS technologies are being supplied to achieve the coordination of multiple service providers, and to provide customers with real-time information. The application of smart card technologies allows customers a seamless fare medium that can be applied to several service providers. Strategies for developing mobility management implementation within the transit industry are being developed in TCRP new paradigm visioning. Finally, FTA will undertake with the transit industry, mobility management demonstrations, and will establish technical assistance and information-sharing activities.

This is a new program for which $100,000 is requested in FY 2000.

Program: FTA 4 Specialized Customer Services		
Key Activities and Products	**Program Schedule**	
	FY 1999	**FY 2000**
4. Specialized Customer Services		
4.1. Job Access Support		$200
4.2. Project Action	$3,000	$3,000
4.3. Job Access Study	$150	
4.4. Community Works-Hennepin County, MN	$1,000	
4.5. Joblinks	$1,000	
4.6. Northern Tier Community Transportation, MA	$500	
4.7. RTAP National Program	$750	$750
4.8. Mobility Manager Assistance		$100
Total Budget Authority	**$6,400**	**$4,050**
Personnel (FTE)		

RELATED PROGRAMS: FTA 1. Fleet Operations, FTA 2. Equipment & Infrastructure

RESOURCE SUMMARY/HISTORY ($000)

Budget Authority	FY 1996 Enacted	FY 1997 Enacted	FY 1998 Enacted	FY 1999 Enacted	FY 2000 Request
Contracts, Grants, Cooperative Agreements	**$2,970**	**$3,000**	**$4,950**	**$6,400**	**$4,050**

Contact: FTA Office of Research and Technology, TRI-1, Phone: 202-366-0184

Program Title: Information Management and Technology
Budget Item No: FTA 5
Amount Requested for FY 2000: $3,800,000

GOALS

Strategic Goal:

Mobility & Accessibility

- Shape America's future by ensuring a transportation system that is accessible, integrated, efficient, and offers flexibility of choices
- Maintain, improve and expand the Nation's transit infrastructure, and balance new physical capacity with operational efficiency
- Increase intermodal physical, informational, and service connectivity
- Ensure the nation's transit systems employ the latest technology to meet the increased needs of mobility and accessibility

Economic Growth & Trade

- Advance America's economic growth and competitiveness domestically and internationally through efficient and flexible transportation
- Improve the reliability of the delivery of people, goods and services to their destinations
- Improve the U.S. international competitive position by promoting competition in domestic and international markets in transportation-related services and facilitating the export of domestic transit goods and services

Safety & Security

- Promote the public health and safety by working toward the elimination of transit-related deaths, injuries, property damage and the improvement of personal security and property protection

Performance Goals:

Economic Growth & Trade

- Increase FTA participation in private and public partnerships supporting the development, adaptation, deployment and testing of advanced technology vehicles and components

Safety & Security

- Reduce the number of fatalities and injuries

NSTC Transportation Science & Technology Strategy Elements:

- Enabling Research
- Transportation Education and Training

MAJOR ACTIVITIES & ANTICIPATED FY 1999 ACCOMPLISHMENTS

- Collect and disseminate financial and operational transit data to fulfill statutory requirements (49 USC 5335) and improve the transit industry's knowledge base
- Provide data for use in Urbanized Area Formula Allocations
- Assist the transit industry in maintaining a competent workforce
- Develop excellence in managerial, technical and professional ranks linked to improve performance and increased productivity
- Develop a technology sharing program to provide the industry access to the latest technological innovations and products for the transit system
- Stimulate participation by small business enterprises in transit systems research and technology development
- Produce baseline information on international activities including contracting opportunities, technology sharing, existing bilateral agreements and human capacity building
- Conduct international workshops with transit businesses, operating entities and other Federal agencies
- Develop geographic information system (GIS) profile to capture advancements in the technology that can help improve transit service delivery and performance
- Produce reports on operating and financial data submitted to FTA under the National Transit Database reporting program
- Peer-to-peer technical assistance support builds on a technical assistance knowledge base drawn from experienced transit practitioners to assist other transit systems in solving operational and service problems
- Distribute information relating to on-going transit research and results using the Internet and other advanced technology approaches, as well as specialty conferences and workshops
- Complete ongoing Phase I Small Business Innovation Research (SBIR) projects in the areas of safety intrusion detection devices, improved maintenance techniques linked to capital development, and transit fare collection decision models for fare policy and cost
- Complete FTA National Transit GIS Phase III effort

KEY FY 2000 PRODUCTS & MILESTONES

- Preparing for transit operator data input via the Internet
- Develop and fund Phase II SBIR research projects to assist FTA in meeting its priority research needs
- Provide GIS data products for increased analysis of transit performance
- Augment internal information dissemination of GIS- related data
- Produce a transit training, technical assistance and information diffusion program for developing nations

FY 2000 Program Request

5.1 Technology Sharing, FTA Website, Transit GIS – $500,000

FTA will embark on a more vigorous program of technology sharing in assisting the transportation industry in keeping abreast of the latest technological innovations in systems, management programs, and equipment and infrastructure. Valuable lessons learned from the research and demonstration programs will be documented and shared with the transportation industry. Using as a model the Tren Urbano technology transfer

program, which was developed as part of the San Juan Turnkey Demonstration Project, FTA is developing a formal technology-sharing program for other New Starts projects.

FTA supports its interest in Federal research and development and its continuing commitment to facilitate the dissemination and implementation of innovative transit research and innovative practices to state and local agencies and the private sector through its in-house full-service Transit Research Information Center. The Research and Technology Management Strategy in the DOT Performance Plan targets milestones needed to improve information networks and provide decision makers with accurate R&D information and real-time access to DOT R&D project information. To keep this information current will require additional resources devoted to analyzing, summarizing and preparing technical and project management information from diverse project performers for inclusion in the new R&D tracking system and management information system.

FTA's support of the Transportation Research Board's activities, including its annual meeting, professional committee activities, and ongoing coordination and research dissemination through Transportation Research Information Services, is a key avenue for technology and information transfer. This is being built through linkages with other information dissemination resources using the Internet and other advanced communications techniques. These sources help inform transit professionals in the U.S. and around the world about FTA's research and technology activities.

These resources also provide FTA and U.S. transit professionals with information about other transit technology and research activities. These are continuing activities with $500,000 requested for FY 2000.

5.2 Small Business Innovation Research – $400,000

FTA is an active participant in the DOT Small Business Innovations Research (SBIR) Program. The program supports research projects that enhance the innovative capacity of small businesses in the United States, as well as meets FTA research needs. It provides an opportunity for small firms to commercialize innovations developed from federal R&D and provides FTA with an effective resource for transit research. The SBIR program is an annual statutory program, coordinated by the Small Business Administration, that conducts research of interest to the US DOT through small businesses, thereby stimulating technological innovation and commercialization in that sector. Research projects are selected based on a competitive procedure and a determination that funding them will enable the firm to validate the feasibility of the particular concept or technology in question. Additional funds are awarded to help develop the concept or technology to the point where it is commercially viable. Overall, the program promotes the growth and development of small businesses and technology firms. It offers small businesses in the United States an opportunity to participate in FTA research and enhance their innovative capacity. FTA participation in the statutory Small Business Innovation Research (SBIR) program is included as a technology-sharing activity. This is a continuing activity.

FY 1999 funding is expected to be prorated from congressionally directed funding for extramural R&D projects; $400,000 is requested for FY 2000.

5.3 The National Transit Database – $2,800,000

The National Transit Database (NTD) program is congressionally mandated under 49U.S.C. 5335(a)(1)(2). The NTD is FTA's national database for statistics for the transit industry. The NTD provides for the national collection and dissemination of a uniform system of transit system financial accounts and operating data. As set forth in legislative formulae, these data are used in the national allocation of FTA formula funding. Further, these data are used to help meet the needs of individual mass transportation systems, Federal, State and local governments, and the public for financial and operating information on which to base mass transportation service planning. The NTD data will be key in assessing FTA's Strategic Plan goals and objectives.

The request for NTD activities in FY 2000 is for $2,800,000. Of this $2,800,000 request, $2,500,000 are requested in FY 2000 for the continuation of the review for accuracy and consistency and computerizing of the public mass transportation financial and operating data submitted by approximately 600 transit agencies. Five different annual reports will be generated from these data. This funding includes preparing reports to be disseminated on the Internet and preparing for transit operator data input via the Internet in the near future. Since this fall, hundreds of researchers have accessed the NTD data which is now disseminated via the Internet, as well as by printed reports. These funds will also provide for new software to help prepare for data to be reported via the Internet, software development to run the urbanized area apportionment formula, and updating and refining national transit time series analysis.

An additional $300,000 is requested in FY 2000 to link the National Transit Database to FTA's grant management system, TEAM. TEAM is the acronym for the Transportation Electronic Award and Management system. Historical NTD data is critical in grant making decisions. State DOT's, individual transit authorities and Metropolitan Planning Organizations need to review transit vehicle fleet management plans, operating performance data and financial data in preparing grant requests. Linking the historical NTD data to the new TEAM, grant-award system would help our grantees by providing one, integrated FTA system.

5.4 International Program: Technical Assistance and Training –$100,000

This program will support the departmental strategic goal to advance economic growth and international competitiveness. In accordance with TEA-21, emphasis will be placed on informing domestic transit agencies about technology available in the international marketplace and affording domestic businesses the opportunity to become more globally competitive. The $100,000 request will finance, in cooperation with domestic businesses, infrastructure training and technical assistance for developing nations in Africa, South America, Eastern Europe and Asia, and host specialty vehicle technology and intelligent transportation systems workshops conducted by foreign representatives.

Program: FTA 5 Information Management and Technology		
Key Activities and Products	**Program Schedule**	
	FY 1999	**FY 2000**
5 Technology Sharing: Information Management & Technology		
5.1. Technology Sharing, FTA Website, Transit GIS		$500
5.2. Small Business Innovation Research		$400
5.3. National Transit Database	$2,300	$2,800
5.4. International Program: Technical Assistance and Training		$100
Total Budget Authority	**$2,300**	**$3,800**

RELATED PROGRAMS: NONE

RESOURCE SUMMARY/HISTORY ($000)

Budget Authority	FY 1996 Enacted	FY 1997 Enacted	FY 1998 Enacted	FY 1999 Enacted	FY 2000 Request
Contracts, Grants, Cooperative Agreements	$1,500	$1,580	$3,509	$2,300	$3,800
Total	**$1,500**	**$1,580**	**$3,509**	**$2,300**	**$3,800**

Contact: FTA Office of Research and Technology, TRI-1, Phone: 202-366-0184

Program Title: Metropolitan/Rural Policy Development
Budget Item No: FTA 6
Amount Requested for FY 2000: $1,600,000

GOALS

Strategic Goals

Mobility & Accessibility

- Shape America's future by ensuring a transportation system that is accessible, integrated, efficient, and offers flexibility of choices
- Maintain, improve, and expand the nation's transit infrastructure
- Increase intermodal physical, informational, and service connectivity
- Ensure that all Americans have access to transit to meet basic mobility need

Economic Growth & Trade

- Advance America's economic growth and competitiveness domestically and internationally through efficient and flexible transportation
- Reduce true economic cost of transportation
- Reduce travel time in the delivery of people, goods and services to their destinations
- Improve US international competitive position

Performance Goals:

Mobility & Accessibility

- Improve the condition of the bus, rail and paratransit fleet
- Increase the percentage of bus facilities and rail infrastructure in good or excellent condition
- Increase the number of rail and air terminals with transit connections
- Increase the urban population within 3/4 miles of transit service
- Increase the amount of transit service
- Increase the percentage of non-metro counties with transit service

Economic Growth & Trade

- Improve the condition of the bus, rail, and paratransit fleet as indicated by age
- Increase the number of bus facilities and rail infrastructure in good or excellent condition
- Improve the efficiency of service by decreasing the cost per passenger mile of transit
- Reduce door-to-door travel times within highly congested corridors where FTA investments have been made
- Increase FTA participation in private and public partnerships supporting advanced technology vehicles and components

MAJOR ACTIVITIES & ANTICIPATED FY 1999 ACCOMPLISHMENTS

- Continue conducting intermodal performance measurements on a sample of corridors to identify urban strategic corridors and to validate methodology
- Continue development of estimates of the benefits of transit to improve community livability
- Further refine the method for estimating transit needs, performance, and conditions in harmony with FHWA's basis for similar estimations
- Continue demonstrations of new and innovative financing techniques by transit operators
- Enhance data collection on transit conditions using GPRA performance reporting

KEY FY 2000 PRODUCTS & MILESTONES

- 49 USC 308 Report estimating transit's condition, performance, and short- and long-term transit investment needs
- 49 USC 5309(o) Reports (Annual and Supplemental) providing recommendations to Congress for allocation of funds to be made available for construction of new fixed guideway systems and extensions

FY 2000 Program Request

6.1 Transit Performance, Condition, and Needs – $300,000

FTA is required by law to submit to Congress every other year a report on the condition, performance, and capital investment requirements of the nation's transit systems. In order to develop the data necessary to complete this report, the FTA has developed the Transit Economics Requirements Model (TERM). In FY 2000, FTA will refine this model in such areas as travel time, regular service, and rural and specialized service. This will help us to improve the accuracy and reliability of collected data so we can better measure our progress in meeting our outcome goals established under GPRA and provide more useful information to Congress.

6.2 Benefits of Transit – $400,000

The primary focus will be on developing measures of the benefits of new transit investments compared with investments to maintain existing infrastructure. This will allow for a comparison of the relative merits of formula and discretionary funding levels. In addition, it will provide an enhanced basis for estimating the benefits of different types of transit investments which will be used to improve the process for estimating transit investment requirements in the future.

6.3 Innovative Financing – $200,000

FTA will continue to support its Innovative Finance Initiative. This will include continued direct technical assistance to grantees and contractor support to grantees, production of publications on innovative finance, working with FHWA on joint efforts including the State Infrastructure Banks, review of innovative finance proposals to assure consistency with policy requirements, and implementation of legislative changes in the area of innovative finance. The initiative helps leverage Federal investments by providing seed money to attract private investment, thus improving the effective and efficient use of public resources and increasing FTA participation in private and public partnerships supporting advanced technology vehicles and components.

6.4 Policy Analysis – $300,000

Research in this area includes a longer-term program of assessing the effect of the FTA program and analysis of transit industry trends as well as short-term research in support of specific policy initiatives. FTA will continue to assess the public policy functions of transit and the benefits that flow from each function. FTA is developing a Transit Performance Monitoring System and a new model for assessing transit investment requirements, the Transit Economic Requirements Model. FTA will also further develop the Transit Performance Monitoring System to integrate it into the National Transit Database. The goal is the ability to obtain information annually on transit user characteristics and user oriented service quality. These efforts will help assess transit conditions, connections, and coverage.

6.5 Program Evaluations and Strategic Plan – $200,000

The requested funding will support program evaluation activities required by the Government Performance and Results Act (GPRA). This funding will also provide outreach support, printing, and other costs associated with the major update of FTA's Strategic Plan. Per GPRA, agencies are to update their strategic plans at least every three years. FTA's current plan was completed in 1997.

6.6 Reauthorization Implementation – $200,000

These funds will be used to support implementation of new requirements in the Transportation Equity Act for the 21st Century. This includes participation in the development of the new joint planning regulations, new starts criteria, studies required by the Act, and outreach activities directed to our constituencies.

Program: FTA 6 Metropolitan/Rural Policy Development		
Key Activities and Products	**Program Schedule**	
	FY 1999	**FY 2000**
6. Metropolitan/Rural Policy Development		
6.1 Transit Performance, Condition and Needs	$300	$300
6.2 Benefits of Transit		$400
6.3 Innovative Financing	$100	$200
6.4 Policy Analysis		$300
6.5 Program Evaluations and Strategic Plan		$200
6.6 Reauthorization Implementation		$200
6.7. City of Bronson, Congestion Study	$450	
Total Budget Authority	**$850**	**$1,600**

RELATED PROGRAMS: FTA 2. Equipment & Infrastructure

RESOURCE SUMMARY/HISTORY ($000)

Budget Authority	FY 1996 Enacted	FY 1997 Enacted	FY 1998 Enacted	FY 1999 Enacted	FY 2000 Request
Contracts, Grants, Cooperative Agreements	**$650**	**$275**	**$1,100**	**$850**	**$1,600**

Contact: FTA Office of Budget and Policy, TBP-10, Bill Menczer, Phone: 202-366-1698

Program Title: Planning and Project Development
Budget Item No: FTA 7
Amount Requested for FY 2000: $2,500,000

GOALS

Strategic Goals:

Mobility & Accessibility

- Shape America's future by ensuring a transportation system that is accessible, integrated, efficient, offers flexibility of choice and enhanced mobility
- Increase intermodal physical, informational, and service connectivity

Economic Growth & Trade

- Advance America's economic growth and competitiveness domestically and internationally through efficient and flexible transportation
- Ensure that improvements in transportation that advance America's economic growth and trade are made in a manner consistent with the President's Executive Order on the cost-effectiveness of infrastructure investment

Human & Natural Environment

- Protect and enhance communities and the natural and human environment
- Improve the sustainability and livability of communities through investments in transportation facilities

Performance Goals:

Mobility & Accessibility

- Increase the number of intermodal ITS projects that relate to connectivity

Economic Growth & Trade

- Increase the percentage of New Starts funds allocated to projects that are consistent with the President's Executive Order on cost effectiveness

Human & Natural Environment

- Increase the number of people having access to high quality transit

MAJOR ACTIVITIES & ANTICIPATED FY 1999 ACCOMPLISHMENTS

Transportation Planning & Programming

- Design, conduct, and evaluate demonstration projects to test new approaches to multimodal system and project planning
- Document best practices in statewide and metropolitan transportation planning

Major Investment Planning & Development

- Develop enhanced New Starts criteria and develop and disseminate guidance on the criteria
- Develop evaluation methodology and evaluate all candidate authorized New Starts projects

- Document innovative case studies in major investment planning and project development
- Provide assistance to regions and agencies involved in major investment planning and development
- Produce annual and supplemental FTA reports to Congress on New Start funding

Land Use-Environmental Planning

- Implement Livable Communities Initiative planning and capital demonstration projects
- Offer technical assistance and training on the relationship of transit and livable communities
- Document and demonstrate best practices in community involvement in transportation planning
- Support a consortium of professional organizations in support of the Livable Communities Initiative
- Offer training in environmental planning and community involvement

Planning Methods

- Continue development of enhanced travel modeling procedures through the Travel Model Improvement Program (TMIP)
- Develop planning tools for improved traditional bus service and innovative transit services

Financial Planning

- Document case studies in the application of innovative finance techniques to transit.
- Develop a financial planning model

KEY FY 2000 PRODUCTS & MILESTONES

- Documentation of best practices in planning and project development, emphasizing customer-friendly, community-oriented transit facilities and services that reflect active community involvement in planning and design
- Technical assistance and training to local and state agencies, the private sector, the public and FTA and other USDOT field offices
- Conference sessions and workshops with professional organizations
- Completion of two case studies using TRANSIMS, the next generation of travel models
- Completion of all New Starts evaluation and reporting requirements, per TEA-21

FY 2000 Program Request

7.1 Transportation Planning and Programming – $750,000

These funds will support development of state of the art and practice for several key areas in the transportation planning arena; (1) seven planning factors enunciated in TEA-21, (2) welfare to work and access to jobs planning data needs to successfully support transit capital investments, (3) Transportation Management Area Certification reviews required by TEA-21 in metropolitan areas, (4) transit planning considerations for National Parks, and (5) rural and small urbanized area planning and consultation in making transportation decisions in plans and programs.

7.2 Major Investment Planning and Project Development – $650,000

This project will support the kind of analysis necessary to provide information for decision making for studies considering major capital investments. It will do this through the development of procedural guidance, technical assistance and training for State DOT's, MPO's and transit operators in such areas as alternatives development, travel demand forecasting, engineering and costing, financial planning, environmental assessment, and multimodal evaluation. This effort supports the kind of planning analysis that is necessary to identify the most effective transportation strategies and capital improvements which address the needs of metropolitan areas.

7.3 Outreach New Provisions/TEA-21 – $200,000

These funds will be used to support implementation of new requirements in the Transportation Equity Act for the 21st Century. This includes outreach to MPOs, States, and transit operators of the new Joint Planning Regulations, New Starts Regulations, MIS integration into the NEPA process, and development of Transportation Plans and Procedure Regulations for transit facilities on public lands.

7.4 Land Use and Environmental Planning – $200,000

This effort includes environmental plan and project reviews, development and dissemination of information about improved methods of environmental assessment and review or changes in the Federal environmental requirements, transit-oriented development, joint development, and the provision of technical assistance and training to field staff, project sponsors and others. This program area also includes technical assistance and outreach, evaluation, and special studies for DOT and FTA initiatives dealing with the livability of communities and the environment. In addition, efforts include documentation of best practices in land use planning and urban design, continued guidance on joint development, and advancement of the state-of-the-art in integrated land use and transportation planning.

7.5 Planning Methods (TMIP) - $600,000

This effort supports development of planning techniques which are needed to determine the impacts of strategies and alternatives that are considered in the planning process. These tools are needed to address the wide variety of factors which are considered in the planning process, e.g. traveler impacts of advanced technologies, risk analysis, capital and operating cost estimation, air quality impacts of transportation alternatives, etc. A specific technique currently under development includes a new generation of travel forecasting models, TRANSIMS.

7.6 Financial Planning- $100,000

This effort will expand financial assessments for projects seeking New Start funding to include assessing the financial condition and the capacity of transit authorities considering new guideway investments by examining the strength of the capital financial plans, the stability and reliability of the transit authority's financial resources, and whether they have sufficient resources to undertake a major capital improvement while maintaining existing transit service and operations for the new service. This effort will also include procedural guidance, technical assistance to the FTA and training for State DOT's, MPO's and transit operators in the area of financial planning and innovative finance.

Program: FTA 7 Planning and Project Development		
Key Activities and Products	**Program Schedule**	
	FY 1999	**FY 2000**
7. Planning and Project Development		
7.1 Transportation Planning and Programming		$750
7.2 Major Investment Planning and Project Development	$450	$650
7.3 Outreach New Provisions/TEA-21		$200
7.4 Land Use and Environmental Planning		$200
7.5 Planning Methods		$600
7.6 Financial Planning		$100
7.7 Skagit County, WA, North Sound Connecting Communities Project	$50	
7.8 Desert Air Quality Comprehensive Analysis, Las Vegas, NV	$1,000	
7.9 Seattle, WA Livable City	$200	
Total Budget Authority	**$1,700**	**$2,500**

RELATED PROGRAMS: NONE

RESOURCE SUMMARY/HISTORY ($000)

Budget Authority	FY 1996 Enacted	FY 1997 Enacted	FY 1998 Enacted	FY 1999 Enacted	FY 2000 Request
Contracts, Grants, Cooperative Agreements	**$1,900**	**$295**	**$1,312**	**$1,700**	**$2,500**

Contact: FTA Office of Planning Operations, TPL-10, Phone: 202-366-1628

Program Title: Human Resources
Budget Item No: FTA 8
Amount Requested for FY 2000: $700,000

GOALS

Strategic Goals:

Economic Growth & Trade

- Advance America's economic growth and competitiveness domestically and internationally through efficient and flexible transportation
- Build professional capacity and promote the education of individuals in transportation-related fields
- Expand opportunities and promote economic growth for all businesses, by encouraging and assisting small, women-owned, and disadvantaged businesses to participate in FTA and FTA-assisted contracts and grants.

Outcome Goals:

Human & Natural Environment

- Protect and enhance communities and the natural environment affected by transit
- Improve the sustainability and livability of communities through investments in transportation facilities
- Expand opportunities and promote economic growth for all businesses, by encouraging and assisting small, women-owned, and disadvantaged businesses to participate in FTA and FTA-assisted contracts and grants

Performance Goals:

Economic Growth & Trade

- Develop programs that support the Garrett A. Morgan Technology and Transportation Futures Program
- Maintain the amount of FTA transit funding being used to contract with small, women-owned, and disadvantaged businesses, consistent with departmental policy

Human & Natural Environment

- Ensure compliance of Title VI and Environmental Justice requirements

NSTC Transportation Science & Technology Strategy Elements:

- Enabling Research
- Transportation Education and Training

MAJOR ACTIVITIES AND ANTICIPATED FY 1999 ACCOMPLISHMENTS

- Provide training and assistance to assist grantees in civil rights compliance
- Provide training and technical assistance for Disadvantaged Business Enterprises (DBEs) to promote long-term economic growth
- Conduct training to result in enhanced outreach for Title VI/Environmental Justice considerations in the planning process and delivery of service
- Provide technical assistance to DBEs to enable their participation in major transit capital projects

- Provide opportunities for high school and college students to gain experience in skills that may lead to careers and job opportunities in transit, including the prerequisite training and educational requirements

KEY FY 2000 PRODUCTS & MILESTONES

- Increased awareness of the potential for transit careers for students
- Training and assistance to transit properties regarding the DBE requirements, resulting in the long-term economic growth of entities such as DBEs
- Training areas that focus efforts toward better educating the transportation community in ensuring transit funds are used in a nondiscriminatory manner
- Training and assistance to enhance Title VI/Environmental Justice considerations in the planning, process, and delivery of service

FY 2000 Program Request

8.1 Job Training and Development – $75,000

These activities will focus on methods and techniques to train unskilled persons and underemployed employees for entry-level and higher employment, with an emphasis on linking training with employment opportunities offered by transit agencies.

8.2 Support for Meeting Title VI/ Environmental Justice/DBE's Federal Requirements – $400,000

Title VI/Environmental Justice/Disadvantaged Business Enterprises —Provides training and outreach to grantees regarding the EEO, DBE and Title VI/Environmental Justice programs and provides technical assistance to DBEs to enable their participation on major transit capital projects.

This project will continue to provide TEA-21 outreach, training, and technical assistance to grantees and outreach, training, and technical assistance on the revised DOT DBE regulations. It will also continue to disseminate information to grantees, the business community, and interested groups on the new DOT DBE regulations. Such dissemination is vital because of new and revised requirements for grantees. Finally, it will continue to provide training and technical assistance that will be needed to assist grantees with reporting on new and revised requirements.

8.3 Garrett A. Morgan Technology and Transportation Futures Program Initiative – $225,000

Francis L. Cardozo Senior High School TransTech Academy – Provides inner city high school students with summer employment and training opportunities to encourage them to go on to careers in transportation.

National Cerebral Palsy High School High Tech – Provides young adults with disabilities early exposure to the work environment, mentoring and support, and show them the opportunities for future careers in transportation and technology.

Los Angeles County Metropolitan Transportation Authority Career Academies – Creates 5 inner city high school transportation academies to provide students opportunities for careers in transportation and technology.

DOT Summer Internship Program for Diverse Groups – Exposes students to opportunities for future careers in transportation through summer internship work experience in DOT agencies.

Program: FTA 8 Human Resources		
Key Activities and Products	**Program Schedule**	
	FY 1999	**FY 2000**
8 Human Resources		
8.1 Job Training and Development		$75
8.2 Support for Meeting Title VI/Environmental Justice/DBE's Federal Requirements	$50	$400
8.3 Garrett A. Morgan Trans. Technology Program		$225
Total Budget Authority	**$50**	**$700**

RELATED PROGRAMS: NONE

RESOURCE SUMMARY/HISTORY ($000)

Budget Authority	FY 1996 Enacted	FY 1997 Enacted	FY 1998 Enacted	FY 1999 Enacted	FY 2000 Request
Contracts, Grants, Cooperative Agreements	$155	$225	$100	$50	$700
Total	**$155**	**$225**	**$100**	**$50**	**$700**

Contact: Human Resources: FTA Office of Civil Rights, TCR-1, Phone: 202-366-4018

Program Title: Transit Cooperative Research Program
Budget Item No: FTA 9
Amount Requested for FY 2000: $8,250,000

GOALS

Strategic Goals:

Safety & Security

- Promote the public health and safety by working toward the elimination of transit-related deaths, injuries, property damage and the improvement of personal security and property protection

Mobility & Accessibility

- Shape America's future by ensuring a transportation system that is accessible, integrated, efficient, and offers flexibility of choices
- Maintain, improve and expand the Nation's transit infrastructure, and balance new physical capacity with operational efficiency
- Ensure the nation's transit systems employ the latest technology to meet the increased needs of mobility and accessibility

Economic Growth & Trade

- Advance America's economic growth and competitiveness domestically and internationally through efficient and flexible transportation
- Improve the reliability of the delivery of people, goods and services to their destinations
- Improve the U.S. international competitive position by reducing trade barriers, supporting economic deregulation, and promoting competition in domestic and international markets in transportation–related services

Human & Natural Environment

- Protect and enhance communities and the natural environment affected by transit

Performance Goals:

Economic Growth & Trade

- Increase FTA participation in private and public partnerships supporting the development, adaptation, deployment and testing of advanced technology vehicles and components

NSTC Transportation Science & Technology Strategy Elements:

- Enabling Research
- Transportation Education and Training

MAJOR ACTIVITIES & ANTICIPATED FY 1999 ACCOMPLISHMENTS

- Promote transit operating effectiveness and efficiency by assisting the industry in developing and applying the latest in technology and operating techniques that could improve mobility and accessibility
- Conduct research responsive to the day-to-day operational problems of transit that will harness information technology, as well as improve communications, information transfer, and the quality of the environment
- Provide adequate resources for the transit industry to develop innovative, near-term solutions to meet local transit demands of the 21st century

Research will begin or continue on the following transit industry problems selected by the TCRP Oversight & Project Selection (TOPS) Committee in November 1998:

Research Topic	Amount Allocated
Simulators as an Effective Training Tool to Reduce Bus Accidents	$250,000
Practices of Innovative and High-Productivity Transit Services in Rural and Small Urban Areas	$150,000
Development of Transit Capacity and Quality of Service Principles, Practices, and Procedures (continuation)	$300,000
Implementation Guidelines for Bus Rapid Transit Systems	$250,000
Increased Customer Convenience Using Information Technology - Additional Scope Relating to Accessibility to Transit Information in the 21st Century (continuation)	$50,000
Providing Transit Options for Older Americans	$300,000
Effective Approaches to Meeting Rural Intercity Bus Transportation Needs	$100,000
Updating the Traveler Response to Transportation System Changes Handbook (DOT-FH-11-9579) (continuation)	$300,000
Relating Consumer Behavior and Customer Loyalty to Transit Use	$250,000
Developing Standards for System and Subsystem Interfaces in Electric Rail Passenger Vehicles (continuation)	$325,000
Joint Track-Related Research with the Association of American Railroads/Transportation Technology Center, Inc.	$250,000
Innovations Deserving Exploratory Analysis: The Transit IDEA Program (continuation)	$500,000
New Paradigms for Local Public Transportation Organizations (continuation)	$400,000
Use of Revenue Bonds to Fund Public Transportation	$100,000
TCRP Strategic Plan Update (continuation)	$75,000
Combating Global Warming Through Sustainable Surface Transportation Policy (continuation)	$50,000
Dissemination and Implementation of Research Findings (ongoing)	$666,000
Synthesis of Information Related to Transit Programs	$400,000
International Transit Studies Program (continuation)	$450,000
Legal Aspects of Transit and Intermodal Transportation Programs (continuation)	$300,000
Quick Response for Special Needs (continuation)	$125,000

- Share completed results with the transit community through distributing published documents, the TCRP Web site (www2.nas.edu/trbcrp), presentations of findings at professional meetings, articles in the trade press, and multi-media packages including videos and CD ROMs. TCRP products to date include 42 Research Reports, 32 Transit Synthesis Reports, 32 Research Results Digests, 12 Legal Research Digests, 9 Transit IDEA Reports on development of innovative products and processes, and 6 software products. Over 270,000 copies of these products have been distributed. TCRP yields nine different types of products:

1. *Research Reports* – Reports are published in a numbered series. Emphasis is placed on producing guidebooks, manuals, and handbooks that will contribute to building professional capacity for many years to come.
2. *Synthesis Studies* – Synthesis studies report the best knowledge available on a topic. They perform an information transfer function, reporting successful practices by transit agencies for potential adoption by others.
3. *Research Results Digests* – This publication series consists of distillations of research results and time-sensitive interim research products.
4. *Legal Research Digests* – Legal Research Digests assemble, analyze, and evaluate legal issues associated with the transit industry that have national significance.
5. *The IDEA Program* – Through the use of unsolicited proposals on innovative concepts, this program explores technical ideas and concepts that, if successful, could result in products that would benefit transit practice.
6. *The International Transit Studies Program* – TCRP sponsors two overseas study missions each year to develop leadership skills and broaden the experience base of mid-career transit professionals. To date, more than 110 transit professionals have participated in nine missions.
7. *Standards Development* – The TCRP is supporting the development of electrical and mechanical standards for electric rail passenger vehicles through the Institute of Electrical and Electronics Engineers (IEEE) and the American Society of Mechanical Engineers (ASME). The technical standards are being developed through a voluntary, consensus-building process, a process that is advocated by the Technology Improvements Act of 1996 (Public Law 104-113). Twelve working groups involving over 350 individuals from transit systems, manufacturers, suppliers, and other organizations are involved in this process. The estimated cost savings to the industry from adoption of these standards is over $100 million.
8. *Testing and Demonstration Activities* – When appropriate, the findings of research studies are tested in partnership with transit agencies and the FTA.
9. *Software and Videos* – The products of some studies include software or videos. These are packaged like commercial products and disseminated to the transit industry.

- The American Public Transit Association will continue its role as the primary agent for dissemination of research results to the transit industry. Some of the research products that will be disseminated in FY 1999 include:

1. Guidelines for Transit Capacity and Quality of Service (Project A-15);
2. Integrating School Bus and Public Transportation Services in Non-Urban Communities (Project A-19);

3. Customer-Defined Transit Service Quality (Project B-11); Fuel Cost 1.0.
4. Software that aids in cost analysis of alternative transit fuels (Project C-8);
5. ParaSpec, A CD-ROM product that aids in writing specifications for paratransit vehicles (Project C-9);
6. Demonstration of Artificial Intelligence Technology for Railcar Diagnostics (Project E-2A);
7. Management Practices at Small Urban and Rural Public Transit Systems (Project G-5);
8. Integrated Urban Model for Simulation of Transit and Land Use Practices (Project H-12)

- The transit industry will continue to apply TCRP products, in ways similar to the following already identified:

1. The National Transit Institute at Rutgers University uses TCRP products in training courses and lists them as supplemental reading, including: Guidelines for the Development of Public Transportation Facilities and Equipment Management Systems; Transit and Urban Form; A Handbook for Acquiring Demand Responsive Software; Wheel/Rail Noise Control Manual; Building Transit Ridership: An Exploration of Transit's Market Share and the Public Policies That Influence It; Transit Markets of the Future: The Challenge of Change; Closing the Knowledge Gap for Transit Maintenance Employees; Multipurpose Transit Payment Media; A Handbook: Using Market Segmentation to Increase Transit Ridership; and Changing Roles and Practices of Bus Field Supervisors.
2. The Institute of Transportation Research and Training at North Carolina State University used TCRP Report 30, Transit Scheduling Manual, in graduate level courses.
3. The National Center for Advanced Transportation Technology at the University of Idaho is incorporating four TCRP products in course work: Report 26, Operational Analysis of Bus Lanes on Arterials; Report 13, Rail Transit Capacity; Report 30, Transit Scheduling Manual; and preliminary materials for the upcoming Transit Capacity and Quality of Service Manual.
4. The New York State Department of Transportation used Synthesis 22, Monitoring of Bus Maintenance Performance, in a state training program.
5. New Jersey Transit and the Rural Transit Assistance Program (RTAP) used TCRP Synthesis 1, Safe Operating Procedures for Alternative Fuel Buses, in alternative fuels training courses.
6. The Southeastern Pennsylvania Transportation Authority used a draft version of the IEEE standard for communications-based train control system performance and functional requirements (developed under TCRP project G-4) to develop the procurement documents for train control in their light rail tunnel.
7. The staff of VIA Metropolitan Transit in San Antonio, Texas, heard a presentation at a conference by the TCRP contractor who developed FuelCost 1.0 software, and requested an advance copy for use in making a decision on alternative fuels for their fleet. They used the software and found it very helpful in making the decision and justifying it to the Board of Directors

- Continue monitoring and completion of research approved in prior years. Representatives of the transit industry serve on panels which guide TCRP projects, providing a direct channel for promptly disseminating results to those who can apply them in practice.

- Update the TCRP Strategic Plan, making it consistent with the FTA Strategic Plan and the FTA Research and Technology Five-Year Plan. The updated TCRP Strategic Plan will incorporate research themes developed earlier through research on New Paradigms for Public Transportation and APTA's Mobility 21 Initiative. The major new paradigm themes are customer service, using technology to provide customer information, and labor-management relations.
- The TOPS Committee will select the ninth-year (FY 2000) research program, based on FTA and TCRP strategic plans and the FTA Five-Year Plan. Contracts will subsequently be awarded for new research projects.

KEY FY 2000 PRODUCTS & MILESTONES

- Final reports on completed TCRP studies and syntheses
- Quarterly and annual reports on the TCRP
- Complete a survey-based report on usage of TCRP products

FY 2000 Program Request

- Award new TCRP research projects in the priority areas of safety & security, policy & planning, customer service, equipment, facilities, operations, human resources, maintenance, and administration
- Continue special long-range TCRP projects such as the "IDEA Program," "Rapid Response to Transit Issues," "Development of New Paradigms for Transit," and the "International Studies Program"
- Continue to develop and update TCRP information dissemination capability to ensure wide coverage, including continuous update of information on the TCRP Web site
- Solicit research statements in the priority areas of safety & security, customer service, policy & planning, fleet operations, equipment & infrastructure, mobility & accessibility, professional capacity building, and information technology transfer that will also correspond to the FTA Strategic Plan
- Continue assessment of transit access at airports
- Continue assessment of fuel emissions during propane, LNG, and CNG refueling
- Continue to integrate market research into transit management, and continue to explore new markets for transit
- Assess the relationship between economic development and economic impact of transit investments
- Develop customer-friendly strategies for increasing transit ridership and continue to assess how information technology can be better applied to the transit environment
- Continue use of Transit Trip Ambassadors to present research results directly to transit agencies and state transit associations

Program: FTA 9 Transit Cooperative Research Program		
Key Activities and Products	**Program Schedule**	
	FY 1999	**FY 2000**
9. Transit Cooperative Research Program (TCRP)	**$8,250**	**$8,250**
Total Budget Authority	**$8,250**	**$8,250**

RELATED PROGRAMS: FTA 1. Safety & Security, FTA 2. Equipment & Infrastructure, FTA 3. Fleet Operations, FTA 4. Specialized Customer Services, FTA 6. Metropolitan/Rural Policy Development, FTA 7 Planning & Project Development

RESOURCE SUMMARY/HISTORY ($000)

Budget Authority	FY 1996 Enacted	FY 1997 Enacted	FY 1998 Enacted	FY 1999 Enacted	FY 2000 Request
Contracts, Grants, Cooperative Agreements	$8,250	$8,250	$4,000	$8,250	$8,250
Total	**$8,250**	**$8,250**	**$4,000**	**$8,250**	**$8,250**
Other: FTA Office of Research and Technology, TRI-1, Phone: 202-366-0184					

Program Title: National Transit Institute
Budget Item No: FTA 10
Amount Requested for FY 2000: $4,000,000

GOALS

Strategic Goals:

Safety & Security

- Promote the public health and safety by working toward the elimination of transit-related deaths, injuries, property damage and the improvement of personal security and property protection.

Mobility & Accessibility

- Shape America's future by ensuring a transportation system that is accessible, integrated, efficient, and offers flexibility of choices
- Maintain, improve and expand the Nation's transit infrastructure, and balance new physical capacity with operational efficiency

Economic Growth & Trade

- Advance America's economic growth and competitiveness domestically and internationally through efficient and flexible transportation
- Improve the reliability of the delivery of people, goods and services to their destinations
- Improve the U.S. international competitive position by reducing trade barriers, supporting economic deregulation, and promoting competition in domestic and international markets in transportation–related services
- Build professional capacity and promote the education of individuals in transportation-related fields

Human and Natural Environment

- Protect and enhance communities and the natural environment affected by transit

Performance Goals:

Economic Growth & Trade

- Increase FTA participation in private and public partnerships supporting the development, adaptation, deployment and testing of advanced technology vehicles and components
- Increase the number of National Transportation Institute (NTI) training courses conducted
- Increase the number of participants in NTI training

NSTC Transportation Science & Technology Strategy Elements:

- Transportation Education and Training

MAJOR ACTIVITIES & ANTICIPATED FY 1999 ACCOMPLISHMENTS

- Serve as a major resource to FTA in support of regulations, standards, and policy initiatives as well as in the implementation of new technology resulting from research initiatives
- Support the implementation of intermodal transportation through the design, development and conduct of training and education in cooperation with the National Highway Institute

- Work will continue in the design, development and conduct of training in support of FTA and the transit industry
- The NTI provides technical support relating to training through a variety of workshops, seminars and panels designed to assist industry practitioners in maintaining and upgrading "in-house" training and development
- Clearinghouse and cataloging of curriculum offered by the NTI and other training resources, as well as referral services identifying best efforts both inside and outside the industry, will continue
- Teleconferencing and other innovative techniques will be utilized to continue bringing up-to-date managerial, technical and professional training and development to transit practitioners at the Federal, state, and local levels on a cost-effective basis
- A "transit fellows" program initiated in 1995 will identify industry experts in a variety of areas and support their involvement in industry conferences and related presentations where transit industry experience can be shared with others seeking a better working knowledge of new technologies and techniques
- Work will continue to develop career path training for industry managers and supervisors matching skill and knowledge training with the changing demands of the transit workplace

KEY FY 2000 PRODUCTS & MILESTONES

- An expanding library of transit-related curricula on a variety of subjects relating to finance, planning, management, technology and other topics to assist the transit industry in keeping pace with the mobility needs of the Nation
- Annual awards at transit trainers' conference for outstanding training accomplishments, acknowledging excellence and sharing innovative practices
- Cooperative programs with National Highway Institute on subjects of mutual interest
- Dialogue with organized labor relating to worker safety and technical skill development

FY 2000 Program Request

- Continue training in all areas relating to transit industry needs
- Design, develop, and conduct training in response to changing needs of FTA, the transit industry and the transportation community
- Link training to the introduction and effective management of new technologies and techniques to improve transit service and cost-effectiveness
- Reinforce the importance of training and career development in the transit industry as critical ingredients in performance and productivity
- Inform the transit industry on the availability of training
- Promote best practices in training and make available subject matter experts at conferences and workshops
- Evaluate training effectiveness as related to improved performance and increased productivity
- Expand the transit training network to potential users in related fields
- Initiate new topics relating to innovative finance and workplace safety

Program: FTA 10 National Transit Institute		
Key Activities and Products	**Program Schedule**	
	FY 1999	**FY 2000**
10. National Transit Institute (NTI)	**$4,000**	**$4,000**
Total Budget Authority	**$4,000**	**$4,000**

RELATED PROGRAMS: FTA 2. Equipment & Infrastructure, FTA 5 Planning & Policy Development

RESOURCE SUMMARY/HISTORY ($000)

Budget Authority	FY 1996 Enacted	FY 1997 Enacted	FY 1998 Enacted	FY 1999 Enacted	FY 2000 Request
Contracts, Grants, Cooperative Agreements	$3,000	$3,000	$3,000	$4,000	$4,000
Total	**$3,000**	**$3,000**	**$3,000**	**$4,000**	**$4,000**

Contact: FTA Office of Research and Technology, TRI-1, Phone: 202-366-0184

Program Title: Rural Transit Assistance Program
Budget Item No: FTA 11
Amount Requested for FY 2000: $5,250,000

GOALS

Strategic Goals:

Mobility & Accessibility

- Shape America's future by ensuring a transportation system that is accessible, integrated, efficient, and offers flexibility of choices
- Maintain, improve and expand the Nation's transit infrastructure, and balance new physical capacity with operational efficiency
- Ensure the nation's transit systems employ the latest technology to meet the increased needs of mobility and accessibility

Safety & Security

- Promote the public health and safety by working toward the elimination of transit-related deaths, injuries, property damage and the improvement of personal security and property protection

MAJOR ACTIVITIES & ANTICIPATED FY 1999 ACCOMPLISHMENTS

- Technical assistance and training to support transit providers in non-urbanized areas
- Training and technical assistance to support the expansion of rural transit service using the increased formula funding under TEA-21
- Scholarship assistance to enable rural transit providers to participate in state, regional, and national conferences and training
- Support for new access to jobs transportation services
- Technical support for drug and alcohol testing compliance
- Support of intercity bus service
- Technical support to ensure Y2K compliance

KEY FY 2000 PRODUCTS & MILESTONES

- Training and technical assistance for existing and new providers of rural transit service
- Technical support for service expansion using steadily increasing TEA-21 formula assistance
- Scholarships to enable rural providers to participate in the 14th National Transportation Research Board conference on rural public and intercity bus transportation and other training opportunities
- Assistance with drug and alcohol testing requirements
- Support for intercity bus service and access to jobs transportation

FY 2000 PROGRAM REQUEST

Program: FTA11 Rural Transit Assistance Program		
Key Activities and Products	**Program Schedule**	
	FY 1999	**FY 2000**
11. Rural Transit Assistance Program (RTAP)	**$5,250**	**$5,250**
Total Budget Authority	**$5,250**	**$5,250**

RELATED PROGRAMS: FTA 1. Safety & Security, FTA 2. Equipment & Infrastructure, FTA 3. Fleet Operations, FTA 4. Specialized Customer Services.

RESOURCE SUMMARY/HISTORY ($000)

Budget Authority	FY 1996 Enacted	FY 1997 Enacted	FY 1998 Enacted	FY 1999 Enacted	FY 2000 Request
Contracts, Grants, Cooperative Agreements	$4,500	$4,500	$4,500	$5,250	$5,250
Total	**$4,500**	**$4,500**	**$4,500**	**$5,250**	**$5,250**
Other: FTA Office of Program Management, TPM, Phone: 202-366-2053					

October 1999

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