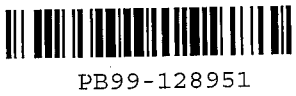

NATIONAL SCIENCE AND TECHNOLOGY COUNCIL

TRANSPORTATION TECHNOLOGY PLAN

Committee on Technology
Subcommittee on Transportation Research and Development

November 1998

About the National Science and Technology Council

President Clinton established the National Science and Technology Council (NSTC) by Executive Order on November 23, 1993. This cabinet-level council is the principal means for the President to coordinate science, space, and technology policies across the Federal Government. NSTC acts as a "virtual" agency for science and technology to coordinate the diverse parts of the Federal research and development enterprise. The NSTC is chaired by the President. Membership consists of the Vice President, Assistant to the President for Science and Technology, Cabinet Secretaries and Agency Heads with significant science and technology responsibilities, and other White House officials.

An important objective of the NSTC is the establishment of clear national goals for Federal science and technology investments in areas ranging from information technologies and health research, to improving transportation systems and strengthening fundamental research. The Council prepares research and development strategies that are coordinated across Federal agencies to form an investment package that is aimed at accomplishing multiple national goals.

To obtain additional information regarding the NSTC, contact the NSTC Executive Secretariat at 202-456-6102.

About the Office of Science and Technology Policy

The Office of Science and Technology Policy (OSTP) was established by the National Science and Technology Policy, Organization and Priorities Act of 1976. OSTP's responsibilities include advising the President in policy formulation and budget development on all questions in which science and technology are important elements; articulating the President's science and technology policies and programs; and fostering strong partnerships among Federal, State, and local governments, and the scientific communities in industry and academe.

To obtain additional information regarding the OSTP, contact the OSTP Administrative Office at 202-395-7347.

50272-101

REPORT DOCUMENTATION PAGE	1. REPORT NO.	2.	3. PB99-128951
4. Title and Subtitle **Transportation Technology Plan**			5. Report Date **November 1998** 6.
7. Author(s) **Office of Science and Technology Policy**			8. Performing Organization Rept. No.
9. Performing Organization Name and Address **Office of Science and Technology Policy** **Old Executive Office Building** **Washington, DC 20502**			10. Project/Task/Work Unit No. 11. Contract © or Grant (G) No. (C) (G)
12. Sponsoring Organization Name and Address **same as above**			13. Type of Report & Period Covered 14.

15. Supplementary Notes

none

16. Abstract (Limit: 200 words)

The National Science and Technology Council (NSTC) Committee on Technology, Subcommittee on Transportation Research and Development (R&D), has created a Transportation Technology Plan that presents initial implementation strategies for the partnership initiatives identified in the 1997 Transportation Science and Technology Strategy. With major involvement of the transportation and research communities, the NSTC developed the 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 articulates national transportation goals in five areas: safety, security, environmental quality and energy efficiency, economic growth and productivity, and mobility and access. It identifies partnerships among government, industry, and academia as critical elements in implementing the Strategy, and defines specific initiatives that can expedite the research process and speed the introduction of new technologies into transportation systems and operations.

17. Document Analysis a. Descriptors

b. Identifiers/Open-Ended Terms

c. COSATI Field/Group

18. Availability Statement	19. Security Class (This Report)	21. No. of Pages
none	**none**	**74**
	20. Security Class (This Page) **none**	22. Price

(See ANSI-Z39.18) *See Instructions on Reverse*

OPTIONAL FORM 272 (4-77)
(Formerly NTIS-35)
Department of Commerce

NATIONAL SCIENCE AND TECHNOLOGY COUNCIL

TRANSPORTATION TECHNOLOGY PLAN

Committee on Technology
Subcommittee on Transportation Research and Development

November 1998

The purpose of this report is to highlight ongoing Federal research efforts in the transportation technology field and to identify new and promising areas where there might be gaps in Federal support. The report is intended for internal planning purposes within the Federal agencies and as a mechanism to convey to the science and technology community the types of research and research priorities being sponsored and considered by the Federal agencies. The Administration is committed to a broad range of high-priority investments (including science and technology), to deficit reduction, and to a smaller, more efficient Federal Government. These commitments have created a very challenging budget environment—requiring difficult decisions and a well-thought-out strategy to ensure the best return for the Nation's taxpayers. As part of this strategy, this document does not represent the final determinant in an overall Administration budget decision-making process. The research programs presented in this report will have to compete for resources against many other high-priority Federal programs. If these programs compete successfully, they will be reflected in future Administration budgets.

THE DEPUTY SECRETARY OF TRANSPORTATION
WASHINGTON, D.C. 20590

Dear Colleague:

In 1997, the National Science and Technology Council (NSTC) released the first *Transportation Science and Technology Strategy*. This landmark document set forth an integrated set of directions for Federal development of technology applicable to transportation.

One of the key elements of this strategy was to develop "strategic partnership initiatives" among government, industry, and academia to address topics and problems of national importance. In some cases, the partnerships were already being formed and simply needed additional emphasis. In other cases, new partnerships had to be evolved and tested to meet the identified needs.

This first *Transportation Technology Plan* is the main vehicle for setting the needed partnerships into action. For areas it covers, it describes the problems and potential opportunities, highlights productive technologies and approaches for solutions, and includes a "technology roadmap" with a schedule and investment strategy.

The *Transportation Technology Plan* is a product both of the Federal Government and of a wide range of State and local government officials, academics, and members of the private sector. However, this is only an early step in what we hope will be a continuing process. In future years, we hope to make it even more useful and responsive to the needs of the transportation community. Only effective collaborations among all the elements of the transportation enterprise can assure that we have the mobility and services we need, both now and into the 21st century.

Sincerely,

Mr. Mortimer L. Downey
Chair

Dr. Duncan T. Moore
Co-Chair

Committee on Technology, Subcommittee on Transportation R&D
National Science and Technology Council

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EXECUTIVE SUMMARY

The National Science and Technology Council (NSTC) was created in 1993 to ensure that the Federal investment in research and technology is 1) coordinated to assure efficient use of Federal funds; 2) focused on projects identified by users, industry, and other stakeholders as being the most critical to achieving success in agencies' missions; and 3) limited to areas where it is clear that major public benefits can be achieved only through cost-shared Federal research.

With major involvement of the transportation and research communities, the NSTC Committee on Transportation Research and Development (R&D)[1] developed the first *Transportation Science and Technology Strategy* in 1997 to help Congress, the White House, and Federal agency heads to establish national transportation R&D priorities and coordinated research activities. The *S&T Strategy* articulates national transportation goals in five areas: safety, security, environmental quality and energy efficiency, economic growth and productivity, and mobility and access. It identifies partnerships among government, industry, and academia as critical elements in implementing the strategy, and defines specific initiatives that can expedite the research process and speed the introduction of new technologies into transportation systems and operations. The initiatives are intended to focus ongoing Federal activities to address the national transportation goals.

The purpose of this document, the *Transportation Technology Plan,* is to present initial implementation strategies for the partnership initiatives called for in the 1997 *S&T Strategy*. For each initiative, a technology roadmap shows the critical technology elements and the activities planned for the 1998–2005 time frame. Although this document focuses on technology, in many cases non-technological approaches may be equally beneficial to implement. The initiatives described in this plan are only part of the Administration's more comprehensive approach to transportation challenges—one that recognizes the value of both technological and non-technological solutions to transportation problems.

The partnership initiatives fall into two broad categories: 1) those representing existing, well-established Federal R&D activities; and 2) new efforts requiring further definition and interagency coordination. Both categories require broadened collaboration among government, industry, and academia to achieve the improvements in transportation needed both in America and globally in the next century.

Four initiatives represent well-established R&D programs. For these, the primary focus is relating the initiative to a broader transportation research agenda; folding it in with other Federal R&D programs; and, where appropriate, expanding its scope or coupling activities that have natural linkages.

[1] In 1998, the Transportation R&D Committee became a subcommittee under a new NSTC Committee on Technology.

These four initiatives are:

- *Aviation Safety Research Alliance*
- *Intelligent Vehicle Initiative*
- *National Intelligent Transportation Infrastructure*
- *Next Generation Global Air Transportation*

The other seven partnerships represent areas that require a large degree of coordination and stimulation to define and implement integrated actions. For these, extensive outreach is being initiated to bring about awareness of the initiative within the transportation and research communities and to assure understanding of those communities' needs. Future activities and progress will depend largely on the continued encouragement of coordinated efforts. These seven initiatives are:

- *Accessibility for Aging and Transportation-Disadvantaged Populations*
- *Enhanced Goods and Freight Movement at Domestic and International Gateways*
- *Enhanced Transportation Weather Services*
- *Monitoring, Maintenance, and Rapid Renewal of the Physical Infrastructure*
- *Next Generation Surface and Marine Transportation Vehicles*
- *Total Terminal Security*
- *Transportation and Sustainable Communities*

Over the next two years, the Committee on Technology and its Subcommittee on Transportation R&D will be expanding efforts to understand the nation's transportation needs and to establish innovative private–public partnerships to address them. Organizations interested in participating in or contributing to these efforts should access the partnerships section of the Transportation Science and Technology home page at scitech.dot.gov.

1. INTRODUCTION AND SUMMARY

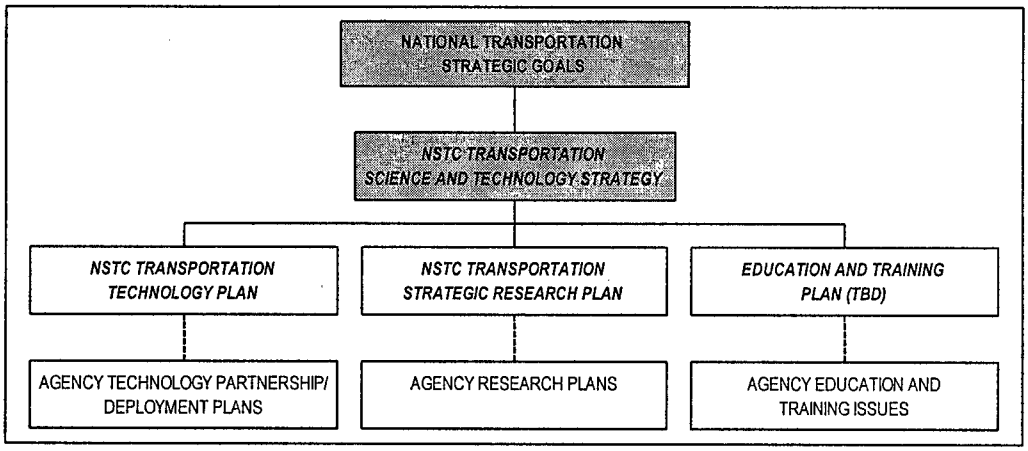
The National Science and Technology Council (NSTC) was created in 1993 to ensure that the Federal investment in research and technology is 1) coordinated to assure efficient use of Federal funds; 2) focused on projects identified by users, industry, and other stakeholders as being the most critical to achieving success in agencies' missions; and 3) limited to areas where it is clear that major public benefits can be achieved only through cost-shared Federal research.

With major involvement of the transportation and research communities, the NSTC Committee on Transportation Research and Development (R&D)[1] developed the first *Transportation Science and Technology Strategy* in 1997 to help Congress, the White House, and Federal agency heads to establish national transportation R&D priorities and coordinated research activities. The *S&T Strategy* articulates national transportation goals in five areas: safety, security, environmental quality and energy efficiency, economic growth and productivity, and mobility and access. It identifies partnerships among government, industry, and academia as critical elements in implementing the *Strategy*, and defines specific partnership initiatives that can expedite the research process and speed the introduction of new technologies into transportation systems and operations.

This document, the *Transportation Technology Plan,* presents initial implementation strategies for the partnership initiatives called for in the 1997 *S&T Strategy*. For each partnership, a technology roadmap shows the critical technology elements and the activities planned for the 1998–2005 time frame. Although this plan focuses on technology, in many cases non-technological approaches may be equally beneficial to implement. The partnerships described in this plan are only part of the Administration's more comprehensive approach to transportation challenges—one that recognizes the value of both technological and non-technological solutions to transportation problems. As the figure on page 2 shows, the *Technology Plan* represents just one of the supporting documents that presents detailed information on *S&T Strategy* implementation.

The partnerships described in this plan meet three criteria: 1) they address recognized national needs; 2) they have a technology focus; and 3) if successful, they could rely on market forces and the private sector for implementation. Each benefits the Nation as a whole and could not proceed in a timely fashion without some cost-shared Federal support of the overall efforts. The partnerships are intended to focus ongoing Federal activities to address the national transportation goals—with any new Federal support to be developed within the overall funding limits and constraints already established.

[1] In 1998, the Transportation R&D Committee became a subcommittee under a new NSTC Committee on Technology.



The partnerships in this plan fall into two broad categories: 1) those representing well-established Federal R&D activities; and 2) new efforts requiring further definition and interagency coordination. Both categories require broadened collaboration among government, industry, and academia to achieve the improvements in transportation needed both in America and globally in the next century.

Four initiatives represent well-established R&D programs: *Aviation Safety Research Alliance*; *Intelligent Vehicle Initiative*; *National Intelligent Transportation Infrastructure*; and *Next Generation Global Air Transportation.* For these, focus has been on relating the initiative to a broader research agenda; folding it in with other Federal programs; and, where appropriate, expanding its scope or coupling activities that have natural linkages.

The other seven partnerships require a large degree of coordination to define and implement integrated actions: *Accessibility for Aging and Transportation-Disadvantaged Populations*; *Enhanced Goods and Freight Movement at Domestic and International Gateways*; *Enhanced Transportation Weather Services*; *Monitoring, Maintenance, and Rapid Renewal of the Physical Infrastructure*; *Next Generation Surface and Marine Transportation Vehicles*; *Total Terminal Security*; and *Transportation and Sustainable Communities*. The NSTC is initiating extensive outreach to bring about awareness of these efforts within the transportation and research communities and to assure understanding of those communities' needs. Future progress will depend on the continued encouragement of coordinated efforts.

Table 1 summarizes the broad vision, goals, outcomes, technology elements, and supporting Federal programs[2] for the eleven partnership initiatives presented in the sections that follow. Although each partnership typically is intended to provide some specific transportation improvement, all support the full range of national goals for safety, security, environmental quality and energy efficiency, economic growth and productivity, and mobility and access. For those partnerships representing new activities, the "Supporting Federal R&D Programs" listed in the table refer to efforts with the same focus as the partnership and upon which a framework for the new effort may be built.

[2] Emphasis is on Department of Transportation R&D activities.

Table 1. Vision, Goals, Outcomes, Technology Elements, and Supporting Federal R&D Programs for NSTC Partnership Initiatives

Accessibility for Aging and Transportation-Disadvantaged Populations
Vision A transportation system that meets the mobility and accessibility needs of the elderly, the poor, persons with disabilities, and all other Americans without access to a private automobile.
Goals Create a model seamless regional transportation system that serves the needs of the elderly and transportation-disadvantaged people while taking full advantage of existing services, resources, and development patterns; promote development of transit-compatible communities that integrate transit and pedestrian services for all users; provide opportunities for employing welfare recipients by preserving communities and enhancing transit.
Outcomes • Improved livability of communities by increasing to 26 percent, from the 1996 baseline, the number of people within .25 miles of transit with service frequency of 15 minutes or less by 2000. • Increase in the percentage of key rail stations that are in compliance with the Americans With Disabilities Act (ADA) from 19 percent in 1996 to 47 percent in 2000. • Increase in the percentage of bus fleets that are ADA-compliant from 63 percent in 1996 to 80 percent in 2000. • Deployment of welfare-to-work transportation strategies in all 50 states by 2003.
Technology Elements • Advanced Public Transit System elements, such as computer-aided dispatch, automatic vehicle location, and electronic fare collection. • Next generation paratransit services.
Supporting Federal R&D Programs • Advanced Public Transit Systems (FTA). • Advanced Rural Transportation Systems (FHWA, FTA). • Autonomous Dial-a-Ride Transit (FTA). • Bridges to Work (HUD). • Metropolitan and Rural Policy Development (FTA). • Rural Transit Assistance Program (FTA). • Safe Mobility for Elders (NHTSA). • Specialized Customer Services (FTA).

Table 1. Vision, Goals, Outcomes, Technology Elements, and Supporting Federal R&D Programs for NSTC Partnership Initiatives (cont.)

Aviation Safety Research Alliance
Vision An even safer aviation system that accommodates continued growth in air traffic while experiencing fewer aircraft accidents and related fatalities.
Goal Identify methods that, when implemented, would reduce the fatal aviation accident rate by 80 percent by 2007, as compared to the1990-1996 baseline.
Outcomes • Elimination of accidents due to widespread aircraft fatigue damage by 2004. • Reduction by 50 percent in fatalities caused by aircraft ground and in-flight icing by 2004. • Reduction by 80 percent in aviation accidents attributed to human error by 2007. • Maintenance of all U.S. multi-engine aircraft in scheduled passenger service under an inspection program based on damage tolerance requirements by 2010. • Elimination of cabin fire as a cause of fatalities by 2017.
Technology Elements • Synthetic and enhanced vision displays. • Improved terrain avoidance and navigation systems. • Improved materials in aircraft structures, airframes, and engines. • Advanced fire prevention, detection, and suppression. • Real-time weather information processors and displays.
Supporting Federal R&D Programs • Aging Aircraft Research (FAA). • Aircraft Icing Research (FAA). • Aviation Human Factors (FAA). • Aviation Performance Measuring System (FAA, NASA). • Aviation Safety Program (FAA, NASA). • Aviation Safety Reporting System (FAA, NASA). • Aviation Weather Analysis and Forecasting (FAA). • Global Analysis Information System (FAA, NASA). • Wake Vortex Research (FAA). • Wind Shear Research (FAA).

Table 1. Vision, Goals, Outcomes, Technology Elements, and Supporting Federal R&D Programs for NSTC Partnership Initiatives (cont.)

Enhanced Goods and Freight Movement at Domestic and International Gateways
Vision A more productive national economy afforded by a more flexible, efficient, and seamless freight transportation system.
Goals Improve freight mobility at the Nation's land borders; ensure diffusion of existing freight information technologies and networks; expedite the global flow of goods.
Outcome • By 2000, reduction in land and waterside access impediments to the flow of cargo through U.S. ports and terminals by 2 percent as compared to the 1998 baseline.
Technology Elements • Electronic toll collection. • Dedicated short-range communications. • Electronic data interchange, e.g., smart tags and cards. • Vehicle-located technologies. • Sensors and displays.
Supporting Federal R&D Programs • Commercial Vehicle Operations (FHWA). • Industry Competitiveness (MARAD). • Intermodal Development (MARAD).

Table 1. Vision, Goals, Outcomes, Technology Elements, and Supporting Federal R&D Programs for NSTC Partnership Initiatives (cont.)

Enhanced Transportation Weather Services
Vision A transportation system that is significantly safer, with far greater capacity and efficiency, by reducing the impacts of adverse weather.
Goal Develop seamless, cost-effective transportation weather information systems.
Outcomes • Reduction in the rate of highway-related fatalities per 100 million vehicle-miles traveled from 1.7 in 1996 to 1.6 in 2000. • Reduction in the rate of highway-related injuries per 100 million vehicle-miles traveled from 141 in 1996 to 128 in 2000. • Reduction in the fatal aviation accident rate for commercial aircraft by 15 percent in 2000 from a 1994-1996 baseline of 0.048 fatal accidents per 100,000 departures. • By 2000, reduction in the rate of air travel delays by 20 percent from a 1994 baseline of 168.5 delays per 100,000 operations.
Technology Elements • Weather satellites, radars, wind profilers, road weather information systems. • Microscale atmospheric models. • ITS Service Centers. • Traveler information systems. • Aviation Gridded Forecast System. • Integrated Terminal Weather System. • Advanced Weather Interactive Processing System.
Supporting Federal R&D Programs • Aviation Weather Analysis and Forecasting Program (FAA). • Strategic Highway Research Program (FHWA).

Table 1. Vision, Goals, Outcomes, Technology Elements, and Supporting Federal R&D Programs for NSTC Partnership Initiatives (cont.)

Intelligent Vehicle Initiative
Vision A roadway system where Americans operate in a significantly safer environment and enjoy greater mobility and efficiency, while enhancing and preserving the environment and character of the communities it serves.
Goals Reduce the number of highway crashes and pedestrian casualties and the resulting injuries and fatalities; improve the effectiveness of intelligent systems to assure safe vehicle operation in residential and pedestrian activity centers.
Outcomes • Reduction in the rate of highway-related fatalities per 100 million vehicle-miles traveled from 1.7 in 1996 to 1.6 in 2000. • Reduction in the rate of highway-related injuries per 100 million vehicle-miles traveled from 141 in 1996 to 128 in 2000.
Technology Elements • Vehicle-located collision-avoidance systems. • Vision enhancement. • Location-specific alerts and warnings. • Automatic collision notification. • Smart restraints. • Traveler information systems. • Vehicle stability warning and diagnostics. • Automated transactions and cargo ID. • Obstacle/pedestrian detection. • Precision docking. • Transit passenger monitoring.
Supporting Federal R&D Programs • Advanced Public Transit Systems (FTA). • Advanced Vehicle Control and Safety Systems (NHTSA). • Automated Vehicle Control and Information Systems (FHWA). • Crash Avoidance (NHTSA). • Motor Carrier Research (FHWA).

Table 1. Vision, Goals, Outcomes, Technology Elements, and Supporting Federal R&D Programs for NSTC Partnership Initiatives (cont.)

Monitoring, Maintenance, and Rapid Renewal of the Physical Infrastructure
Vision A self-sustaining, environmentally compatible transportation infrastructure that is durable and efficient and that requires fewer human, economic, and environmental resources to produce, operate, and maintain.
Goals Accelerate the comprehensive renewal and advancement of the Nation's aging transportation infrastructure using stronger, cheaper, and environmentally superior materials and more cost-effective delivery systems; reduce waste, pollution, and emissions generated in the production of infrastructure materials.
Outcomes • Increase in the percentage of miles on the National Highway System that meet pavement performance standards for acceptable ride quality from 90.4 percent in 1996 to 91.8 percent in 2000. • Improvement in the condition of National Highway System bridges by reducing the percentage of bridges that are deficient from 23.4 percent in 1997 to 22.7 percent in 2000. • Continued maintenance of 93 percent of runways at major airports in good or fair condition.
Technology Elements • Mobile nondestructive testing and evaluation. • Superpave and other new materials. • Recycled construction materials. • Computer-aided design and development tools. • Improved models of condition & performance. • Risk management. • Tunneling. • Spread-spectrum radio-based systems. • Construction safety technologies.
Supporting Federal R&D Programs • Applied Research and Technology (FHWA). • Communication-based Train Control (FTA). • Local Technical Assistance Program (FHWA). • Pavement Research (FHWA). • Seismic Research and Development Program (FHWA). • State Planning and Research Program (FHWA). • Strategic Highway Research Program (FHWA). • Structures Research Program (FHWA). • Technology Assessment and Deployment (FHWA). • Track, Structures, and Train Control (FRA). • Transit Cooperative Research Program (FTA). • Turnkey Demonstration Program (FTA).

Table 1. Vision, Goals, Outcomes, Technology Elements, and Supporting Federal R&D Programs for NSTC Partnership Initiatives (cont.)

National Intelligent Transportation Infrastructure
Vision A truly seamless intermodal surface transportation system that accommodates private, public, and commercial vehicles; permits increasing communication and cooperation between infrastructure and vehicles; and utilizes relevant communication and information technologies to promote access and commerce.
Goals Reduce traffic crashes and fatalities; make the most effective use of the existing transportation system; reduce the costs of operating and using the surface transportation system; reduce travel time for all system users; increase productivity and improve customer service for highway and transit users; provide accurate system information to enable more effective transportation planning, operating policies, and pricing/control strategies; and permit experimentation with, and demonstration of, policy-sensitive traffic control strategies.
Outcomes • Reduction in delays on Federal-aid highways to 9 hours of delay per 1,000 vehicle-miles traveled in 2000, a decrease of 12 minutes from the 1996 level of 9.2 hours. • Reduction in the rate of highway-related fatalities per 100 million vehicle-miles traveled from 1.7 in 1996 to 1.6 in 2000. • Reduction in the rate of highway-related injuries per 100 million vehicle-miles traveled from 141 in 1996 to 128 in 2000. • Reduction in the rate of rail-related crashes to 3.32 (or fewer) per million train-miles in 2000, as compared to the 1995 baseline of approximately 4 crashes per million train-miles. • Reduction in the rate of rail-related fatalities to 1.54 (or fewer) per million train-miles in 2000, as compared to the 1995 baseline. • By 2000, reduction in the rate of grade-crossing crashes from 2.85 per million train-miles in 1995 to 2.28 (or fewer).
Technology Elements • Traffic surveillance and control systems. • Electronic toll collection. • Traveler information systems. • Commercial Vehicle Operations components. • Advanced Public Transit System components.
Supporting Federal R&D Programs • ITS Architecture and Standards (FHWA, FTA). • ITS Deployment Incentive Program (FHWA). • ITS Mainstreaming (FHWA, FTA). • ITS Program Support (FHWA).

Table 1. Vision, Goals, Outcomes, Technology Elements, and Supporting Federal R&D Programs for NSTC Partnership Initiatives (cont.)

Next Generation Global Air Transportation
Vision A safer, more efficient, environmentally compatible, and sustainable airspace system that meets future needs for global air transportation.
Goal Achieve a global air transportation system that supports "free flight" and similar concepts and that 1) assures the most effective use of present and future air system capacity and 2) assures that system capacity is devoted to meeting the highest priority needs for it.
Outcomes • By 2000, reduction in the rate of air travel delays by 20 percent from a 1994 baseline of 168.5 delays per 100,000 operations. • By 2000, increase in the number of flights flown off preferred routes to 80 percent from a 1996 baseline of 73 percent. • Maintenance of runway incursions at a level 15 percent below the 1997 baseline of 318 incursions by 2000.
Technology Elements • Air/ground and ground/ground digital communications. • Automated decision-support tools for air traffic control and flight planning. • Automatic dependent surveillance. • Global Positioning System navigation. • Advanced weather information.
Supporting Federal R&D Programs • ATM Advanced Concept Studies (FAA, NASA). • Human Factors (FAA, NASA). • System Performance Assessment (FAA, NASA). • ATM Methods and Analysis (FAA, NASA). • Application of Aircraft Capabilities (FAA, NASA). • Collaborative Decision Making (FAA, NASA). • Airport Surface Management (FAA, NASA). • Tower/Airfield Functionality (FAA, NASA). • Low/Zero Visibility Tower (FAA, NASA). • Final Approach Spacing Tool (FAA, NASA). • Dynamic Final Approach Spacing (FAA, NASA). • Parallel Runway Spacing Reduction (FAA, NASA). • Hazardous Weather Avoidance (FAA, NASA). • CTAS Adaptation/Implementation (FAA, NASA). • Collaborative Arrival Planning (FAA, NASA). • FMS/RNAV Routing (FAA, NASA). • Arrival/Departure Management (FAA, NASA). • Capabilities to Support Free Flight (FAA, NASA). • Advanced Oceanic Automation System (FAA, NASA). • Separation Methods and Standards (FAA, NASA).

Table 1. Vision, Goals, Outcomes, Technology Elements, and Supporting Federal R&D Programs for NSTC Partnership Initiatives (cont.)

Next Generation Surface and Marine Transportation Vehicles
Vision A far more sustainable transportation system with fewer harmful environmental impacts and reduced dependence on fossil fuels.
Goal Develop internationally competitive, domestically produced motor vehicles and ships that achieve unprecedented gains in fuel efficiency and in both environmental and operational performance.
Outcomes • Reduction in on-road mobile source emissions by 2 percent from 1999 to 2000, or a target of 62.7 million tons as compared to the 1996 baseline of 65.9 million tons. • Development of a production prototype midsize sedan that achieves up to three times the fuel efficiency of comparable 1994 models, while maintaining performance, size, utility, and cost of ownership and operation and meeting or exceeding Federal safety and emissions requirements. • Development of light trucks, sport utility vehicles, and medium- and heavy-duty vehicles with dramatically improved fuel efficiency (target to be determined).
Technology Elements • Lightweight structural materials. • Occupant protection systems. • Fuel cells and other energy conversion/storage technologies. • Improved internal combustion technologies. • Fuel preparation, delivery, and storage methods. • Advanced manufacturing processes. • High-speed rail technology.
Supporting Federal R&D Programs • Advanced Bus Propulsion Systems (FTA). • Advanced Combustion Engine R&D (DOE). • Advanced Technology Transit Bus (FTA). • Advanced Vehicle Program (RSPA, FHWA). • Automotive Alternative Fuels R&D (DOE). • Automotive Materials Technology Program (DOE). • Electric Vehicle R&D (DOE, FTA). • Fuel Cell R&D (DOE, FTA). • Heavy Vehicle Alternative Fuels R&D (DOE). • Heavy Vehicle Materials Technology (DOE). • Heavy Vehicle Systems R&D (DOE). • Heavy Vehicles (NHTSA). • Infrastructure, Systems, and Safety (DOE). • Motor Carrier Research (FHWA). • New Bus Vehicles and Infrastructure (FTA). • Next Generation High-Speed Rail (FRA). • Partnership for a New Generation of Vehicles (DOC,DOE, DOT). • Safety of High-Speed Ground Transportation (FRA). • Safety Systems (NHTSA). • Shipyard Revitalization (MARAD). • Vehicle Systems R&D (DOE).

Table 1. Vision, Goals, Outcomes, Technology Elements, and Supporting Federal R&D Programs for NSTC Partnership Initiatives (cont.)

Total Terminal Security
Vision Passenger and freight transportation terminals that are secure from acts of terrorism and crime.
Goal Develop a comprehensive approach to assessing security threats at transportation terminals and to implementing integrated security technologies and procedures tailored to these threats.
Outcomes • Improvement in the detection of simulated, improvised explosive devices and weapons from the 1998 baseline. • Reduction in the percentage of infrastructure assessed as unsatisfactory in a sample of key components and facilities.
Technology Elements • High-accuracy explosive and weapons detectors. • Motion detectors. • High-confidence systems and software. • Real-time passenger profiling and cargo information systems. • High-accuracy chemical and biological agent detection.
Supporting Federal R&D Programs • Aircraft Hardening (FAA). • Airport Security Technology Integration (FAA). • Aviation Security Human Factors (FAA). • Domestic Counterterrorism Program (DOJ/NIJ). • Explosives and Weapons Detection (FAA). • Force Protection (Air Mobility Command/DOD). • Safety and Security (FTA).

Table 1. Vision, Goals, Outcomes, Technology Elements, and Supporting Federal R&D Programs for NSTC Partnership Initiatives (cont.)

Transportation and Sustainable Communities
Vision A transportation system that meets the needs for mobility and accessibility while balancing the current and long-term goals of economic growth, environmental quality, and social equity.
Goals Integrate and coordinate research agendas to minimize duplication and research gaps; develop improved technical tools to analyze the impacts of transportation on the natural and social environment.
Outcomes • Reduce on-road mobile source emissions by 2 percent from 1999 to 2000, or a target of 62.7 million tons as compared to the 1996 baseline of 65.9 million tons. • Improve the livability of communities by increasing to 26 percent, from the 1996 baseline, the number of people within .25 miles of transit with service frequency of 15 minutes or less by 2000. • Minimize the adverse impacts of transportation projects on wetlands and, where impacts are unavoidable, replace 1.5 acres of wetlands for every 1 acre affected. • By 2000, reduce the rate of oil spilled into the water by maritime sources to 4.83 gallons per million gallons shipped, as compared to a 1998 baseline of 5.25 gallons.
Technology Elements • Travel-demand and other models (e.g., TRANSIMS). • Air quality and other environmental models. • Alternative fuels and vehicles. • Technologies that replace transportation or reduce its adverse impacts (i.e., ITS).
Supporting Federal R&D Programs • Alternative Fuels Evaluation (National Park Service). • Biofuels Feedstock/System Technology Development Programs (DOE). • Clean Cities Program (DOE). • Communities 2020 (HUD). • Community Development Patterns and Water Quality (EPA). • Ecosystem Linkages (U.S. Fish and Wildlife Service, U.S. Forest Service). • Environmental Impact and Ecosystem Management & Restoration (USACE). • Environmental Justice (FHWA, FRA, FTA). • Environmental/Transportation Planning Research (FHWA). • Environmentally Sensitive Low-Impact Development (EPA). • Evaluation of MOBILE Emissions Factor Model (FHWA, EPA). • Hydrogeomorphic Wetlands Assessment (EPA, USACE). • Institutional Aspects of Urban Runoff Management (EPA). • Livable Communities (FTA). • Metropolitan and Rural Policy Development (FTA). • Model Solutions to Recycling Brownfield Areas (HUD). • Planning and Project Development (FTA). • Planning Methodologies and Watershed Management (USACE). • Policy Research (FHWA, FTA). • Projects Related to Healthy People Goals and Objectives (CDC). • Regional Biomass Energy Program (DOE). • Right-of-Way Research (FHWA). • Rural and Specialized Transportation (FTA). • Transit Services Management Innovation (FTA). • Travel Demand Forecasting (FHWA, FTA, EPA). • Travel Model Improvement Program (FHWA, FTA, EPA).

2. ACCESSIBILITY FOR AGING AND TRANSPORTATION-DISADVANTAGED POPULATIONS

VISION

A transportation system that meets the mobility and accessibility needs of the elderly, the poor, persons with disabilities, and all other Americans without access to a private automobile.

GOALS

Create a model seamless regional transportation system that serves the needs of the elderly and transportation-disadvantaged people while taking full advantage of existing services, resources, and development patterns; promote development of transit-compatible communities that integrate transit and pedestrian services for all users; provide opportunities for employing welfare recipients by preserving communities and enhancing transit.

OUTCOMES

Among the specific outcomes of this partnership are the following, most of which are stated in the DOT *FY 1999 Performance Plan*:

- Improve the livability of communities by increasing to 26 percent, from the 1996 baseline, the number of people within .25 miles of transit with service frequency of 15 minutes or less by 2000.

- Increase the percentage of key rail stations that are in compliance with the Americans With Disabilities Act (ADA) from 19 percent in 1996 to 47 percent in 2000.

- Increase the percentage of bus fleets that are ADA-compliant from 63 percent in 1996 to 80 percent in 2000.

- Deploy welfare-to-work transportation strategies in all 50 states by 2003.

MAGNITUDE OF THE PROBLEM

Although the United States possesses one of the safest and most extensive passenger transportation systems in the world, the system is unable to provide optimal mobility for selected and growing portions of the population. These segments include the elderly, the physically challenged, and the poor.

Today, 12 percent of the U.S. population is 65 or older. Estimates suggest that by the year 2020, 17 to 20 percent of the population—or approximately 50 million Americans—will be over 65. The fastest growing cohort will be those least likely to have easy access to an automobile—those 85 and older. Yet, most of the elderly today are drivers and, by 2010, nearly all will be licensed. Having come to depend on the level of mobility afforded by the automobile, many elderly Americans will have to rely on alternative transit services once they are no longer able to drive.

Likewise, those young or old with physical disabilities have considerable mobility needs. More than 40 million Americans are disabled and many cannot drive or live in areas that are not served by transit. For these Americans, access to medical facilities, schools, training centers, and workplaces are critical to health and well-being.

Finally, welfare reform will require about 832,000 recipients to find jobs over the next 5 years. Due to welfare eligibility rules and high vehicle operating costs, most welfare recipients, and others with low incomes, do not own a car: only 6 percent of welfare families reported a car as an asset in 1995. Moreover, the "spatial mismatch" that often exists between the locations of jobs (about 70 percent of which are located in the suburbs) and the poor (80 percent of whom live in central cities or rural areas) exacerbates mobility problems. Previously tried transportation alternatives, such as employer- or publicly sponsored vanpools, attempted to provide transportation to service journey-to-work travel alone. However, 90 percent of the welfare recipients who will be required to work—and the heads of most poor families—are single mothers. Any effective mobility option must support trip-chaining patterns of working mothers, including work, child care, and other trips that are routine parts of managing a household.

REQUIREMENTS

Government investment in paratransit has provided the vast majority of the transportation options available to those without access to an automobile who are not served by conventional fixed-route transit. *Paratransit* is typically defined as flexible-route, low- or medium-capacity vehicles serving a predetermined group of people, such as the elderly, for a fee. The need for these services is growing. Demand-responsive paratransit nationwide has doubled the number of miles traveled over the last 10 years to nearly 600 million miles per year.

Although paratransit fills an important transportation gap for many parts of the population, its financial viability has been underwritten with substantial government

funding—Federal, State, local, and private—rather than from its own revenues. High operating costs and poor management strategies that do not optimize the use of drivers and vehicles have made such services costly and less than fully responsive to their riders' mobility needs.

This partnership focuses on improving the mobility of the elderly and transportation-disadvantaged through better management of paratransit operations, advanced transit technologies, and livable communities. A major component of the initiative is developing, deploying, and testing a regional paratransit program that uses selected information technologies, including automatic vehicle location, state-of-the-art vehicle communications, geographic information systems, computer-aided dispatch, and electronic fare collection. These technologies will be integrated into a centralized regional control system to manage otherwise independent paratransit operators. Dispatching, monitoring, and fare collection for paratransit services provided by transit properties, Councils on Aging, and human service providers within a single region will be conducted from a regional mobility management center. To assure the effective evolution of coordinated services, support for policies promoting transit-friendly development and livable local communities will be critical.

Although a number of "smart" technologies are currently being used or individually demonstrated throughout the country, no single regional testbed exists that attempts to manage all paratransit services within a region. The power and reduced cost of commercial off-the-shelf information, communication, and navigation systems makes the deployment of a regional access and mobility program possible.

INVESTMENT STRATEGY

Participants

Federal: DOT (FTA, FHWA, NHTSA, ITS Joint Program Office); HHS; HUD.

Other: Public agencies (American Public Transit Association, Community Transportation Association of America, Metropolitan Planning Organizations, National Association of Regional Councils, National Governors Association, Area Agencies on Aging, National Association of Housing and Redevelopment Officials); private sector (information and communication system vendors, transit providers, employers); universities.

Management

The FTA's Office of Research, Demonstration, and Innovation will provide overall program management for this initiative. However, the management structure and process will make full use of existing mechanisms for interagency cooperation—in particular, the Joint Program Office, the Joint DOT/HHS Coordinating Council on Human Services

Transportation, and joint FTA/HUD efforts—and will seek ongoing guidance from non-Federal partners in this initiative.

Critical Technology Elements and Activities

The partners in this initiative will undertake the following activities to develop and deploy regional paratransit services (see the technology roadmap below):

- *Outreach:* This activity will bring together interested parties from all levels of government and the private sector to 1) define the problem of providing regional paratransit services; 2) address the applicability of various intelligent transportation system (ITS) technologies; and 3) better understand the transportation needs of the affected populations, including the need for access to walkable communities.

- *Technology Concepts for Model Deployment:* This activity will develop broad implementation strategies for promising regional paratransit concepts. It will develop the overall justification for the concept(s); determine the applicability and availability of various technologies, for example, computer-aided dispatch, automatic vehicle location, and electronic fare collection; identify existing paratransit systems or services that may be similar; identify needed supporting development policies to assure livable communities; and outline participants' roles and responsibilities. In addition, this effort will address the incentives needed to encourage development of more mixed-use, walkable destinations that would allow paratransit operations to provide more effective and efficient service, as well as the research needed to develop the proper incentive structure.

- *Technology Demonstration and Research Design:* This effort will develop and document the demonstration and research design to be employed, including performance indicators, for at least one of the technology concepts identified in the activity described above.

- *System Plan:* This effort will determine and document project resources, schedules, and milestones.

- *System Integration and Deployment:* This activity will involve acquisition engineering, installation, testing, and integration of the various technology components comprising concept development and deployment.

- *System Operation:* This effort will involve the introduction of the model system into revenue service.

- *System Evaluation:* This activity will include assessing system performance (using the indicators specified in the Technology Demonstration and Research Design) and documenting the research results.

Funding Requirement

Funding will be provided from a mix of Federal, State, and local government and private sources. The overall funding requirement has not yet been determined. Federal funding will be determined through the annual budget process.

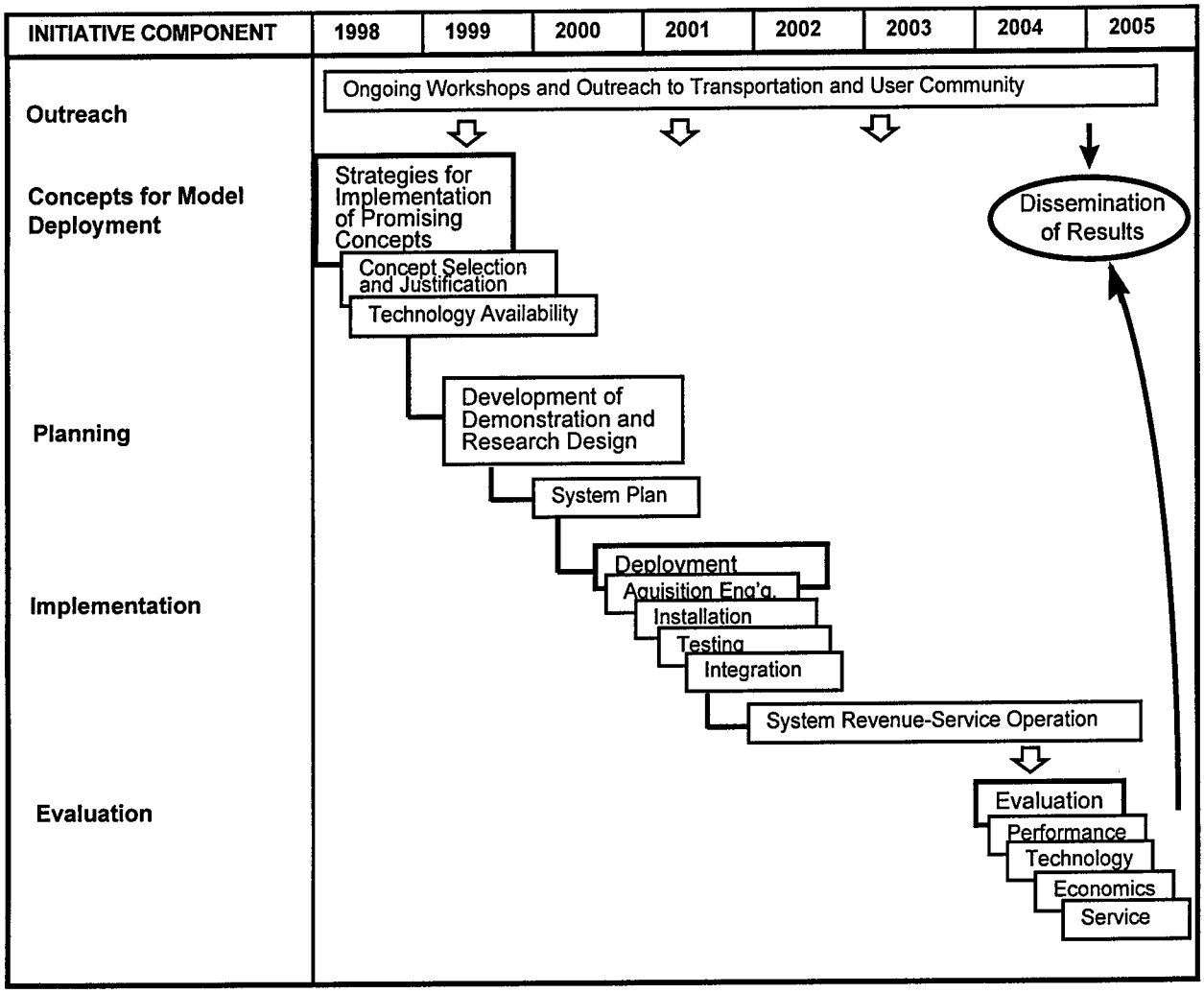
TECHNICAL CHALLENGES AND IMPLEMENTATION ISSUES

The primary technical challenge for this initiative is integrating and combining various ITS technologies for seamless paratransit service across an entire region. This initiative also faces a major institutional barrier to implementation: the need to remove existing obstacles to effective interagency and public–private cooperation, particularly at the local and regional levels. In the longer term, it requires more effective linkages between transportation planning and the development of options for community and regional growth.

ACRONYMS

ADA	Americans With Disabilities Act
DOT	U.S. Department of Transportation
FHWA	Federal Highway Administration
FTA	Federal Transit Administration
HHS	U.S. Department of Health and Human Services
HUD	U.S. Department of Housing and Urban Development
ITS	Intelligent Transportation Systems
NHTSA	National Highway Traffic Safety Administration

Technology Roadmap for the Accessibility for Aging and Transportation-Disadvantaged Populations Initiative



3. AVIATION SAFETY RESEARCH ALLIANCE

VISION

An even safer aviation system that accommodates continued growth in air traffic while experiencing fewer aircraft accidents and related fatalities.

GOAL

Identify methods that, when implemented, would reduce the fatal aviation accident rate by 80 percent by 2007, as compared to the 1990–1996 baseline.

OUTCOMES

Examples of outcomes from this partnership include the following:

- By 2004, eliminate accidents due to widespread aircraft fatigue damage.
- By 2004, reduce by 50 percent the number of fatalities caused by aircraft ground and in-flight icing.
- By 2007, reduce by 80 percent the aviation accidents primarily attributed to human error.
- By 2010, maintain all multi-engine aircraft operating in the U.S. in scheduled fare-paying passenger service under an inspection program based on damage tolerance requirements.
- By 2017, eliminate cabin fire as a cause of fatalities.

MAGNITUDE OF THE PROBLEM

Great strides have been made over the past 40 years to make flying the safest of all major modes of transportation. Aviation accidents have leveled off at extremely low rates. Yet, although the accident rate is very low, it has remained relatively constant for the past decade, and public concern about air safety continues to grow. Moreover, air traffic has grown rapidly and should continue to do so well into the foreseeable future. Coupled with the constant accident rate, the projected growth in air traffic could result in a dramatic increase in accidents—with perhaps as many as 4,500 fatalities worldwide each year by 2025. Without an effective program to reduce the accident rate, accidents could be so frequent that the public may no longer view aviation as a preferred mode of travel.

On February 12, 1997, the White House Commission on Aviation Safety and Security issued its final report to President Clinton. The report emphasized the need to reduce dramatically the aviation accident rate as air traffic doubles over the next decade. As stated by the President, "We will achieve a national goal of reducing the fatal aircraft accident rate by 80 percent within 10 years."

Historically, major advances in air safety have been driven by technological revolutions, beginning with airframe structures and followed by the development of turbojet engines and navigational aids. Today, aviation is in the midst of yet another revolution: the introduction of increasingly sophisticated automation into virtually every aspect of flight. These new capabilities are transforming aviation in a profound way and offer both opportunities and challenges for air safety.

REQUIREMENTS

As indicated above, investment in research and technology is the key to achieving significant advances in aviation safety. Safety programs have been under way for many years within the FAA, DOD, and NASA, as well as within the private sector and universities. These efforts have been successful in holding constant the aviation accident rate and in countering potential safety problems associated with the introduction of new technologies. However, reducing the fatal aviation accident rate by 80 percent requires a truly integrated partnership among Federal agencies and the support of both industry and academia. This partnership will meet this challenge through a coordinated program to 1) identify and conduct the research needed to meet the national safety goal and 2) work with industry to deploy research results in the form of new safety technologies.

INVESTMENT STRATEGY

Participants

Federal: DOD, FAA, NASA; also DOE, NIST, NWS, and U.S. Bureau of Mines.

Other: United Nations/International Civil Aviation Organization, aircraft and avionics manufacturers, airlines, aviation organizations, universities.

Management

This initiative will be managed jointly by the FAA, NASA, and DOD. These agencies have a variety of coordinating committees that have historically dealt with issues that cross agency boundaries. At the present time, these committees are providing an overarching management structure for coordinating safety research programs. In addition, new work groups and personnel exchanges will provide an even greater degree of integration. Among the formal structures now in place for carrying out this partnership

are the FAA–NASA Coordinating Committee, the Astronautics and Aeronautics Coordinating Board, and the Trilateral Meeting.

Critical Technology Elements and Activities

As shown in the accompanying roadmap, this initiative addresses five broad aviation safety technology areas. These activities also are integral elements of the Next Generation Global Air Transportation initiative, discussed later in this plan.

- *Human Error Prevention:* Research and development in this area addresses the White House Commission's recommendation for greater emphasis on human factors in aviation safety programs. The technology developed under this partnership would provide means of preventing accidents due to human error. Supporting research activities seek to quantify and predict the susceptibility of automated systems to human error; to develop design guidelines for such systems; to reduce the consequences of flight crew errors through better flight deck designs; to develop improved methods of training pilots and maintenance crews; to develop scheduling tools and other countermeasures that promote alertness and enhance performance; and to improve pilot performance through enhanced vision displays and other technological aids.

- *Flight Critical Systems and Information Integrity:* These safety technologies include systems to prevent accidents due to unexpected failures, damage, or upset situations; more durable aircraft materials and components; technologies that extend the useful safe life of aircraft structures, airframes, and engines; technologies that assure the integrity of flight information; and sensing and processing technologies to aid in aircraft monitoring.

- *Aviation Weather Technologies:* Research in this area is reducing weather-related accidents through technologies that communicate and display real-time weather information to airborne and ground-based users; eliminating visibility-induced errors through synthetic and enhanced vision displays, worldwide terrain databases, and Global Positioning System navigation; improving the effectiveness of ice-protection systems and reducing development costs for the industry; and developing and validating technology to detect atmospheric turbulence and to mitigate its effects on commercial aircraft.

- *Human Survivability:* These research efforts seek to ensure human survivability should an aircraft accident occur. Specific programs are developing advanced fire prevention, detection, and suppression methods; a systems approach to aircraft crashworthiness that includes new structural concepts and materials, safer cabin designs, advanced restraint equipment, and a validated analysis methodology; and a systems approach to passenger evacuation comprising computer simulation and improved procedures, training, equipment, and design criteria.

- *Systemwide Monitoring, Modeling, and Simulation Technologies:* Research in this area is developing advanced tools for converting aviation safety data into operationally useful information; tools, services, and standards for sharing data across the National Airspace System; and valid measures of unsafe incidents and conditions that may be accident precursors.

Funding Requirement

FY 1998 Federal funding is $200 million (NASA, $100 million; FAA, $100 million). Future funding will be provided from a mix of Federal, State, and local government and private sources. The overall funding requirement has not yet been determined. Federal funding will be determined through the annual budget process.

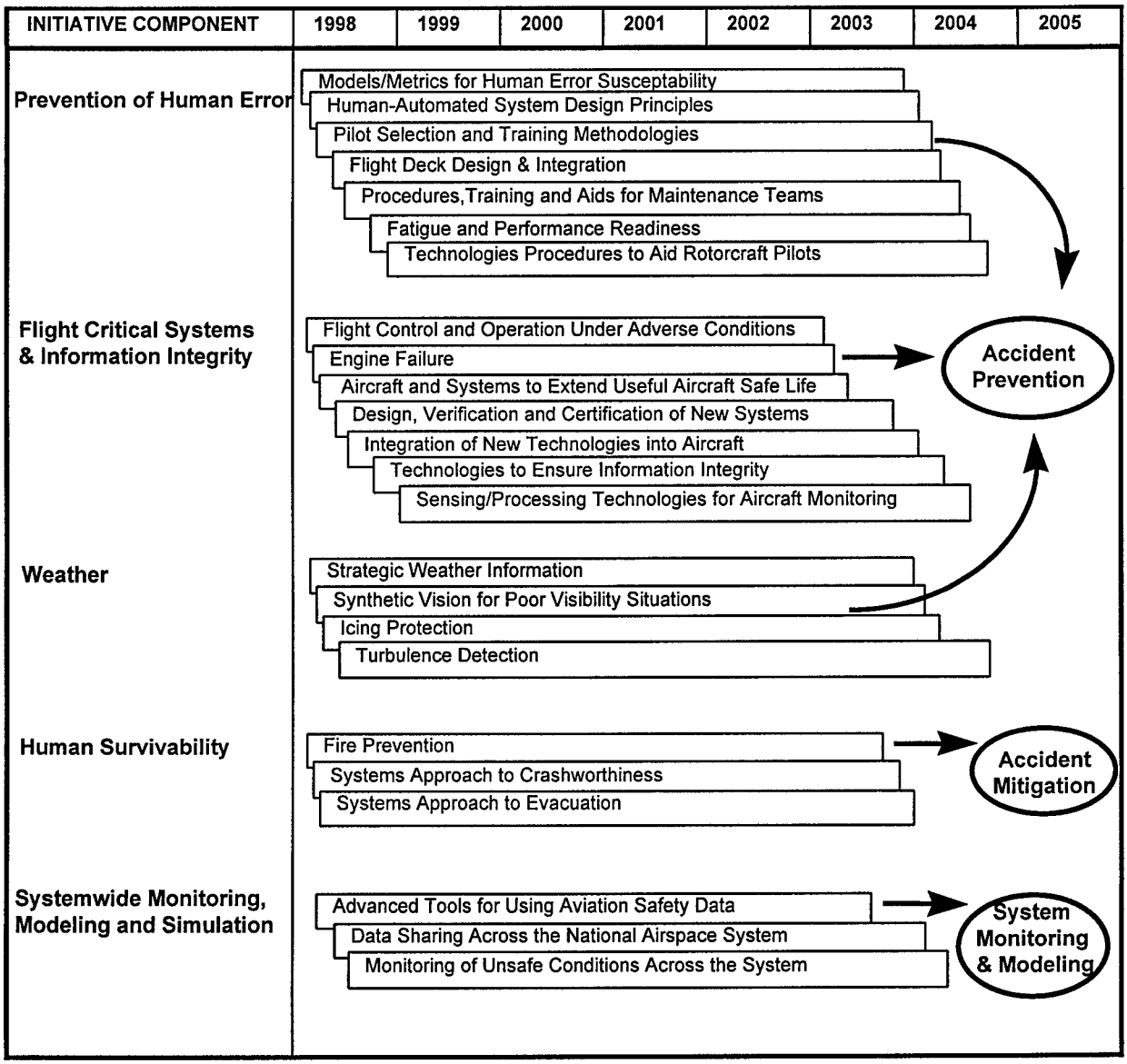
TECHNICAL CHALLENGES AND IMPLEMENTATION ISSUES

The primary issue for this initiative is deploying the new safety technologies within a time frame that permits partners to meet the ambitious outcome targets that have been established.

ACRONYMS

DOD	U.S. Department of Defense
DOE	U.S. Department of Energy
FAA	Federal Aviation Administration
FY	Fiscal Year
NASA	National Aeronautics and Space Administration
NIST	National Institute of Science and Technology
NWS	National Weather Service

Technology Roadmap for the Aviation Safety Research Alliance Initiative



4. ENHANCED GOODS AND FREIGHT MOVEMENT AT DOMESTIC AND INTERNATIONAL GATEWAYS

VISION

A more productive national economy afforded by a more flexible, efficient, and seamless freight transportation system.

GOALS

Improve freight mobility at the Nation's land borders; ensure diffusion of existing freight information technologies and networks; expedite the global flow of goods.

OUTCOMES

Among the specific outcomes of this partnership is the following stated in the DOT *FY 1999 Performance Plan*:

- By 2000, reduce land and waterside access impediments to the flow of cargo through U.S. ports and terminals by 2 percent as compared to the 1998 baseline.

MAGNITUDE OF THE PROBLEM

Several trends in the past decade have transformed the way that goods are transported across the globe.

First and foremost is the unprecedented growth in the volume of international trade. NAFTA, in particular, has led to unprecedented growth in trade and land border traffic: U.S. exports to Mexico have grown by 37 percent and to Canada by 34 percent. Laredo, across the Rio Grande from Mexico, has become the Nation's largest inland port, handling more than 2,000 loaded tractor trailers a day and over 23,000 passenger cars and buses. The lines formed by vehicles at Laredo's border inspection gates are mile-long and take several hours to clear.

On highways, truck congestion has reduced freight mobility, with trucks on many key freight arteries accounting for as much as one-fourth of the average daily traffic. Delays due to congested highways are estimated at 2 billion hours per year.

Finally, congestion at container ports creates delays for shippers and increased costs for consumers. This congestion can result from bottlenecks on or near freight terminals or from city- or region-wide surface transportation congestion and inefficiencies.

While congestion is creating freight bottlenecks, the process of moving freight is becoming increasingly information-intensive. Already, information technologies have improved the logistics and management of freight movement and transformed the ability of trading partners to compete in global markets. Automation of terminal operations, for example, has afforded tremendous productivity improvements, while electronic scheduling and dispatch systems have increased both facility capacity and equipment utilization.

REQUIREMENTS

Spurred by ISTEA and NAFTA, Federal, State, and local agencies are working with the private sector to enhance freight movement at international and domestic gateways. To date, an estimated $4.8 billion of ISTEA funds has been spent on freight gateway projects, with the Federal share totaling about 24 percent. Such efforts have included:

- *Gateway, Port Infrastructure, and Advanced Technology Investments*: These projects include bridge and tunnel rehabilitation; highway access improvements; terminal structure and layout improvements; port access improvements; and tests of intelligent transportation system (ITS) technologies for electronic clearance of commercial vehicles at Canadian and Mexican land borders.

- *Investments at Advanced Freight Terminals*: Mostly funded privately and by local and State agencies, these investments primarily support improvements at rail terminals, cargo consolidation hubs, and cargo airports.

Building on these efforts, this partnership will facilitate information exchange and technology demonstrations to promote the deployment of innovative logistics practices and information technologies at freight gateways.

INVESTMENT STRATEGY

Participants

Federal: DOT (Secretary's Office of Intermodalism, ITS Joint Program Office, FAA, FHWA, FRA, MARAD, USCG); DOC; DOD; DOE; DOJ (INS); EPA; State; Treasury (U.S. Customs); USDA.

Other: State and local transportation agencies; port and airport authorities; industry (air cargo companies, trucking companies, shippers, railroads, parcel and freight companies, equipment manufacturers, vehicle manufacturers).

Management

Coordinated by the NSTC, Federal participants will contribute resources and support as required, seeking ongoing guidance and participation from State, local, and private partners. DOT's ITS Joint Program Office will provide overall leadership and management of this initiative.

Critical Technology Elements and Activities

This partnership involves the following concurrent activities, as illustrated in the technology roadmap:

- *Demonstrations and Pilot Programs:* These demonstrations are assessing full-scale, integrated technology and logistics improvements at key freight gateways and freight interface points.

- *Tailored Technology Applications:* Supporting the full-scale demonstrations, this activity will apply advanced technologies and practices, such as electronic toll collection, electronic clearance, and smart cards, to specific improvements at freight terminals, ports, border crossings, and trade corridors.

- *Technology Assessments:* This effort will characterize the technologies and innovative practices currently available, determine their potential for improving freight mobility, and identify any new improvements that need to be developed.

- *System Architectures:* This involves the development of detailed blueprints for automated freight gateways and trade corridors.

- *Standards:* An integral part of each of the above activities, this work will ensure interoperable and standardized U.S. freight transportation networks.

- *Information Exchange:* An ongoing, crosscutting activity, this involves coordination and information exchange among Federal, State, local, and private partners.

Funding Requirement

Funding will be provided from a mix of Federal, State, and local government and private sources. The overall funding requirement has not yet been determined. Federal funding will be determined through the annual budget process.

TECHNICAL CHALLENGES AND IMPLEMENTATION ISSUES

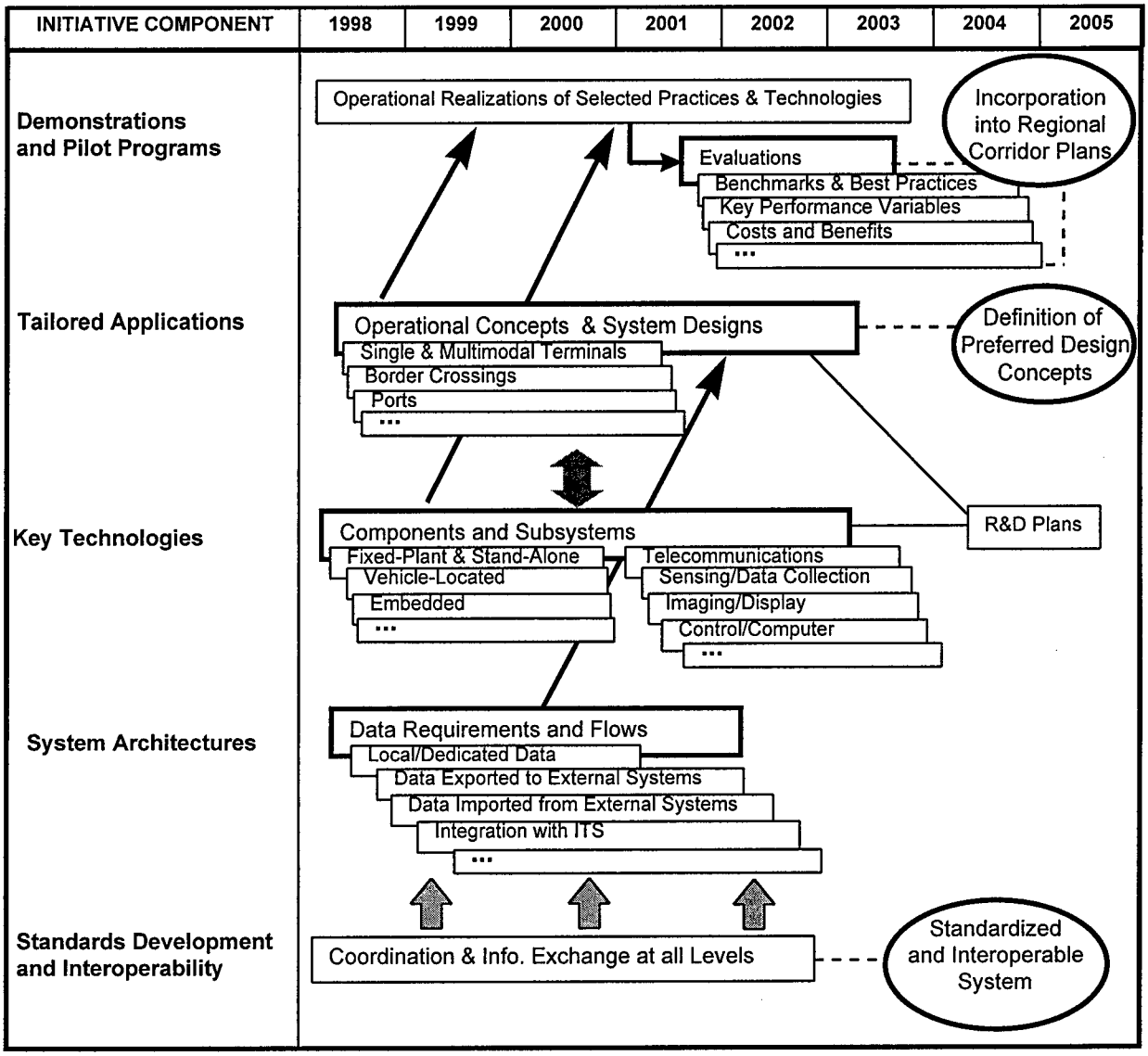
A major implementation issue for this initiative is the role of the Federal Government in diffusing new technologies and facilitating information exchange, and the willingness of the private sector to work with Federal partners.

In particular, the transfer of innovative technologies and practices developed in the past three or four decades is among this initiative's foremost opportunities. The Federal role in this process is significant, as new technology has little or no economic significance until there is "*innovation*," that is, until the technology is adopted and applied. Within the private sector, the decision to innovate is a function of the level of risk and the expected rate of return. Transfer of proven technologies and practices by Federal agencies reduces the risk to industry and generates net economic benefits to society.

ACRONYMS

DOC	U.S. Department of Commerce
DOD	U.S. Department of Defense
DOE	U.S. Department of Energy
DOJ	U.S. Department of Justice
DOT	U.S. Department of Transportation
EPA	U.S. Environmental Protection Agency
FAA	Federal Aviation Administration
FHWA	Federal Highway Administration
FRA	Federal Railroad Administration
INS	Immigration and Naturalization Service
ISTEA	Intermodal Surface Transportation Efficiency Act of 1991
ITS	Intelligent Transportation Systems
MARAD	Maritime Administration
NAFTA	North American Free Trade Agreement
NSTC	National Science and Technology Council
R&D	Research and Development
USCG	United States Coast Guard
USDA	U.S. Department of Agriculture

Technology Roadmap for the Enhanced Goods and Freight Movement at Domestic and International Gateways Initiative



5. ENHANCED TRANSPORTATION WEATHER SERVICES

VISION

A transportation system that is significantly safer, with far greater capacity and efficiency, by reducing the impacts of adverse weather.

GOAL

Develop seamless, cost-effective transportation weather information systems.

OUTCOMES

Among the outcomes to which this partnership will contribute are the following from the DOT *FY 1999 Performance Plan*:

- Reduce the rate of highway-related fatalities per 100 million vehicle-miles traveled from 1.7 in 1996 to 1.6 in 2000.
- Reduce the rate of highway-related injuries per 100 million vehicle-miles traveled from 141 in 1996 to 128 in 2000.
- Reduce the fatal aviation accident rate for commercial aircraft by 15 percent in 2000 from a 1994-1996 baseline of 0.048 fatal accidents per 100,000 departures.
- By 2000, reduce the rate of air travel delays by 20 percent from a 1994 baseline of 168.5 delays per 100,000 operations.

MAGNITUDE OF THE PROBLEM

The safety, mobility, and economic impacts of weather on transportation are considerable. The White House Office of Science and Technology Policy (OSTP) estimates that weather causes or contributes to 6,000 fatalities on U.S. highways and 800 aviation-accident-related deaths each year. According to the General Estimate System crash database, in 1995 there were approximately 435,000 injury crashes in the United States due to adverse weather.

More than half of all flight delays, and between 25 and 35 percent of all intercity road accidents, are attributable to bad weather. Despite the fact that North America spends more than $2 billion a year on snow and ice control, road accidents increase during adverse weather by a factor of from two to five.

Life-threatening and costly weather events are not limited to winter storms: The United States experiences more severe local storms and flooding than any other country in the world. In a typical year, the United States can expect about 10,000 violent thunderstorms; 5,000 floods; 1,000 tornadoes; and several hurricanes.

REQUIREMENTS

Advances in weather technologies and meteorology over the past decade hold promise for mitigating many of the impacts of severe weather on transportation.

For surface transportation, research, testing, and evaluation in this area have primarily addressed 1) winter maintenance, including road weather information systems (RWIS) for anti-icing and de-icing operations; 2) visibility; and 3) intelligent transportation systems (ITS). Within DOT's ITS program, a number of projects include weather information, five of which include such information as a core part of the system designs. These five projects are the Advanced Transportation Weather Information System, the Idaho Storm Warning System, TravelAid, a variable speed limit project in Nevada, and the Weather Information for Surface Transportation project, also known as Foretell. Of these, Foretell is the most comprehensive project with respect to adverse weather. It addresses the information needs of a range of surface transportation users and operators and works closely with the National Oceanic and Atmospheric Administration (NOAA).

A partnership among the FHWA, Iowa DOT, and the private sector, Foretell's objective is to demonstrate and evaluate an integrated weather information system—first within a "pilot" Midwestern region, then over multiple regions, and eventually throughout North America. The program's first phase will deploy a road and weather information system across five states in the Mississippi Valley region plus western Ontario: a total land area of almost 750,000 square miles. Fully integrated within a wider suite of ITS services, the system will make use of state-of-the art weather radars and observing systems, including RWIS; the Doppler Weather Surveillance Radar (the FAA's and DOD's NEXRAD); Automated Surface Observing System; Advanced Weather Interactive Processing System; the NWS's Weather Forecast Offices; and advanced communication systems and weather satellites.

To reduce weather hazards in aviation, the FAA, NOAA, and other agencies are working with industry through the Aviation Weather Analysis and Forecasting (AWAF) Program. This program has two main objectives: 1) improve access to and delivery of aviation weather information; and 2) reduce the consequences of weather events by generating weather observations, warnings, and forecasts with higher resolution and greater accuracy than existing aviation weather services. Specific products under development will provide the following capabilities: accurately depict current and forecasted areas of in-flight icing, including severity and type; couple high-resolution and timely gridded weather data with interactive data assimilation and editing; forecast snowfall type and rate; detect and forecast en route turbulence, particularly clear-air turbulence; predict storm growth, initiation, and decay; make short-term predictions of ceiling and visibility

in the terminal area; provide hourly forecasts of windshear events; forecast terrain-induced hazards; and provide short-term forecasts of conditions that affect wake vortices.

INVESTMENT STRATEGY

Participants

Federal: DOT (ITS Joint Program Office, FAA, FHWA, FRA); DOD; NASA; NOAA; NWS.

Other: Iowa DOT and other State DOTs, Environment Canada, commercial weather products vendors, ITS Service Centers, National Center for Atmospheric Research, airlines, airports, the aviation industry, foreign aviation authorities.

Management

For the Foretell program, the Iowa DOT is the lead public sector partner, with the cooperation of the other four states participating in the demonstration and the Province of Ontario. The ITS Joint Program Office and FHWA will provide technical assistance for the project and about one-third of the funding required for Phase I. Castle Rock Services, which runs two ITS Service Centers in a public–private partnership with the Virginia DOT, is the private sector lead.

The FAA is the lead agency for the AWAF Program, a broad-based partnership involving NOAA, the NWS, and other Federal agencies; airlines; airports; and the aviation industry.

Critical Technology Elements and Activities

This effort is closely related to the Aviation Safety Research Alliance, the Intelligent Vehicle Initiative, and the initiative for the National Intelligent Transportation Infrastructure, described in other sections of this plan. Broad activities include:

- *Prototype Demonstrations and Pilot Programs:* This activity involves applications of weather technologies in specific modal, geographical, and climatological circumstances, and evaluation of benefits and costs.

- *Data Sharing:* To combine weather data from disparate sources, this effort defines compatible data architectures and exchange standards and coordinates weather information services across agencies and with industry.

- *Meteorology and Data Sources:* This involves the fusion of improved prediction algorithms and atmospheric models with weather information delivery systems. The goal is to apply advances in meteorology to provide weather products with far greater precision and finer resolution.

- *Information Dissemination and Display*: This looks at strategies and technologies for delivering weather information to users. Specific issues include user interfaces for data selection; the display of information specific to particular users' needs; the design of interactive, human-centered displays; and integration of information systems with ITS and air traffic control (ATC).

Funding Requirement

For Foretell, FY 1998 Federal funding is $1.3 million. Future funding will be provided from a mix of Federal, State, and local government and private sources. The overall funding requirement has not yet been determined. Federal funding will be determined through the annual budget process.

Funding for the AWAF Program also will come from a combination of Federal, State, local, and private partners. As with Foretell, the Federal share has not yet been determined, and the budget process will determine all Federal funding.

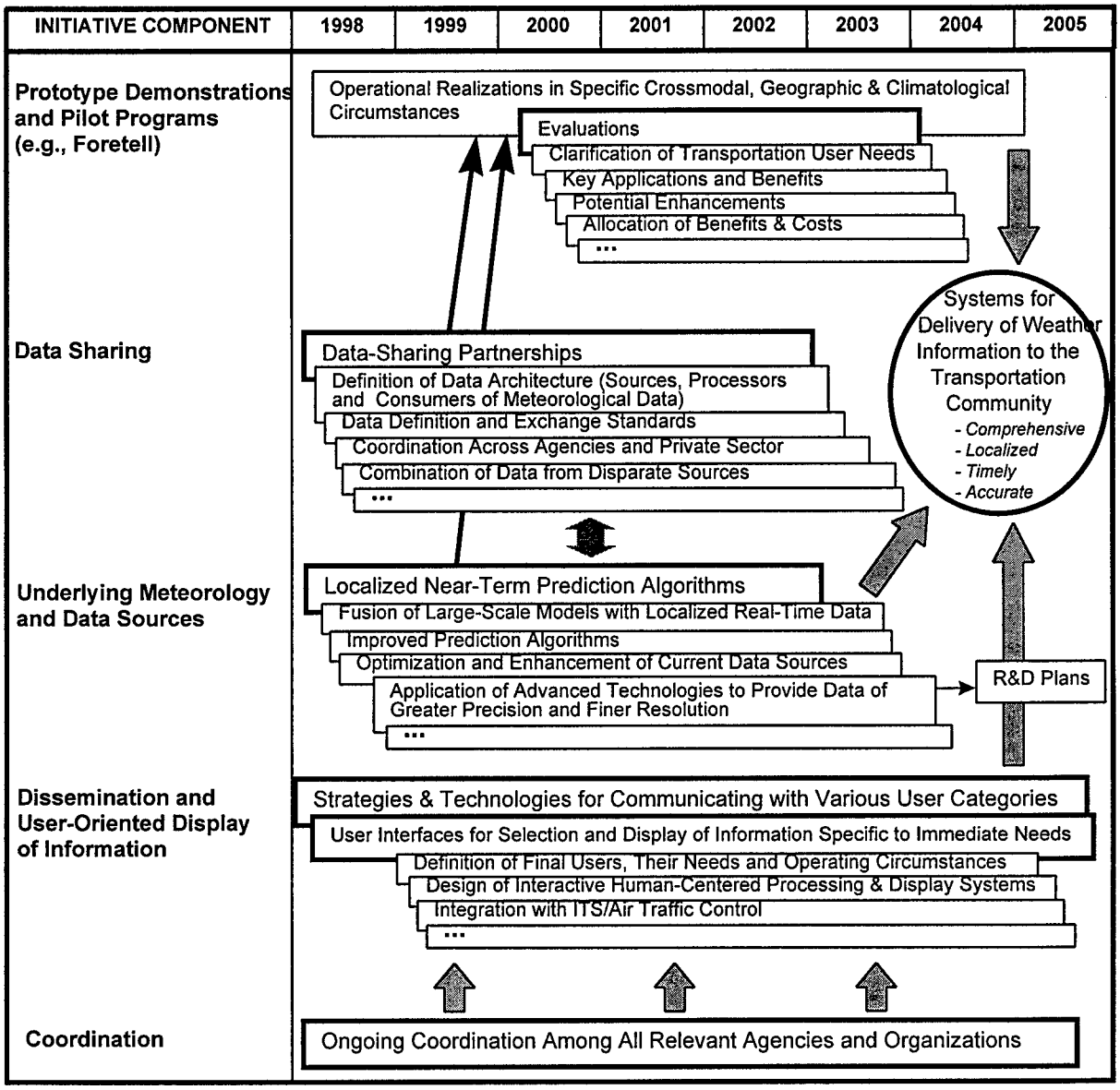
TECHNICAL CHALLENGES AND IMPLEMENTATION ISSUES

The most formidable challenge for both Foretell and AWAF is technological: fusing the entire set of weather data-collection systems; integrating this data with the full array of information, communication, and ITS technologies; and disseminating weather information in multiple easy-to-use formats.

ACRONYMS

ATC	Air Traffic Control
AWAF	Aviation Weather Analysis and Forecasting
DOD	U.S. Department of Defense
DOT	U.S. Department of Transportation (also State DOTs)
FAA	Federal Aviation Administration
FHWA	Federal Highway Administration
FRA	Federal Railroad Administration
FY	Fiscal Year
ITS	Intelligent Transportation Systems
NASA	National Aeronautics and Space Administration
NEXRAD	Next Generation Weather Radar
NOAA	National Oceanic and Atmospheric Administration
NWS	National Weather Service
OSTP	Office of Science and Technology Policy
R&D	Research and Development
RWIS	Road Weather Information System

Technology Roadmap for the Enhanced Transportation Weather Services Initiative



6. INTELLIGENT VEHICLE INITIATIVE

VISION

A roadway system where Americans operate in a significantly safer environment and enjoy greater mobility and efficiency, while enhancing and preserving the environment and character of the communities it serves.

GOALS

Reduce the number of highway crashes and pedestrian casualties and the resulting injuries and fatalities; improve the effectiveness of intelligent systems to assure safe vehicle operation in residential and pedestrian activity centers.

OUTCOMES

This partnership is central to meeting the following outcomes identified in the DOT *FY 1999 Performance Plan*:

- Reduce the rate of highway-related fatalities per 100 million vehicle-miles traveled from 1.7 in 1996 to 1.6 in 2000.

- Reduce the rate of highway-related injuries per 100 million vehicle-miles traveled from 141 in 1996 to 128 in 2000.

MAGNITUDE OF THE PROBLEM

The personal, social, and economic costs of motor vehicle crashes include pain and suffering; direct costs sustained by the injured persons and their insurers; indirect costs to taxpayers for health care and public assistance; and, for many crash victims, a lower standard of living and quality of life. During the past two decades, motor vehicle crashes accounted for over 90 percent of all transportation fatalities and an even larger percentage of accidents and injuries. More than 40,000 people die each year in highway crashes, with a total economic loss estimated at over $150 billion annually. In addition, 30,000 bus crashes over the past 5 years resulted in 17,000 deaths and injuries. Driver error is cited as the primary cause in about 90 percent of all police-reported crashes involving cars, buses, and trucks. Pedestrian deaths and injuries pose yet another significant problem.

REQUIREMENTS

Research indicates that collision-avoidance systems offer the potential for significantly reducing motor vehicle crashes. In particular, preliminary NHTSA estimates show that

rear-end, lane-change, and roadway-departure crash-avoidance systems have the potential, collectively, to reduce crashes by one-sixth, or about 1.2 million crashes a year. Such systems may warn drivers, recommend control actions, or introduce temporary or partial automated control of the vehicle in hazardous situations.

The Intelligent Vehicle Initiative (IVI) is a government–industry program to accelerate the development and commercialization of these safety- and mobility-enhancing driver-assistance systems. The underlying proposition is that Federal involvement will move up the timetable for introducing such publicly beneficial innovations into common use and reduce the possibility of degraded safety from non-integrated after-market applications. At the same time, in recognition of the need for balance between public benefits and marketability, government and industry partners in the IVI will ensure that all safety benefits identified are reasonable, that the proposed systems are commercially viable, and that products can be implemented in the near term.

The overall emphasis of the IVI is on four areas: 1) research and evaluation of the costs and benefits of IVI products; 2) development of industry-wide standards; 3) system prototyping; and 4) field test evaluations of the most promising products.

INVESTMENT STRATEGY

Participants

Federal: DOT ITS Joint Program Office, FHWA, FTA, NHTSA.

Other: Motor vehicle and trucking industries, State DOTs, local agencies, fleet operators, universities and other research organizations.

Management

The FHWA, FTA, and NHTSA will jointly manage the IVI, with the Joint Program Office responsible for program coordination and budget oversight. Guidance and direction will be sought from all interested parties.

Critical Technology Elements and Activities

Ongoing and recently completed work on crash avoidance, obstacle sensing, intelligent speed control, in-vehicle information systems, automated highway systems, and motor carrier safety provides a strong foundation for intelligent vehicle research. The IVI will continue and expand these efforts, particularly in areas such as human factors, sensor performance, modeling, and driver acceptance. This work is closely related to the National Intelligent Transportation Infrastructure and Enhanced Transportation Weather Services initiatives and has further applications for Transportation and Sustainable Communities.

The broad technology elements of the IVI, shown in the technology roadmap, include:

- *Crosscutting Technology Activities:* Guiding and influencing all other program elements, these activities include architecture and standards development; research, development, and testing in human factors and technology; acquisition, expansion, and validation of simulation models and other evaluation tools; development and execution of an outreach plan to ensure the participation of industry and others; development and implementation of evaluation plans for field operation; and program planning and administration.

- *Development of Specific Technologies and Services:* This covers the research, development, testing, and evaluation of individual crash-avoidance and efficiency-enhancing systems, including rear-end, road-departure, lane-change, merge, intersection, and railroad-crossing collision avoidance; vision enhancement; location-specific alerts and warnings; automatic collision notification; smart restraints; navigation and routing; real-time traffic and traveler information; vehicle stability warning; vehicle diagnostics; cargo identification; automated transactions; obstacle/pedestrian detection; precision docking; and transit passenger monitoring.

- *Selection of Technologies and Services for Integration:* This represents the selection of specific intelligent vehicle technologies, and a mix of services, to be included in integrated packages. Selection involves extensive work on estimating benefits and costs and user acceptance.

- *System Design and Development*: Two types of activities are included in this category: 1) research, development, and prototype testing to assess intelligent vehicle capabilities; and 2) developing system and subsystem specifications for the vehicles and infrastructure modifications necessary for operational tests.

- *Operational Tests and Technology Evaluation:* Work in this area implements the plans for field tests on actual highways, evaluates the integrated intelligent vehicle services subject to the operational tests, develops deployment plans, establishes performance thresholds, and develops recommendations.

- *Technology Deployment:* This refers to the actions by manufacturers and their suppliers to make and offer intelligent vehicle systems in production motor vehicles. It is anticipated that manufacturers will adopt the systems as part of their standard product lines. Product deployment also includes the installation of infrastructure-based components by regional, State, and local highway agencies. This activity is the final step and ultimate objective of the IVI.

Funding Requirement

FY 1998 Federal funding is $25 million. Future funding will be provided from a mix of Federal, State, and local government and private sources. The overall funding requirement has not yet been determined. Federal funding will be determined through the annual budget process.

TECHNICAL CHALLENGES AND IMPLEMENTATION ISSUES

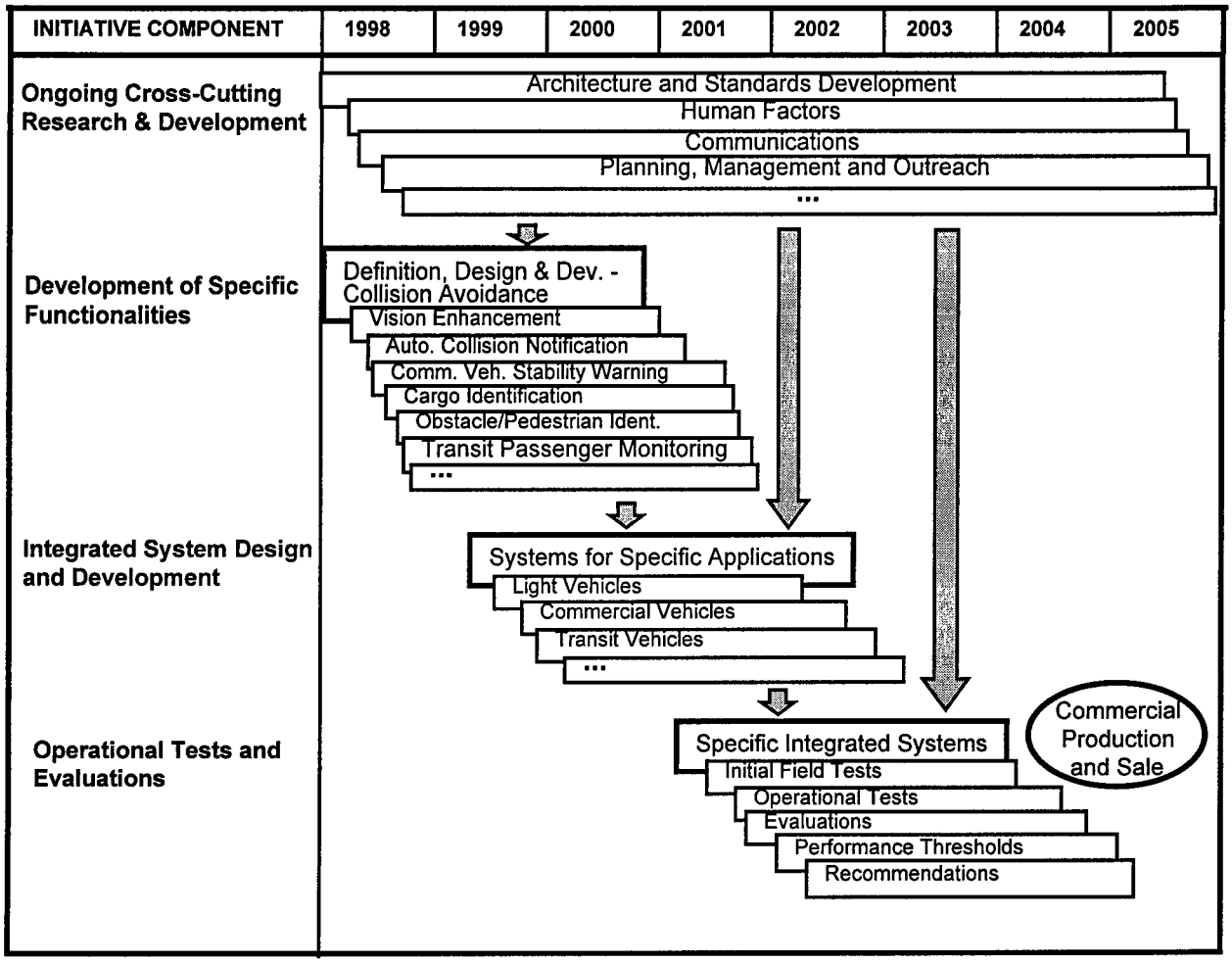
A primary technical hurdle is developing technologies that complement, and perhaps even accomplish on their own, the human visual and higher cognitive abilities by which collision avoidance occurs.

Among non-technical issues, the most critical is the need for the ongoing support of the automotive industry. The active role of automakers and their suppliers is important for achieving the program's strategic goal and outcomes.

ACRONYMS

DOT	U.S. Department of Transportation
FHWA	Federal Highway Administration
FTA	Federal Transit Administration
FY	Fiscal Year
ITS	Intelligent Transportation Systems
IVI	Intelligent Vehicle Initiative
NHTSA	National Highway Traffic Safety Administration

Technology Roadmap for the Intelligent Vehicle Initiative



7. MONITORING, MAINTENANCE, AND RAPID RENEWAL OF THE PHYSICAL INFRASTRUCTURE

VISION

A self-sustaining, environmentally compatible transportation infrastructure that is durable and efficient and that requires fewer human, economic, and environmental resources to produce, operate, and maintain.

GOALS

Accelerate the comprehensive renewal and advancement of the Nation's aging transportation infrastructure using stronger, cheaper, and environmentally superior materials and more cost-effective delivery systems; reduce waste, pollution, and emissions generated in the production of infrastructure materials.

OUTCOMES

Among the outcomes to which this partnership will contribute are the following from the DOT *FY 1999 Performance Plan*:

- Increase the percentage of miles on the National Highway System that meet pavement performance standards for acceptable ride quality from 90.4 percent in 1996 to 91.8 percent in 2000.

- Improve the condition of National Highway System bridges by reducing the percentage of bridges that are deficient from 23.4 percent in 1997 to 22.7 percent in 2000.

- Continue to maintain 93 percent of runways at major airports in good or fair condition.

MAGNITUDE OF THE PROBLEM

The well-being and vitality of the transportation physical infrastructure are essential to the economic prosperity of the Nation. Transport infrastructure is the engine that powers the economy, employing 12 million and attracting one of every 5 dollars in total household spending. In direct expenditures alone, transportation-related activities account for almost 20 percent of the U.S. Gross Domestic Product (GDP), with about 15 percent of that applied to construction, operation, and maintenance of transportation systems. Of these expenditures, more than 80 percent are for maintenance of our transportation infrastructure. Despite this fact, there is a need to update the technologies

and practices used in infrastructure maintenance and construction if our transportation systems are to keep pace with the demands of the next century.

REQUIREMENTS

Recent advances in materials, technologies, and practices have the potential to improve infrastructure condition and performance without big increases in infrastructure spending. For example, engineers are beginning to use a variety of self-repairing, or "smart," materials in the repair and retrofit of bridges, docks, highways, and other elements of the transportation infrastructure; these materials use unique shape memory alloys to restore a structural component to its original shape, stiffness, or orientation. Moreover, structural monitoring and sensing devices promise to revolutionize the way we build, maintain, and operate built structures. And, as engineers take advantage of the enormous potential of high-performance concrete, fiber-reinforced polymers, and other advanced materials, the Nation will benefit from huge reductions in traffic delays, downtime, and other costs associated with infrastructure repair.

Yet, despite these advances, a number of factors combine to discourage innovation. These include the high cost of insurance for engineering and construction firms, the multitude of regulations, and industry fragmentation. There is a very real perception that innovation is risky: a recent survey by the American Consulting Engineers Council found that the threat of litigation caused 76 percent of respondents to avoid innovative methods and materials. Moreover, although the U.S. design and construction industry represents almost 13 percent of our GDP, it is highly fragmented, comprising over 1.2 million firms—85 percent of which have fewer than 10 employees.

This initiative represents the transportation component of the Partnership for the Advancement of Infrastructure and its Renewal (PAIR), an umbrella organization for existing government, private sector, and university infrastructure programs. Called PAIR-T, this initiative will create an environment that fosters an unprecedented level of collaboration and synergy on transportation research and development, demonstration, testing, evaluation, and technology transfer to State and local institutions. The PAIR-T partners will collaborate both on developing new infrastructure technologies and on accelerating market acceptance of existing products.

INVESTMENT STRATEGY

Participants

Federal: DOT (FAA, FHWA, FRA, FTA, MARAD, RSPA, USCG); DOD (USACE); DOC (NIST); NSF.

Other: CERF; State and local transportation agencies; chemical, automotive, and material manufacturers; commercial freight, air transport, and insurance industries; infrastructure construction, planning, and management firms; communications, water, gas, and electric utilities; universities; industry and trade associations.

Management

PAIR-T is explicitly a cost-shared partnership between the private and public sectors. Representing the different participants from these sectors, a PAIR-T Executive Committee will be responsible for developing and administrating operational policies, including all fiscal and administrative procedures. The Executive Committee will provide guidance on all major PAIR-T initiatives and will be responsible for maintaining and documenting project schedules, milestones, and human and capital resources. CERF will serve as Secretariat to the PAIR-T Executive Committee.

Critical Technology Elements and Activities

PAIR-T builds on earlier public–private efforts, including the NSTC Committee on Technological Innovation, Construction and Building Subcommittee; HUD's Partnership for Advancing Technologies in Housing; the CERF CONMAT effort, a 10-year, $2 billion strategic research and demonstration initiative; and the CERF Innovation Centers.

In addition to these efforts, PAIR-T will undertake the following activities, which are shown on the accompanying roadmap:

- *Critical Technology R&D:* Among other activities, this will develop methods and materials for improving the durability and extending the life of the transportation infrastructure; expand deployment of mobile nondestructive testing (NDT) and develop new NDT methods and equipment; adapt information technology to collect and analyze data to model infrastructure condition and performance; improve methods for rapid disaster recovery and response; and develop and evaluate uses of sustainable and less environmentally sensitive materials in highway construction. These materials should have fewer negative effects on the environment, both in their manufacture and their subsequent use in construction.

- *Infrastructure and Technology Assessment*: This includes assessing infrastructure repair and replacement needs; reviewing existing standards and procurement processes to permit fast-track approval of new technologies; prequalifying and preapproving innovation to reduce liability; evaluating the use of performance specifications, rather than design specifications, for infrastructure projects; and evaluating the use of life-cycle-cost planning methods and addressing key non-technical barriers.

- *Technology Education and Outreach:* This includes such efforts as providing guidance on infrastructure performance evaluation and methods; publishing manuals and guidance to encourage the adoption of innovative technologies; and developing a national recognition program for State and local governments that use advanced infrastructure technologies, materials, and systems.

- *Consensus Building:* This work will establish consensus-based industry goals and performance standards; leverage existing Federal, State, local, and private initiatives; develop coordinating mechanisms within agencies at all governmental levels; and establish and share databases on infrastructure technologies, performance, and assessment.

Funding Requirement

Funding will be provided from a mix of Federal, State, and local government and private sources. The overall funding requirement has not yet been determined. Federal funding will be determined through the annual budget process.

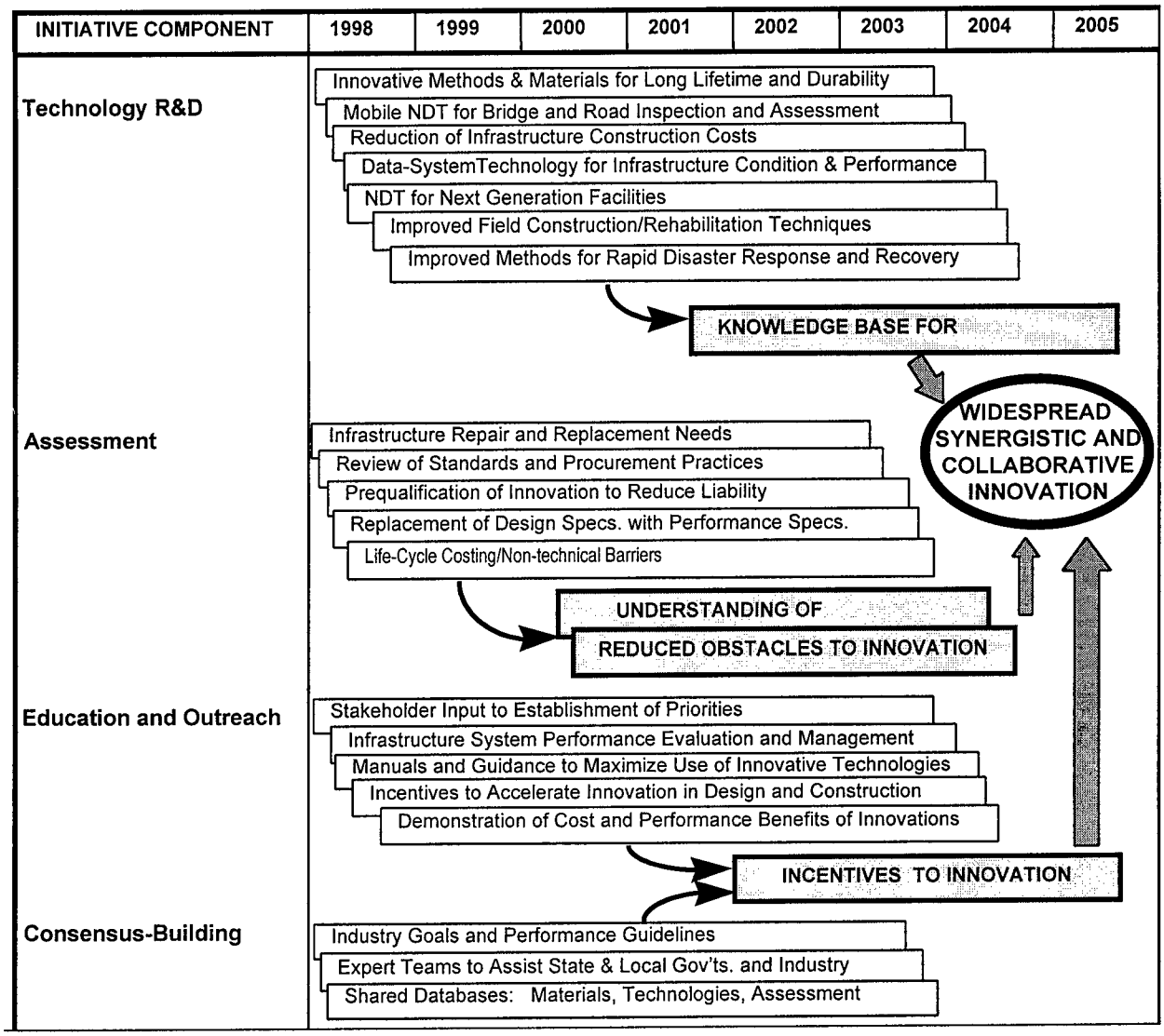
TECHNICAL CHALLENGES AND IMPLEMENTATION ISSUES

This initiative's key implementation issue is overcoming cultural and commitment barriers. As discussed above, the infrastructure sector is highly fragmented, making united action difficult. Moreover, the public works and civil infrastructure community is historically conservative and risk-averse. Only if "market pull" matches the "technology push" can innovations rapidly penetrate and develop market share in the infrastructure construction, materials, and equipment industries.

ACRONYMS

AASHTO	American Association of State Highway and Transportation Officials
CERF	Civil Engineering Research Foundation
CONMAT	High-Performance CONstruction MATerials and Systems Program
DOC	U.S. Department of Commerce
DOD	U.S. Department of Defense
DOT	U.S. Department of Transportation
FAA	Federal Aviation Administration
FHWA	Federal Highway Administration
FRA	Federal Railroad Administration
FTA	Federal Transit Administration
GDP	Gross Domestic Product
HUD	U.S. Department of Housing and Urban Development
MARAD	Maritime Administration
NDT	Nondestructive Testing
NIST	National Institute of Standards and Technology
NSF	National Science Foundation
NSTC	National Science and Technology Council
PAIR	Partnership for the Advancement of Infrastructure and its Renewal
R&D	Research and Development
RSPA	Research and Special Programs Administration
USACE	United States Army Corps of Engineers
USCG	United States Coast Guard

Technology Roadmap for the Monitoring, Maintenance, and Rapid Renewal of the Physical Infrastructure Initiative



8. NATIONAL INTELLIGENT TRANSPORTATION INFRASTRUCTURE

VISION

A truly seamless intermodal surface transportation system that accommodates private, public, and commercial vehicles; permits increasing communication and cooperation between infrastructure and vehicles; and utilizes relevant communication and information technologies to promote access and commerce.

GOALS

Reduce traffic crashes and fatalities; make the most effective use of the existing transportation system; reduce the costs of operating and using the surface transportation system; reduce travel time for all system users; increase productivity and improve customer service for highway and transit users; provide accurate system information to enable more effective transportation planning, operating policies, and pricing/control strategies; and permit experimentation with, and demonstration of, policy-sensitive traffic control strategies.

OUTCOMES

This partnership is central to meeting the following outcomes identified in the DOT *FY 1999 Performance Plan*:

- By 2000, reduce delays on Federal-aid highways to 9 hours of delay per 1,000 vehicle-miles traveled, a decrease of 12 minutes from the 1996 level of 9.2 hours.
- Reduce the rate of highway-related fatalities per 100 million vehicle-miles traveled from 1.7 in 1996 to 1.6 in 2000.
- Reduce the rate of highway-related injuries per 100 million vehicle-miles traveled from 141 in 1996 to 128 in 2000.
- Reduce the rate of rail-related crashes to 3.32 (or fewer) per million train-miles in 2000, as compared to the 1995 baseline of approximately 4 crashes per million train-miles.
- Reduce the rate of rail-related fatalities to 1.54 (or fewer) per million train-miles in 2000, as compared to the 1995 baseline.

- By 2000, reduce the rate of grade-crossing crashes from 2.85 per million train-miles in 1995 to 2.28 (or fewer).

MAGNITUDE OF THE PROBLEM

Surface transportation in the United States faces a number of challenges. Despite the fact that we have one of the best transportation systems in the world, congestion costs an estimated $40 billion a year. Moreover, safety remains a serious problem: traffic crashes result in the loss of 40,000 lives each year and represent a $150 billion financial burden to the economy. Finally, surface transportation safety and efficiency have direct impacts on economic growth, land use, and accessibility to jobs and critical services. The inefficient movement of vehicles, whether private, commercial, or transit, reduces productivity, wastes energy, increases emissions, and threatens the quality of life that we enjoy.

REQUIREMENTS

Intelligent transportation systems (ITS) offer promising solutions to the problems of congestion, highway crashes, and environmental impacts. At their most basic level, ITS apply information technologies to make surface transportation safer and more efficient. However, no single technology "fix" can meet America's growing demand for travel. Although individual ITS products and services have their unique merits, it is important that they be seamlessly integrated to support multimodalism and intermodalism in metropolitan and rural areas and on interstate corridors.

This partnership seeks to deploy an integrated National Intelligent Transportation Infrastructure (NITI) across the United States within the next decade. A communication and information "backbone," the NITI refers to the integrated electronics, communications, and hardware and software elements that will enable ITS products and services to work together to save time and lives, including DOT's Nationwide Differential Global Positioning System. Analogous to the local- and wide-area networks used in many workplaces, the NITI will allow the surface transportation system to be managed as a seamless entity by integrating transportation and management information systems across both modal and jurisdictional lines within a region and, where appropriate, across the country. The NITI also will be a rich source of data for use in transportation planning and demand-management strategies. Partners have configured the initiative to address the needs of three specific types of users:

- The *Metropolitan Intelligent Transportation Infrastructure* will integrate the various NITI components in metropolitan areas of the country.

- The *Commercial Vehicle Operations Infrastructure* will integrate existing information databases to promote safe and efficient freight operations and enable electronic business transactions.

- The *rural initiative* has identified clusters of related technologies to enhance the safety of rural highways and upgrade transportation services in rural communities.

Key NITI components focus on improvements in public transportation. Known collectively as Advanced Public Transit Systems, these elements include Traffic Management, for example, through automated dispatching or automatic vehicle location; Electronic Fare Payment, through use of "smart cards" or other media; and Traveler Information Systems, such as automated kiosks. Another important component, Positive Train Control, will communicate with other NITI elements to ensure positive train separation, enforce speed restrictions, and detect hazards at highway–rail crossings.

Although today travelers across the country are using ITS, no area has all of the NITI components in place, and very few have integrated the components into a regional communication and information platform.

INVESTMENT STRATEGY

Participants

Federal: DOT ITS Joint Program Office, FHWA, FRA, FTA.

Other: State DOTs, Metropolitan Planning Organizations, emergency response and law enforcement agencies, railroads, trucking companies, information systems vendors and manufacturers, ITS Service Centers, other private companies.

Management

DOT's ITS Joint Program Office (JPO) provides strategic leadership for ITS research and deployment support, guides and coordinates the development of ITS program policies, coordinates the ITS program with the various DOT modal administrations, and ensures resource accountability. The JPO receives policy guidance from the ITS Management Council, which is chaired by the DOT Deputy Secretary, and acts as a liaison among the modal administrations that actually carry out the research.

As with all other ITS research and technology programs, this initiative will be coordinated by the JPO and implemented by the modal administrations responsible for its various components, in cooperation with industry and State and local agencies.

Critical Technology Elements and Activities

This partnership is pursuing several activities to support and eliminate barriers to the deployment of an integrated NITI across the country. Related work is being conducted as

part of the Intelligent Vehicle Initiative and the initiative for Enhanced Transportation Weather Services. As shown below, there are six fundamental elements of this strategy:

- *Showcase NITI Benefits:* This initiative will demonstrate the benefits of integrated regional travel management and travel information systems at four sites: Seattle, Phoenix, San Antonio, and New York City. Similarly, it will showcase seven commercial vehicle deployments initiated in 1996 in California, Colorado, Connecticut, Kentucky, Michigan, Minnesota, and Washington/Oregon.

- *Create Funding Incentives for NITI Technologies:* TEA-21 includes an incentive funding program targeted at the integration of ITS functions in metropolitan areas, rural communities, and commercial vehicle operations. The program calls for a 50 percent match by the local authority or private partner.

- *Build Professional Capacity:* Because there are not enough professionals with the skills necessary to support the effective delivery of ITS services, professional capacity building is crucial to establishing an NITI. Under this initiative, partners will develop and present a number of workshops and seminars across the country.

- *Provide Technical Assistance:* Partners in this initiative are supporting ITS implementation among State and local authorities through guidance and documentation on project planning, technology procurements, enabling technologies, and innovative financing.

- *Accelerate Standards Development:* Completed in 1996, the National ITS Architecture defines those areas in which standards would promote ITS interoperability and integration. Based on these requirements, and working closely with users and manufacturers, DOT initiated a program to accelerate standards setting, resulting in 50 new standards in 1997 and several others to be developed over the next 3 years.

- *Establish Conformity Criteria for Architecture and Standards:* A key effort will be to identify criteria that will enable localities to ensure that their regional frameworks conform to the National ITS Architecture and agreed-upon standards.

Funding Requirement

FY 1998 Federal funding is $135 million. Future funding will be provided from a mix of Federal, State, and local government and private sources. Federal funding will be determined through the annual budget process.

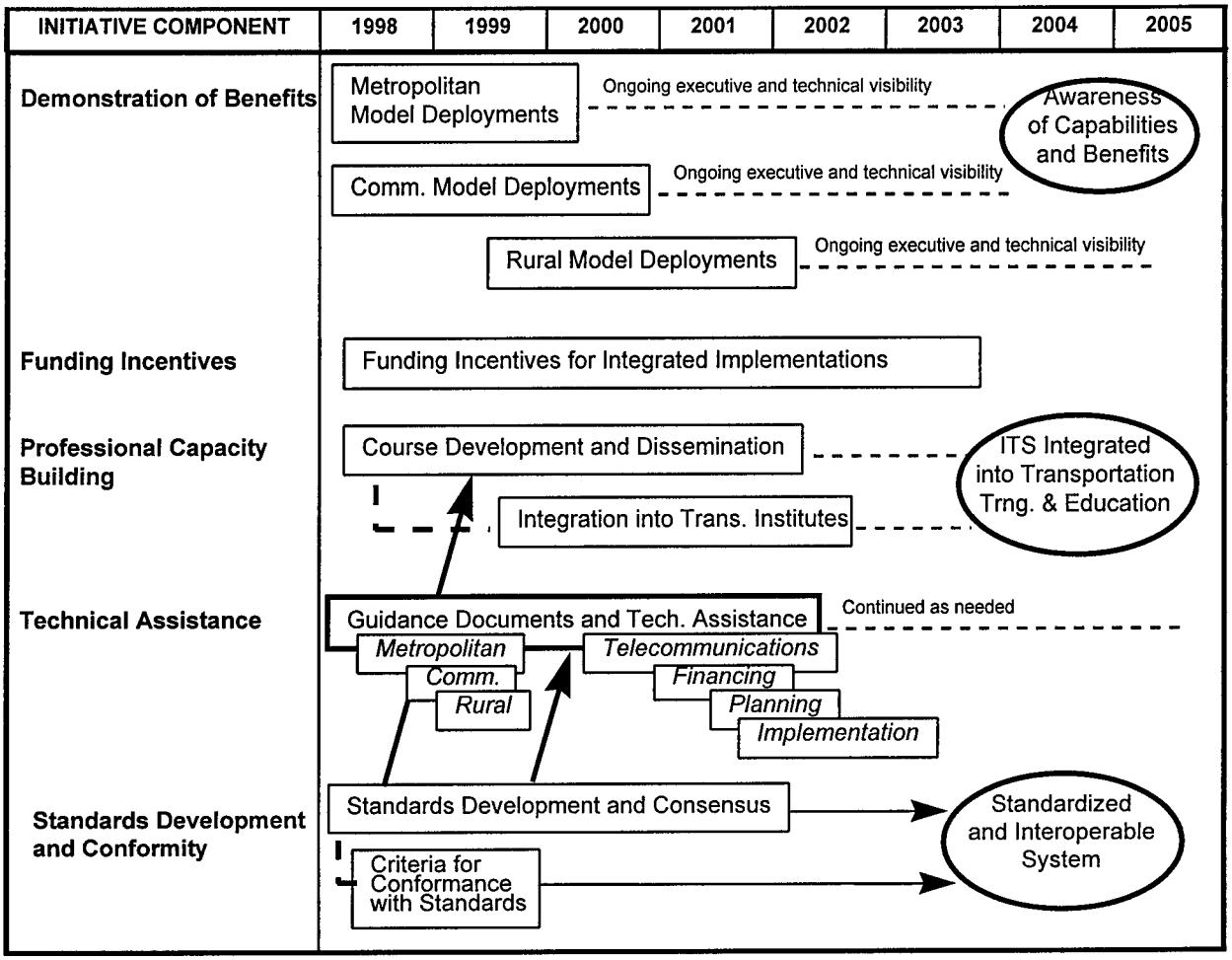
TECHNICAL CHALLENGES AND IMPLEMENTATION ISSUES

Achieving this initiative's goals requires that multiple decision makers and organizations, at multiple levels, coordinate and share a common vision. Yet, a number of different agencies build and operate highways, streets, and transit systems, and still others are responsible for emergency response, law enforcement, and other functions. In particular, each State government has multiple agencies that regulate various aspects of commercial vehicle operations, with little or no coordination among these agencies.

ACRONYMS

DOT	U.S. Department of Transportation
FHWA	Federal Highway Administration
FRA	Federal Railroad Administration
FTA	Federal Transit Administration
FY	Fiscal Year
ITS	Intelligent Transportation Systems
JPO	ITS Joint Program Office
NITI	National Intelligent Transportation Infrastructure
TEA-21	Transportation Equity Act for the 21st Century

Technology Roadmap for the National Intelligent Transportation Infrastructure Initiative



9. NEXT GENERATION GLOBAL AIR TRANSPORTATION

VISION

A safer, more efficient, environmentally compatible, and sustainable airspace system that meets future needs for global air transportation.

GOAL

Achieve a global air transportation system that supports "free flight" and similar concepts and that 1) assures the most effective use of present and future air system capacity and 2) assures that system capacity is devoted to meeting the highest priority needs for it.

OUTCOMES

Among the outcomes for which this partnership is critical are the following identified in the DOT *FY 1999 Performance Plan*:

- By 2000, reduce the rate of air travel delays by 20 percent from a 1994 baseline of 168.5 delays per 100,000 operations.
- By 2000, increase the number of flights flown off preferred routes to 80 percent from a 1996 baseline of 73 percent.
- Maintain runway incursions at a level 15 percent below the 1997 baseline of 318 incursions by 2000.

MAGNITUDE OF THE PROBLEM

Many factors will challenge our ability to operate the National Airspace System (NAS) safely and efficiently. For one, the FAA expects that world revenue passenger miles will increase by 64 percent between 1997 and 2008. To meet this demand, airlines will increase the hours flown by their large aircraft, by as much as 52 percent. In fact, the use of larger and heavier aircraft to accommodate demand will help to increase airlines' inventories of aircraft by 50 percent.

REQUIREMENTS

Air transportation is essential to the Nation's economic well being. Since 1960, the U.S. gross domestic product has grown 14-fold and U.S. exports 30-fold. Today, American exports total more than $580 billion a year. Such growth is made possible largely by

safe, reliable, and consistent air transportation. In this era of global economies, air transportation helps make it possible to move quickly millions of people and billions of dollars of goods to markets around the world. The challenge today is to keep ahead of this growth in globalization by getting people and freight anywhere in the world safely, efficiently, and at a reasonable cost.

Anticipating the future growth in air traffic, this partnership includes the Flight 2000 program, a precursor of free flight. It also embodies the research in the FAA/NASA *Integrated Plan for Air Traffic Management Research and Technology Development*, which, when combined with other initiatives (such as those under way for communications, navigation, and surveillance (CNS); human factors; and next generation weather concepts) will satisfy the future needs of the aviation community. "Free flight" refers to an airspace system that greatly increases user flexibility to plan and fly preferred routes, saving both fuel and time and affording more efficient use of airspace. Indicators suggest that free flight will yield significant benefits to system users by 1) removing constraints and restrictions on flight operations; 2) improving the exchange of information and collaborative decision making among users and air traffic managers; and 3) providing tools and models to aid air traffic service providers.

Undertaken in cooperation with the aviation industry, this partnership initiative will develop the CNS and air traffic management (ATM) systems required to make free flight a reality. Such systems would allow air traffic service providers to manage resources strategically, in conjunction with system users, to achieve maximum safety and efficiency.

INVESTMENT STRATEGY

Participants

Federal: FAA and NASA; also DOD, NWS, USCG.

Other: Airlines, aircraft and avionics industries, academia, International Civil Aviation Organization.

Management

A Memorandum of Understanding (MOU) between the FAA and NASA provides the formal management structure for the ATM portion of this initiative. To implement this MOU, the agencies have established an Interagency Air Traffic Management Integrated Product Team (IAIPT), which is responsible for strategically managing the research efforts and developing the *Integrated Plan for Air Traffic Management Research and Technology Development*. The IAIPT comprises both an Interagency Integrated Management Team and Area Work Teams. Rather than manage individual agency programs directly, the IAIPT assures an overall collaborative effort capitalizing on the resources and strengths of both the FAA and NASA.

The FAA's Flight 2000 Initial Program Plan governs the planning and execution of the Flight 2000 program. NASA participates in this effort through its membership in the Flight 2000 Steering Group and the Radio Technical Commission for Aeronautics Board of Directors' Select Committee on Free Flight.

This initiative also will continue existing efforts such as NASA's Advanced General Aviation Technology Experiments (AGATE) Program, a partnership among industry, government, and academia to create the technological basis necessary to revitalize the U.S. general aviation industry.

Critical Technology Elements and Activities

This initiative comprises the following major technology elements and activities, illustrated in the roadmap below:

- *Technology Integration:* At its most basic level, "Flight 2000" refers to the integration of a variety of technologies that provide critical air traffic information: state-of-the-art digital communications, automated decision-making tools for air traffic control (ATC) and flight planning, automatic dependent surveillance, navigation satellites, weather information processors, and cockpit displays for all phases of flight.

- *Demonstration of Operational Capabilities:* This activity essentially transfers the free flight concept to an operational setting prior to full deployment. In 2002, free flight capabilities will be demonstrated in a controlled environment and a variety of weather conditions and terrain.

- *Evaluation and Validation:* Based upon the results of the operational demonstrations in Alaska and the Ohio Valley, this activity will either validate the Flight 2000 concept for full system implementation or identify necessary changes to the proposed technologies, supporting methodologies, or functional capabilities.

As mentioned above, these activities are coordinated with and closely related to those conducted as part of the Aviation Safety Research Alliance.

Funding Requirement

FY 1998 Federal funding for IAIPT efforts is $105.6 million (FAA, $69.8 million; NASA, $35.8 million). Future funding will be provided from a mix of Federal, State, and local government and private sources. The overall funding requirement for this initiative has not yet been determined. Federal funding will be determined through the annual budget process.

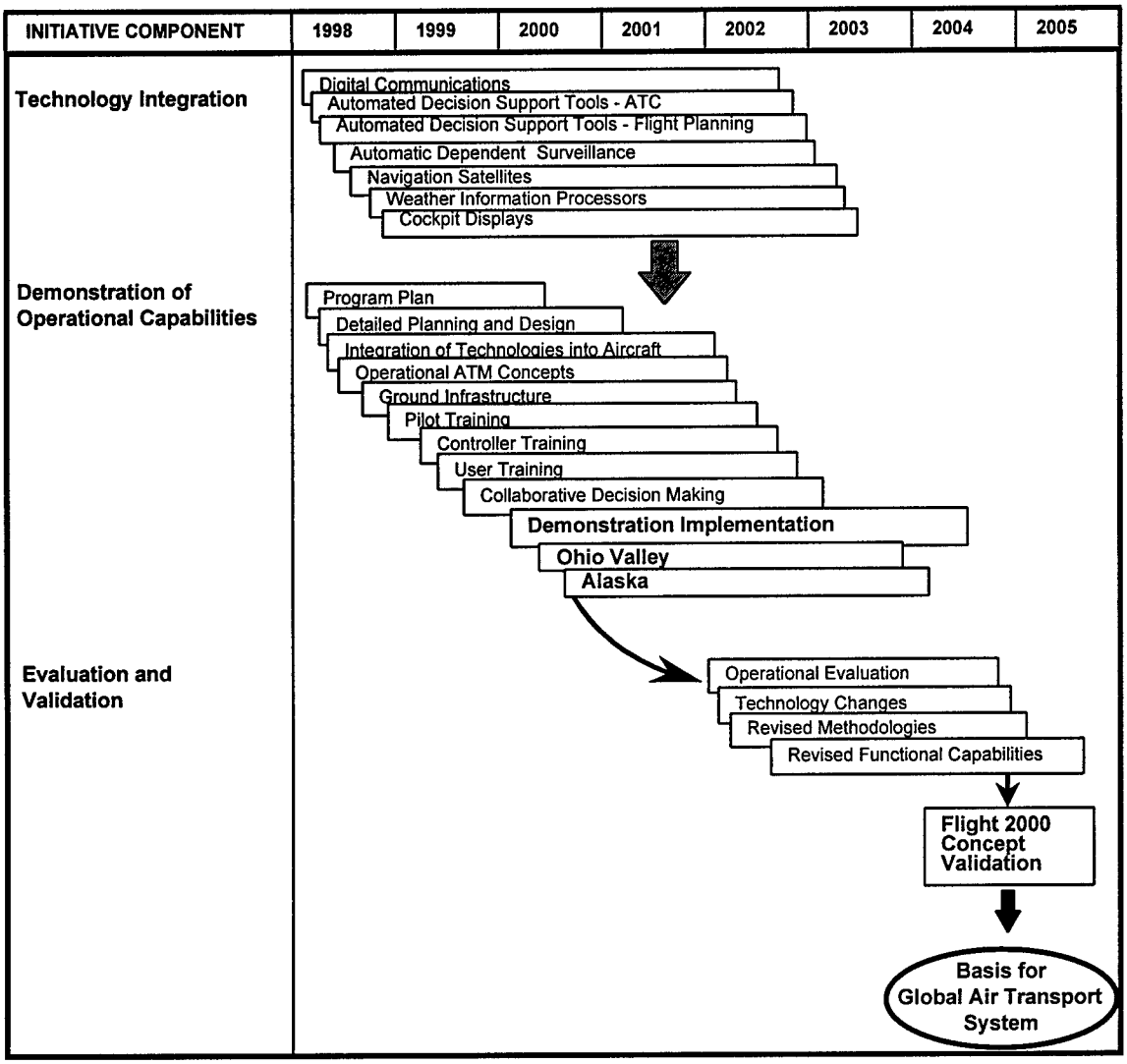
TECHNICAL CHALLENGES AND IMPLEMENTATION ISSUES

For this initiative, the principal technical challenge is coordinating implementation and deployment schedules for NASA's programs and the FAA's overall NAS architecture.

ACRONYMS

AGATE	Advanced General Aviation Technology Experiments
ATC	Air Traffic Control
ATM	Air Traffic Management
CNS	Communication, Navigation, and Surveillance
DOD	U.S. Department of Defense
FAA	Federal Aviation Administration
FY	Fiscal Year
IAIPT	Interagency Air Traffic Management Integrated Product Team
MOU	Memorandum of Understanding
NAS	National Airspace System
NASA	National Aeronautics and Space Administration
NWS	National Weather Service
USCG	United States Coast Guard

Technology Roadmap for the Next Generation Global Air Transportation Initiative



10. NEXT GENERATION SURFACE AND MARINE TRANSPORTATION VEHICLES

VISION

A far more sustainable transportation system with fewer harmful environmental impacts and reduced dependence on fossil fuels.

GOAL

Develop internationally competitive, domestically produced motor vehicles and ships that achieve unprecedented gains in fuel efficiency and in both environmental and operational performance.

OUTCOMES

Among the outcomes to which this partnership will contribute are the following, the first of which is from the DOT *FY 1999 Performance Plan*:

- Reduce on-road mobile source emissions by 2 percent from 1999 to 2000, or a target of 62.7 million tons as compared to the 1996 baseline of 65.9 million tons.

- Develop a production prototype midsize sedan that achieves up to three times the fuel efficiency of comparable 1994 models, while maintaining performance, size, utility, and cost of ownership and operation and meeting or exceeding Federal safety and emissions requirements.

- Develop prototype light trucks, sport utility vehicles, and medium- and heavy-duty vehicles with dramatically improved fuel efficiency (target to be determined).

MAGNITUDE OF THE PROBLEM

As the world's reliance on motor vehicles has grown, so have concerns about concomitant increases in petroleum consumption, carbon emissions, and air pollution. Here in the United States, transportation consumes two-thirds of all petroleum used and produces one-third of greenhouse gases. The U.S. relies on petroleum to provide more than 95 percent of the energy required for transportation. Some researchers estimate that even a brief supply curtailment (i.e., two years) could drain as much as $500 billion from the economy. Yet another problem associated with motor vehicles is urban air quality. Although many U.S. cities have seen recent air-quality improvements, vehicular emissions of ozone precursors and fine particles continue to create health problems. Today as many as 120 million U.S. residents live in areas with unhealthy air.

REQUIREMENTS

Addressing the problems of petroleum dependence, global warming, and air pollution requires significant advances in transportation vehicle technology. This partnership responds to this need through research leading to the development of highway vehicles, locomotives, and ships that are better designed, more efficient, and less polluting.

Highway Vehicles: This effort will continue the Partnership for a New Generation of Vehicles (PNGV) and Advanced Technology Transit Bus (ATTB) activities and supplement them by also focusing on dramatic improvements in medium- and heavy-duty-vehicle fuel efficiency.

In 1993, the Clinton Administration joined in a historic partnership with the automobile industry, the PNGV, to establish global technical leadership in the development and production of affordable, fuel-efficient, and low-emission automobiles that meet today's safety and performance standards. However, while automobiles account for 40 percent of the Nation's highway transportation energy demand, trucks of all classes account for the rest. Since the oil embargo in 1973, essentially all of the increase in highway transportation energy use has been due to trucks, for two reasons: 1) the increase in demand for freight transport (provided by medium- and heavy-duty trucks) as the Nation's economy and gross domestic product have grown; and 2) the increase in popularity for personal transport of light-duty trucks such as pickups, vans, and sport utility vehicles, which weigh more than a comparable automobile and need bigger engines (200–250 horsepower).

DOE's work in clean diesel technologies is designed to slow the tremendous increase in fuel demand associated with the Nation's growing reliance on all types of trucks. For heavy- and medium-duty trucks, these efforts aim to make diesel engines more fuel-efficient, less polluting, and able to use other suitable fuels. DOE research for light-duty trucks, conducted under 50 percent cost-shared cooperative agreements with U.S. diesel engine manufacturers and automakers, focuses on development of technologies for low-emission diesel engines that can replace gasoline engines in these vehicles. This approach would result in reduced greenhouse gas emissions without adverse economic impacts, given that the infrastructure for manufacturing and servicing the engine, as well as for refueling, is already in place.

In recent years, the FTA has worked in collaboration with the transit industry, DARPA, and DOE to develop a prototype ATTB. This bus uses lightweight composite materials and an electric drivetrain to achieve a four-to-five–ton reduction in curb weight, low emissions, and reduced fuel consumption. Moreover, a proposed DOT/DOE Joint Partnership for Advanced Vehicles, Components, and Infrastructure—the Advanced Vehicle Program (AVP)—would develop and demonstrate a range of technologies for medium- and heavy-duty vehicles to reduce energy intensity and emissions and to improve industry competitiveness.

Locomotives: Applications in the U.S. for high-speed trains require a non-electric high-acceleration locomotive. Although most high-speed technology uses electric propulsion, virtually the only portion of the U.S. rail system currently electrified is the Northeast Corridor—and the cost of electrification is daunting. This initiative will support the development, test, and demonstration of non-electric high-speed rail (HSR) technology to establish a technological context in which State and local governments and private industry can proceed to implement new rail services.

Ships: The President's shipbuilding revitalization program includes an R&D element, MARITECH, that focuses on advanced ship designs and shipyard modernization. Additional research needs to address not only ship structure, but also ship systems. This initiative will demonstrate a commitment to improved fuel efficiency and environmental performance through reduced fuel consumption, pollutant emissions, volume and toxicity of waste, and life-cycle cost. An aggressive program to demonstrate and develop the marine application of fuel cells has led to a partnership among the Departments of Transportation, Defense, Commerce, and Energy. The program's purpose is to develop fuel-cell technology for wider use in the government fleet and to transfer this technology to the private sector. Addressing the unique challenges of the marine environment, this initiative builds on existing efforts of DOE, DOD, and industry to develop fuel-cell technology for stationary shore-side power and land-vehicle propulsion.

INVESTMENT STRATEGY

Participants

Federal: DOT (FHWA, FRA, FTA, MARAD, USCG); DOD (U.S. Army, U.S. Navy, DARPA); DOC; DOE; EPA; NSF.

Other: Vehicle, engine, and fuel-cell manufacturers; fuel producers; component suppliers; developers of fuel cells and other new energy-conversion technologies; shipyards; State and local authorities; universities.

Management

The management structure for this partnership initiative remains to be determined.

Critical Technology Elements and Activities

This initiative comprises vehicle research and technology in the following areas:

- *PNGV/Light Truck Clean Diesel Program/AVP:* This research will apply the technologies and concepts developed under the PNGV, Light Truck Clean Diesel Program, and AVP to improve dramatically the fuel efficiency of automobiles and light-, medium-, and heavy-duty trucks while maintaining safety and performance. Activities will address lightweight materials, crashworthiness, energy conversion and storage, emission control, and advanced manufacturing technologies.

- *Advanced Buses*: This effort is developing and fostering the commercialization of low- and zero-emission transit buses. Work includes completing development of a fuel-cell bus propulsion system, developing a 40-foot fuel-cell bus, research on the safe handling of fuel for fuel cells, and accelerated demonstration of all-electric and hybrid-electric transit bus technologies.

- *Next Generation High-Speed Rail*: This program is developing and validating cost-effective high-speed (125–150 miles per hour) passenger rail technology that operates on existing infrastructure. A principal objective is to make proven high-speed technologies available for implementation by the year 2000. Specific activities include demonstrating the operating and maintenance characteristics of non-electric locomotive designs, demonstrating the operability of flywheel energy storage, and testing active locomotive noise control.

- *Ship Building and Ship Structure*: This activity, part of the MARITECH program, is developing improvements in commercial ship design and in shipyard facilities, processes, and procedures. A related effort, the Ship Structure Cooperative Research Program, investigates ship structural problems, pursues new technology, and develops innovative structural design, analysis, and fabrication techniques.

- *Marine Application of Fuel Cells:* This effort is developing, testing, and installing affordable, highly efficient, low- or zero-emission shipboard fuel-cell power and propulsion systems. The first phase will develop and test a conceptual design and components for a fuel-cell power plant capable of operating on naval distillate (diesel) fuel. Phase 2 will design and build a reduced-scale fuel-cell power plant and perform land-based tests. The final phase will demonstrate the diesel-fed fuel cell in a marine environment.

Funding Requirement

Funding will be provided from a mix of Federal, State, and local government and private sources. The overall funding requirement has not yet been determined. Federal funding will be determined through the annual budget process.

TECHNICAL CHALLENGES AND IMPLEMENTATION ISSUES

For the PNGV, the most formidable goal is to develop a new class of automobiles that achieves a tripling in fuel economy without a penalty in emissions, performance, utility, or life-cycle cost. Technical challenges to achieving this goal could affect nearly every aspect of automobile design and construction. Although these challenges can be traded off against one another through a balanced approach that also addresses fuel and fuel quality, three broad issues appear prominent at this time: 1) dramatic reduction in body and chassis mass, while meeting safety standards; 2) dramatic increase in energy-conversion efficiency, while meeting emissions standards; and 3) recovery of kinetic energy normally lost during braking, while meeting cost targets.

The most critical challenge for diesel engine technologies for all types of trucks and automobiles is meeting increasingly stringent emission standards. Results from single-cylinder diesel engine tests indicate that, indeed, very low emissions are technically feasible. Arriving at the most cost-effective and workable emissions-control strategy, however, requires a three-pronged systems approach: 1) understanding the effects of fuel composition and properties on engine performance and emissions; 2) improved understanding of the combustion process to better control emissions formation inside the cylinder; and 3) innovative exhaust after-treatment techniques to further clean up what comes out of the engine.

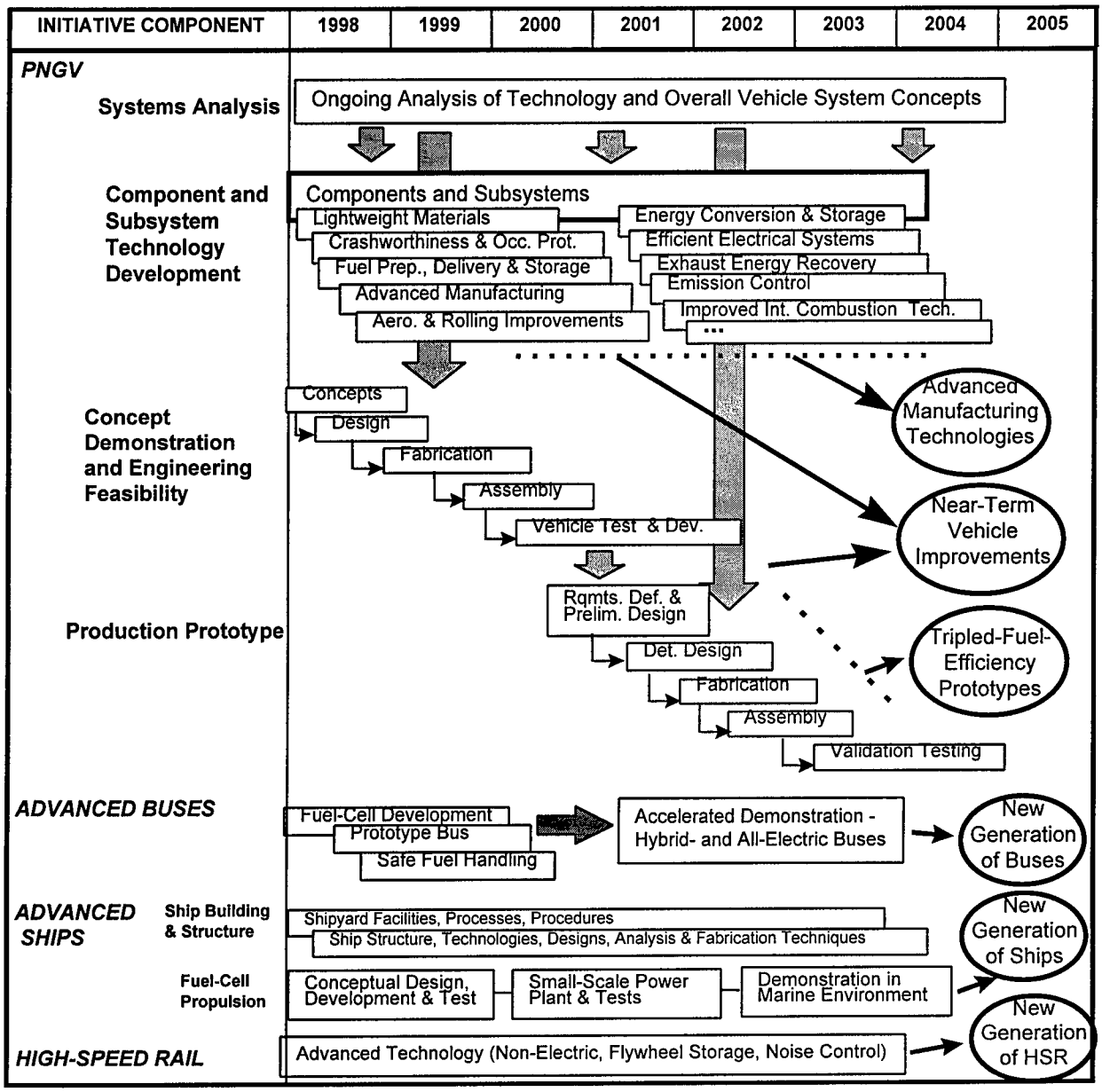
Beyond the technical challenges, there are many other issues that may ultimately be important as next generation automobiles, trucks, and buses are deployed. In all cases, the consideration of options for the use of accumulated investments in both physical infrastructure and trained workers and vehicle users will be important. Among the specific challenges are 1) the supply of alternative raw materials and the infrastructure needed to produce finished materials at commercially viable costs; 2) the motor vehicle industry structure and the capital, labor, and energy required to manufacture components and assemble vehicles; and 3) consumer acceptance of the new vehicles.

For next generation rail and ships, affordability is a primary issue. A key goal of high-speed locomotive research is to reduce the per-mile infrastructure upgrade costs from about $10 million to $2 to $3 million. In the marine fuel-cell program, affordability is stressed by addressing the costs associated with ship design, fabrication, outfitting, maintenance, and operation, and by using commercial technology wherever possible.

ACRONYMS

ATTB	Advanced Technology Transit Bus
AVP	Advanced Vehicle Program
DARPA	Defense Advanced Research Projects Agency
DOC	U.S. Department of Commerce
DOD	U.S. Department of Defense
DOE	U.S. Department of Energy
DOT	U.S. Department of Transportation
EPA	U.S. Environmental Protection Agency
FHWA	Federal Highway Administration
FRA	Federal Railroad Administration
FTA	Federal Transit Administration
HSR	High-Speed Rail
MARAD	Maritime Administration
NSF	National Science Foundation
PNGV	Partnership for a New Generation of Vehicles
R&D	Research and Development
USCG	United States Coast Guard

Technology Roadmap for the Next Generation Surface and Marine Transportation Vehicles Initiative



11. TOTAL TERMINAL SECURITY

VISION

Passenger and freight transportation terminals that are secure from acts of terrorism and crime.

GOAL

Develop a comprehensive approach to assessing security threats at transportation terminals and to implementing integrated security technologies and procedures tailored to these threats.

OUTCOMES

Among the outcomes to which this partnership will contribute are the following from the DOT *FY 1999 Performance Plan*:

- Improve the detection of simulated, improvised explosive devices and weapons from the 1998 baseline.

- Reduce the percentage of infrastructure assessed as unsatisfactory in a sample of key components and facilities.

MAGNITUDE OF THE PROBLEM

Recent events in the United States and in other parts of the world have focused considerable attention on the potential occurrence of major incidents of public terrorism. In our own country, such incidents have included the bombings of the World Trade Center in New York City, the Federal Building in Oklahoma City, and the Olympic Park in Atlanta. Throughout the rest of the world there have been bombings and chemical weapon attacks in Japan, Europe, the Middle East, South America, and, most recently, in Africa. The high level of concern about terrorism is reflected in the President's creation of a Presidential Commission on Critical Infrastructure Protection and a White House Commission on Aviation Safety and Security.

Historically, transportation is among the most visible and frequent targets of terrorist attacks, and recent terrorist incidents have reinforced that observation. Yet another security concern in transportation is cargo theft. Estimates place the losses resulting from such theft at over $13 billion a year.

REQUIREMENTS

Assessing the potential threat to transportation facilities and the range of measures that can be taken to guard against them requires the participation and assent of all organizations, both public and private, involved in transportation operations and oversight. This includes numerous Federal agencies with transportation, law enforcement, and threat-analysis responsibilities, as well as their State and local counterparts; transit and port authorities; and private transportation providers.

This partnership's focus is on developing and implementing means of improving the overall security of passenger and freight terminals, as well as of the people and cargo transiting those locations. In this regard, the initiative will address at a minimum the following topics:

- Physical security of terminals.
- Security of vital communication and information systems that service these terminals.
- Development and dissemination of information about security incidents, as well as assessments of the potential threats to transportation facilities and operators.

In particular, this partnership addresses three key recommendations of the White House Commission on Aviation Safety and Security: 1) develop a comprehensive plan with industry to address the threat of explosives and other objects in luggage or cargo; 2) establish a security system that provides a high level of protection for aviation information systems; and 3) assess the possible use of chemical and biological weapons as tools of terrorism.

INVESTMENT STRATEGY

Participants

Federal: DOT (Secretary's Office of Intelligence and Security, FAA, FHWA, FRA, FTA, ITS Joint Program Office, MARAD, USCG); DOD; DOJ (FBI, INS, NIJ); Treasury (U.S. Customs).

Other: State and local law enforcement agencies; port and airport authorities; transportation service providers (airlines, bus lines, transit agencies, trucking companies, ship lines, railroads, parcel and freight companies).

Management

Participants will undertake this initiative under the overall guidance of the NSTC, with each providing resources and support as required. In the case of freight terminals, the executive staff of the National Cargo Security Council has offered to collaborate closely with the initiative's partners.

Critical Technology Elements and Activities

This initiative will undertake the following activities, as illustrated in the accompanying technology roadmap:

- *Transportation Community Awareness and Understanding:* This includes 1) outreach events on topics related to passenger and freight security and 2) an ongoing program of system-level vulnerability assessments at major transportation terminals (air, rail, transit, port).

- *Identification of Best Practices:* This activity will assess a number of operational concepts and designs for an integrated security approach, document those that have proven to be the most effective, and identify where further technological or procedural improvements are needed.

- *Identify Key Technologies and Research Needs:* This effort will characterize the security technologies currently available, identify their potential application in an integrated security approach, and determine where further technology development is required.

Funding Requirement

Funding will be provided from a mix of Federal, State, and local government and private sources. The overall funding requirement has not yet been determined. Federal funding will be determined through the annual budget process.

TECHNICAL CHALLENGES AND IMPLEMENTATION ISSUES

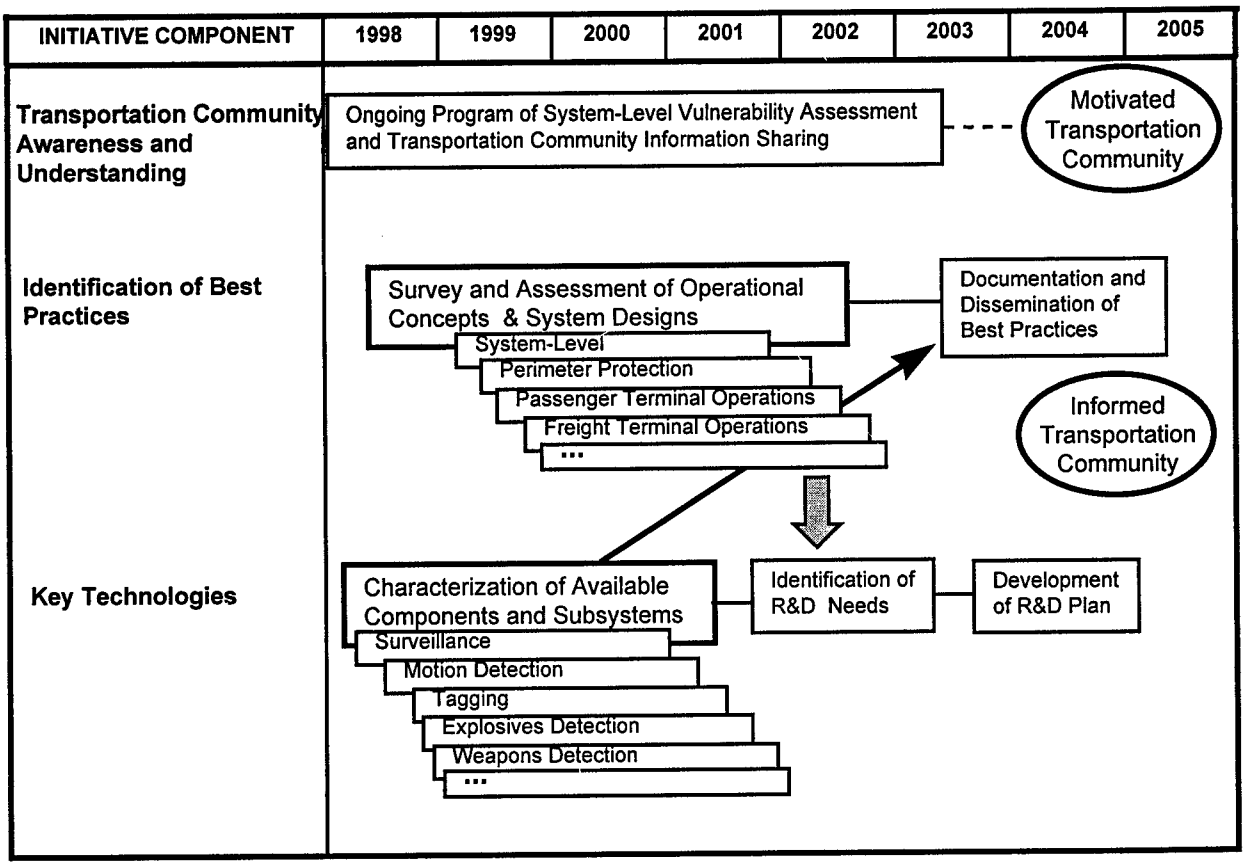
One of the most interesting technical challenges for this partnership will be determining the best means of successfully implementing countermeasures originally developed for one mode or environment—for example, airports—in another mode or environment with different characteristics, operational procedures, and resource levels.

Moreover, a major non-technical issue is that transportation operations require the effective cooperation of a variety of institutions, some of which have differing or even conflicting perspectives and goals. Any major security feature must achieve at least the consent of these varying organizations to be successfully implemented.

ACRONYMS

DOD	U.S. Department of Defense
DOJ	U.S. Department of Justice
DOT	U.S. Department of Transportation
FAA	Federal Aviation Administration
FBI	Federal Bureau of Investigation
FHWA	Federal Highway Administration
FRA	Federal Railroad Administration
FTA	Federal Transit Administration
INS	Immigration and Naturalization Service
ITS	Intelligent Transportation Systems
MARAD	Maritime Administration
NIJ	National Institute of Justice
NSTC	National Science and Technology Council
R&D	Research and Development
USCG	United States Coast Guard

Technology Roadmap for the Total Terminal Security Initiative



12. TRANSPORTATION AND SUSTAINABLE COMMUNITIES

VISION

A transportation system that meets the needs for mobility and accessibility while balancing the current and long-term goals of economic growth, environmental quality, and social equity.

GOALS

Integrate and coordinate existing research agendas to minimize duplication and research gaps while optimizing support for a sustainable transportation system; develop improved technical tools and models to analyze the impacts of transportation activities on both the natural and the social environment.

OUTCOMES

"Sustainability" may be considered a matter of degree, or as movement along a continuum, with various measures used to assess progress. Among the outcomes to which this initiative will contribute are the following stated in the DOT *FY 1999 Performance Plan*:

- Reduce on-road mobile source emissions by 2 percent from 1999 to 2000, or a target of 62.7 million tons as compared to the 1996 baseline of 65.9 million tons.

- Improve the livability of communities by increasing to 26 percent, from the 1996 baseline, the number of people within .25 miles of transit with service frequency of 15 minutes or less by 2000.

- Minimize the adverse impacts of transportation projects on wetlands and, where impacts are unavoidable, replace 1.5 acres of wetlands for every 1 acre affected.

- By 2000, reduce the rate of oil spilled into the water by maritime sources to 4.83 gallons per million gallons shipped, as compared to a 1998 baseline of 5.25 gallons.

MAGNITUDE OF THE PROBLEM

Transportation is vital to our economy and our society. It supports economic development through the movement of goods and through access to jobs, services, and other activities. However, as we approach the 21st century, concerns have mounted about

how to meet increasing demands for access and mobility, capacity of the current transportation infrastructure, environmental quality, and social equity.

The negative effects of transportation activities, and the development patterns they support, include contribution to greenhouse gases and global warming, congestion, air and water pollution, inefficient land use, unequal access to transportation, and ecosystem fragmentation. Specifically:

- Transportation accounts for as much as a third of U.S. greenhouse gas emissions.
- After bottoming out in 2010 at levels about 30 percent lower than in 1990, nitrogen oxide emissions in the Northeast Ozone Transport Region will reverse course and begin climbing through 2015 and beyond, unless new technologies can keep pace.
- Congestion costs are $6.6 billion in New York City and $7.7 billion in Los Angeles, where it would require 665 new lane miles of highway annually just to maintain current mobility.
- Welfare reform may move 1 to 2 million people into the work force; only 6 percent of recipients own autos, and in many urban areas, transit does not reach most of the potential jobs.

These and related concerns are of vital importance to regional, national, and international environmental policy.

REQUIREMENTS

Despite widespread recognition of the concerns listed above, there is a lack of understanding of how best to balance the often conflicting goals of economic growth, environmental quality, and sustainability. This initiative's key focus is exploring how sustainable transportation and land use can contribute to this balance.

As acknowledged above, transportation systems interact with other built, social, and natural systems, and thus have broad impacts on sustainability. This initiative looks at the interrelationships between transportation decisions—including policies, investments, and strategies—and development. These relationships produce environmental, social equity, and economic outcomes, sometimes characterized as the "Three E's." Transportation can be considered "sustainable" to the extent that it contributes to improved economic opportunity, social equity, public health, and environmental quality.

Federal agencies contribute to sustainable communities through several means, including:

- Expanding understanding of both the positive and negative consequences of transportation choices.
- Facilitating development of effective regional entities that can guide investment in transportation and other infrastructure.
- Developing better forecasting, planning, and impact assessment tools for use by regional bodies and localities.
- Continuing environmentally beneficial technology research.
- Supporting development, demonstration, and evaluation of sustainable community and transportation initiatives.

This partnership will further the efforts of Federal agencies to work with each other and with other levels of government and the private sector to contribute to sustainability.

INVESTMENT STRATEGY

Participants

Federal: DOE; DOT (BTS, FAA, FHWA, FRA, FTA); EPA; HHS (CDC); HUD; Interior (National Parks Service); OMB; U.S. Army Corps of Engineers.

Other: State and local transportation/environmental agencies and organizations; public health agencies; Metropolitan Planning Organizations; mayoral offices; environmental advocates; environmental technology manufacturers and vendors; transportation system design, engineering, and construction firms; materials manufacturers; vehicle and fuel manufacturers; universities.

Management

The Federal partners in this initiative will jointly manage its activities, with overall direction from the NSTC and guidance from the non-Federal participants.

Critical Technology Elements and Activities

This initiative encompasses a broad range of research and technology development:

- *Improved Awareness and Understanding of Sustainable Transportation:* This activity will further dialog among Federal, State, and local agencies; the private sector; environmental and other advocacy groups; and, ultimately, the public, on the national policy implications and choices relating to transportation and sustainable communities.

- *Behavioral, Social, and Institutional Factors:* This activity seeks to 1) explicate the complex relationships among transportation planning, land use, and social equity and 2) develop model institutional approaches for cooperative decision making and regional transportation and land-use planning.

- *Implementation Issues for Next Generation Vehicles and Fuels:* Addressing the critical role of alternative fuels and vehicles in making transportation more sustainable, this activity involves analysis of 1) the implications of new vehicles and fuels for the transportation infrastructure and the economy; 2) the different evolutionary pathways in moving toward an alternative vehicle/fuel system; and 3) the broader role of petroleum alternatives in achieving sustainability.

- *Information Technology and Sustainable Transportation:* This looks at the implications of information technologies for sustainability, such as whether they result in major changes in travel demand and patterns. It also addresses how such technologies could promote sustainability, for example, by increasing the productivity of transit systems; facilitating congestion pricing; affording better methods for transportation and environmental planning; or enabling intelligent vehicle applications, such as electronic speed-control systems, that regulate vehicle speeds in residential areas and pedestrian activity centers.

- *Improved Analytical Tools and Indicators:* This activity will develop better tools for understanding the complex relationships between transportation systems and land use and development strategies—including improved data, performance measures, and a new generation of analytical models.

- *Aviation and Sustainability:* Efforts in this area will examine the environmental impacts of continued growth in aviation, including the implications of introducing "free flight"; policy options for managing this growth; and competitive intermodal options for intercity transportation.

Funding Requirement

Funding will be provided from a mix of Federal, State, and local government and private sources. The overall funding requirement has not yet been determined. Federal funding will be determined through the annual budget process.

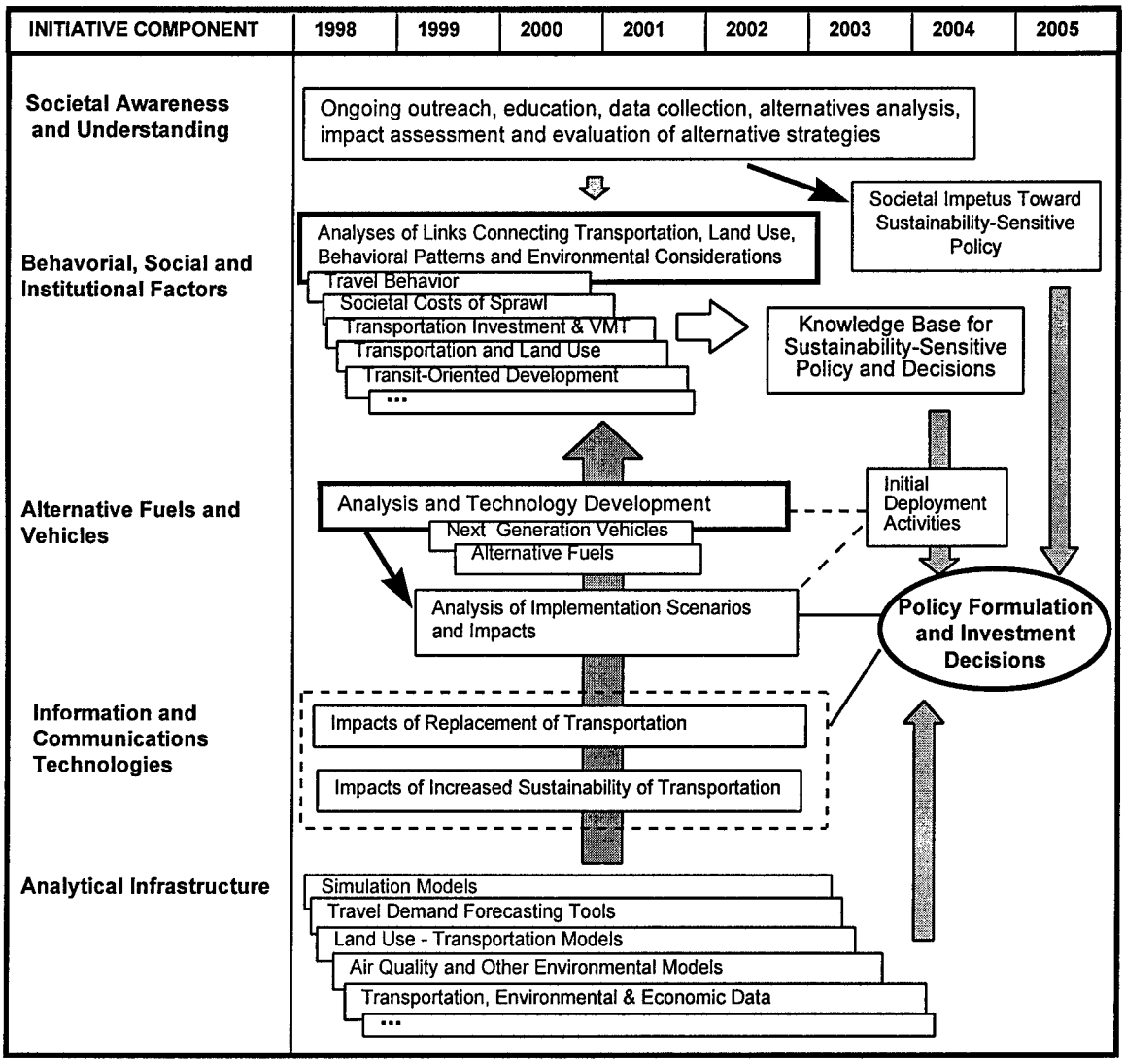
TECHNICAL CHALLENGES AND IMPLEMENTATION ISSUES

As discussed above, "sustainability" is a matter of degree, with progress measured by outcomes ranging from reduced greenhouse gases to better access to jobs. Thus, the greatest challenge for decision makers at all levels is to achieve a balance among preferred sustainability outcomes, some of which may be in competition. For this initiative, the choice of outcomes and measures will be evolutionary and will continue to be refined by participating agencies and key stakeholders.

ACRONYMS

BTS	Bureau of Transportation Statistics
CDC	Centers for Disease Control
DOE	U.S. Department of Energy
DOT	U.S. Department of Transportation
EPA	U.S. Environmental Protection Agency
FAA	Federal Aviation Administration
FHWA	Federal Highway Administration
FRA	Federal Railroad Administration
FTA	Federal Transit Administration
HHS	U.S. Department of Health and Human Services
HUD	U.S. Department of Housing and Urban Development
NSTC	National Science and Technology Council
OMB	Office of Management and Budget
VMT	Vehicle-Miles Traveled

Technology Roadmap for the Transportation and Sustainable Communities Initiative



ABSTRACT

The National Science and Technology Council (NSTC) Committee on Technology, Subcommittee on Transportation Research and Development (R&D), has created a *Transportation Technology Plan* that presents initial implementation strategies for the partnership initiatives identified in the 1997 *Transportation Science and Technology Strategy*. With major involvement of the transportation and research communities, the NSTC developed the *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* articulates national transportation goals in five areas: safety, security, environmental quality and energy efficiency, economic growth and productivity, and mobility and access. It identifies partnerships among government, industry, and academia as critical elements in implementing the *Strategy*, and defines specific initiatives that can expedite the research process and speed the introduction of new technologies into transportation systems and operations.

This document, the *Transportation Technology Plan*, identifies the critical technology elements of the partnership initiatives and activities planned for the 1998–2005 time frame. Since many of the partnerships are new and will require significant involvement of all levels of government, industry, and academia, the implementation strategies presented should be viewed as the first step in a longer term process to demonstrate and accelerate the deployment of technology into the transportation system.

Although this document focuses on technology, in many cases non-technological approaches may be equally beneficial to implement. The partnerships fall into two broad categories: 1) those representing existing, well-established Federal R&D activities; and 2) new efforts requiring further definition and interagency coordination. Both categories require broadened collaboration among government, industry, and academia to achieve the improvements in transportation needed both in America and globally in the next century.

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