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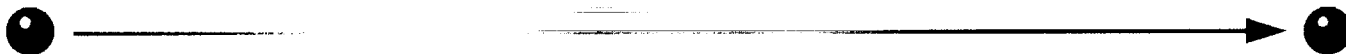
U.S. Department of Transportation

# Strategic Research, Development, and Technology Plan

2006 - 2010

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DEPT OF TRANSPORTATION  
BOOKS



Research and Innovative Technology Administration



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## Executive Summary

The Department of Transportation's (DOT) Research, Development, and Technology (RD&T) programs foster innovation through targeted research, development, and technology implementation activities. This *Strategic RD&T Plan 2006-2010* responds to requirements in the *Safe, Accountable, Flexible, and Efficient Transportation Equity Act—A Legacy for Users (SAFETEA-LU)* for a five-year plan to guide transportation RD&T activities. It describes the strategic goals that are the primary purposes for RD&T and the RD&T strategies and emerging research priorities required to accomplish these goals.

For each RD&T strategy, the plan identifies anticipated funding levels and information the Department expects to gain. The plan incorporates the RD&T programs of all DOT operating administrations and considers how research by other Federal agencies, State DOTs, the private sector, and others contributes to Departmental goals and how unnecessary duplication is avoided. The National Research Council's Transportation Research Board has reviewed the plan.

The Department developed this *Strategic RD&T Plan* through an ongoing coordination process involving all DOT operating administrations. Two crossmodal bodies lead this process: the RD&T Planning Council, composed of the heads of the operating administrations, the Under Secretary for Policy, and other senior DOT leaders; and the RD&T Planning Team, including the operating administrations' Associate Administrators for RD&T. Assisted by the Research and Innovative Technology Administration (RITA), the result is crossmodal planning and collaboration of RD&T at the highest levels of the Department.

The Department of Transportation's Strategic RD&T Plan is the result of a DOT-wide coordination process led by the Department's senior leadership and executed at the highest levels.

## STRATEGIC RD&T PLAN FRAMEWORK

Working across the Department, the RD&T Planning Council and RD&T Planning Team have identified the RD&T strategies and emerging research priorities that will guide RD&T investments over the next five years and advance the Department's strategic and organizational goals: *safety; reduced congestion; global connectivity; environmental stewardship; security, preparedness and response; and organizational excellence.*

### Safety

*DOT Goal:* Enhance public health and safety by working toward the elimination of transportation-related deaths and injuries.

#### *RD&T Strategies:*

- Understand and address causal factors and risks.
- Mitigate the consequences of accidents and incidents.
- Assess impacts of new technologies, vehicles, concepts, designs, and procedures.

### Strategic Goals

- Safety
- Reduced Congestion
- Global Connectivity
- Environmental Stewardship
- Security, Preparedness and Response
- Organizational Excellence

*Emerging Research Priorities:*

- Human–Automation Interaction—Research leading to an increased understanding of human-machine interactions.
- Application of Enhanced Transportation Safety Data and Knowledge—Efforts to convert the data produced by digital technology applications into useful knowledge to improve safety.

**Reduced Congestion**

*DOT Goal:* Reduce congestion and other impediments to using the Nation’s transportation system.

*RD&T Strategies:*

- Reduce traffic, freight gateway, and aviation system congestion.
- Extend the life of the existing transportation system and improve infrastructure durability.
- Advance use of next generation technologies and combinations of modes.
- Improve the planning, operation, and management of transportation services and assets.
- Improve transportation services for underserved areas and populations.
- Advance the Nation’s transportation workforce and research capability.

*Emerging Research Priorities:*

- Congestion Reduction Policy Research and Technologies—Analysis of congestion reduction, congestion pricing, and innovative financing and of the effectiveness of Intelligent Transportation System (ITS) technologies, products, and services designed to reduce congestion.
- System Resilience and Global Logistics—Research to identify freight bottlenecks and changing transportation patterns and to develop and implement technologies to enhance cargo flow.
- Next Generation Air Transportation System—Research to achieve greater aviation throughput, capacity, and productivity; reduce user and service costs; and ensure a safe, secure, and environmentally compatible aviation system.

---

**Strategic Goals**

- Safety
- **Reduced Congestion**
- Global Connectivity
- Environmental Stewardship
- Security, Preparedness and Response
- Organizational Excellence



## **Global Connectivity**

*DOT Goal:* Facilitate an international transportation system that promotes economic growth and development.

*RD&T Strategy:*

- Harmonize transportation standards and support leadership for U.S. transportation providers.

## **Environmental Stewardship**

*DOT Goal:* Promote transportation solutions that enhance communities and protect the natural and built environment.

*RD&T Strategies:*

- Understand and mitigate transportation impacts on the environment.
- Improve the environmental review process.

*Emerging Research Priority:*

- Energy Efficiency and Alternative Fuels—Research to understand the impact of fuel prices on mobility, to improve fuel efficiency, to identify requirements for alternative fuel infrastructures, and to assess safety impacts of alternative fuel vehicles.

## **Security, Preparedness and Response**

*DOT Goal:* Balance transportation security requirements with the safety, mobility, and economic needs of the Nation, and be prepared to respond to emergencies that affect the viability of the transportation sector.

*RD&T Strategies:*

- Reduce vulnerability and improve system preparedness and recovery.
- Secure hazardous materials shipments and assess the risks of hazmat events.

## **Organizational Excellence**

*DOT Goal:* Advance the Department's ability to manage for results and achieve the goals of the President's Management Agenda.

*RD&T Strategy:*

- Consistently apply the President's R&D Investment Criteria of relevance, quality, and performance.

## **Strategic Goals**

- Safety
- Reduced Congestion
- Global Connectivity
- Environmental Stewardship
- Security, Preparedness and Response
- Organizational Excellence

Table E-1 shows the Department's RD&T strategies and emerging research priorities, their relationship to DOT goals, and their estimated funding levels for FY 2006.

**Table E-1. DOT Goals, RD&T Strategies, and Emerging Research Priorities and Estimated FY 2006 Funding<sup>1</sup>**

| DOT Goal                             | RD&T Strategies   | Emerging Research Priorities  |
|--------------------------------------|---|---|
| <p>Safety<br/>\$361.5M</p>           | <p>Understand and Address Causal Factors and Risks<br/>\$285.5M</p> <p>Mitigate Accidents and Incidents<br/>\$59M</p> <p>Assess New Technologies, Vehicles, Concepts, Designs, and Procedures<br/>\$17M</p>   | <p>Human-Automation Interaction<br/>\$31.6M</p> <p>Enhanced Safety Data<br/>\$41.6M</p>   |
| <p>Reduced Congestion<br/>\$652M</p> | <p>Reduce Traffic, Freight, and Aviation Congestion<br/>\$74.5M</p> <p>Extend System Life and Improve Durability<br/>\$97M</p> <p>Advance Use of Next Generation Technologies and Combinations of Modes<br/>\$87.5M</p> <p>Improve Planning, Operations, and Management<br/>\$57M</p> | <p>Congestion Reduction Policy Research and Technologies<br/>TBD</p> <p>System Resilience and Global Logistics<br/>TBD</p> <p>Next Generation Air Transportation System<br/>\$55.8M</p> |

<sup>1</sup> Funding estimates for DOT goals, RD&T strategies, and emerging research priorities are preliminary and subject to change.

| <b>DOT Goal</b>                              | <b>RD&amp;T Strategies</b>   | <b>Emerging Research Priorities</b>                |
|--|--|--|
|  | <p>Improve Services for Underserved Areas and Populations<br/>\$23M</p> <p>Advance the Transportation Workforce and Research Capability<br/>\$313M<sup>2</sup></p> |  |
| Global Connectivity<br>\$5M                  | Harmonize Standards and Support Leadership for U.S. Transportation Providers<br>\$5M   |  |
| Environmental Stewardship<br>\$52.5M         | <p>Understand and Mitigate Transportation Impacts<br/>\$49M</p> <p>Improve the Environmental Review Process<br/>\$3.5M</p>   | Energy Efficiency and Alternative Fuels<br>\$44.7M |
| Security, Preparedness and Response<br>\$10M | <p>Reduce Vulnerability and Improve Preparedness and Recovery<br/>\$9M</p> <p>Secure Hazardous Materials Shipments and Assess Risks<br/>\$1M</p>                   |  |
| Organizational Excellence<br>\$69M           | Consistently Apply the R&D Investment Criteria<br>\$69M <sup>3</sup>   |  |

<sup>2</sup> Includes university and cooperative research programs.

<sup>3</sup> Includes administrative expenses for research.

## RD&T PROGRAMS 2006-2010

Over the next five years, the RD&T programs in the Department's operating administrations will advance DOT goals, RD&T strategies, and emerging research priorities while supporting modal priorities and mission requirements. The following DOT offices and administrations have missions that include supporting RD&T:

- Federal Aviation Administration (FAA)
- Federal Highway Administration (FHWA)
- Federal Motor Carrier Safety Administration (FMCSA)
- Federal Railroad Administration (FRA)
- Federal Transit Administration (FTA)
- Maritime Administration (MARAD)
- National Highway Traffic Safety Administration (NHTSA)
- Office of the Secretary (OST)
- Pipeline and Hazardous Materials Safety Administration (PHMSA)
- Research and Innovative Technology Administration (RITA)

### ***RD&T to Improve Transportation Safety***

To achieve the Department's highest priority strategic goal, DOT's operating administrations will work with stakeholders to develop, make available, and enforce the technologies and techniques necessary to identify and resolve safety issues. Table E-2 lists DOT's safety RD&T strategies, research areas the Department will focus on over the next five years, and the operating administrations with supporting RD&T programs.

**Table E-2. Safety RD&T Strategies, Research Areas, and Supporting DOT Operating Administrations**

| <b>RD&amp;T Strategy</b>                               | <b>Research Areas</b>                          | <b>Operating Administrations</b>              |
|--|--|---|
| <i>Understand and Address Causal Factors and Risks</i> | Human Factors and Medical Risks                | FAA, FHWA, FMCSA, FRA, NHTSA                  |
|  | Vehicle, Equipment, and Infrastructure Factors | FAA, FHWA, FMCSA, FRA, FTA, NHTSA, OST, PHMSA |
|  | Operational Factors                            | FAA, FHWA, FRA, FTA                           |
|  | Hazardous Materials Transportation             | FMCSA, FRA, OST, PHMSA                        |

| <b>RD&amp;T Strategy</b>  | <b>Research Areas</b>                               | <b>Operating Administrations</b>  |
|---|---|-----------------------------------|
|   | Safety Data, Information Systems, and Risk Analysis | FAA, FHWA, FMCSA, FRA, FTA, NHTSA |
| <i>Mitigate Accidents and Incidents</i>                                     | Emergency Response and Operations                   | FHWA, FTA                         |
|   | Crashworthiness and Occupant Protection             | FAA, FHWA, FMCSA, FRA, FTA, NHTSA |
| <i>Assess New Technologies, Vehicles, Concepts, Designs, and Procedures</i> | Safety Rulemaking and Advanced Technologies         | FAA, NHTSA, RITA                  |

### ***RD&T to Reduce System Congestion***

Growing transportation congestion poses a substantial threat to the economy and to the quality of life of millions of Americans. The Department's RD&T programs will seek to reduce congestion and other transportation impediments, to preserve the existing transportation system, and to improve the durability and life of transportation infrastructure. Table E-3 lists DOT's congestion reduction RD&T strategies, research areas the Department will focus on over the next five years, and the operating administrations with supporting RD&T programs.

**Table E-3. Congestion Reduction RD&T Strategies, Research Areas, and Supporting DOT Operating Administrations**

| <b>RD&amp;T Strategy</b>   | <b>Research Areas</b>  | <b>Operating Administrations</b> |
|--|--|----------------------------------|
| <i>Reduce Traffic, Freight, and Aviation Congestion</i>                      | Reducing Recurring Congestion                                    | FAA, FHWA, FTA, OST              |
|  | Reducing Non-recurring Congestion                                | FAA, FHWA                        |
| <i>Extend System Life and Improve Durability</i>                             | Preserving Existing Infrastructure                               | FAA, FHWA, FRA, FTA              |
|  | Improving Infrastructure Durability and Characterizing Materials | FAA, FHWA, FRA, OST              |
| <i>Advance Use of Next Generation Technologies and Combinations of Modes</i> | Multimodal and Intermodal Transportation                         | FHWA, OST, RITA                  |
|  | Next Generation Technologies and Systems                         | FAA, FHWA, FRA, OST, RITA        |

| <b>RD&amp;T Strategy</b>  | <b>Research Areas</b>   | <b>Operating Administrations</b> |
|---|---|----------------------------------|
| <i>Improve Planning, Operations, and Management</i>                 | Improving Efficiency of Operations and Investments            | FAA, FHWA, FTA, OST              |
|   | Improving Planning and Decisionmaking                         | FHWA, FTA                        |
|   | Promoting Innovations in Transportation Finance               | FTA, OST                         |
| <i>Improve Services for Underserved Areas and Populations</i>       | Improving Access for Transportation-Disadvantaged Populations | FHWA, FTA, OST                   |
|   | Improving Transportation in Rural Areas and Small Communities | FHWA, FTA, OST, RITA             |
| <i>Advance the Transportation Workforce and Research Capability</i> | University Research and Education                             | FAA, FHWA, FRA, RITA             |
|   | Cooperative and Stakeholder Research                          | FAA, FHWA, FTA                   |
|   | Technical Assistance and Training                             | FHWA, FTA, RITA                  |
|   | DOT Research Facilities and Expertise                         | FAA, FRA, NHTSA                  |

***RD&T to Enhance Global Connectivity***

The Nation’s continued economic prosperity depends on a strong and interconnected global transportation system. Table E-4 lists DOT’s global connectivity RD&T strategy, research areas the Department will focus on over the next five years, and the operating administrations with supporting RD&T programs.

**Table E-4. Global Connectivity RD&T Strategy, Research Areas, and Supporting DOT Operating Administrations**

| <b>RD&amp;T Strategy</b>  | <b>Research Areas</b>                    | <b>Operating Administrations</b>  |
|---|--|-----------------------------------|
| <i>Harmonize Standards and Support Leadership for U.S. Transportation Providers</i> | International Standards and Coordination | FAA, FHWA, FTA, NHTSA, OST, PHMSA |
|   | Transportation Industry Development      | FHWA, FTA, OST                    |

***RD&T to Support Environmental Stewardship***

Transportation exerts pressure on environmental resources worldwide. The Department must balance environmental challenges with the need for a safe and efficient transportation network. Table E-5 lists DOT's environmental stewardship RD&T strategies, research areas the Department will focus on over the next five years, and the operating administrations with supporting RD&T programs.

**Table E-5. Environmental Stewardship RD&T Strategies, Research Areas, and Supporting DOT Operating Administrations**

| <b>RD&amp;T Strategy</b>                              | <b>Research Areas</b>  | <b>Operating Administrations</b>             |
|---|--|--|
| <i>Understand and Mitigate Transportation Impacts</i> | Understanding Transportation Impacts                         | FAA, FHWA, OST, PHMSA                        |
|   | Advancing Technologies, Plans, and Methods to Manage Impacts | FAA, FHWA, FRA, FTA, NHTSA, OST, PHMSA, RITA |
| <i>Improve the Environmental Review Process</i>       | Environmental Streamlining                                   | FAA, FHWA, FTA                               |

***RD&T to Ensure Security, Preparedness and Response***

There is a critical need to ensure the transportation system's rapid response and recovery from disruptions due to attacks, natural disasters, and other major events; to protect the system against terrorism; and to ensure that it remains a vital link for defense mobilization. Table E-6 lists DOT's security RD&T strategies, research areas the Department will focus on over the next five years, and the operating administrations with supporting RD&T programs.

**Table E-6. Security, Preparedness and Response RD&T Strategies, Research Areas, and Supporting DOT Operating Administrations**

| <b>RD&amp;T Strategy</b>  | <b>Research Areas</b>                         | <b>Operating Administrations</b> |
|---|---|----------------------------------|
| <i>Reduce Vulnerability and Improve Preparedness and Recovery</i> | Preparedness and Response                     | FHWA, FTA                        |
|   | Security Risks and Vulnerabilities            | FHWA, FRA, OST                   |
| <i>Secure Hazardous Materials Shipments and Assess Risks</i>      | Hazardous Materials Risks and Vulnerabilities | FMCSA, FRA, OST, PHMSA           |

***Organizational Excellence in RD&T***

To advance the President's Management Agenda, the Department seeks to consistently apply the R&D investment criteria of relevance, quality, and performance to all RD&T programs. Table E-7 lists DOT's organizational excellence RD&T strategy and the operating administrations with supporting RD&T programs.

**Table E-7. Organizational Excellence RD&T Strategy and Supporting DOT Operating Administrations**

| <b>RD&amp;T Strategy</b>                                  | <b>Operating Administrations</b>               |
|---|--|
| <i>Consistently Apply the R&amp;D Investment Criteria</i> | FAA, FHWA, FMCSA, FRA, FTA, NHTSA, PHMSA, RITA |

**RD&T COORDINATION**

The Department's RD&T programs are based on cooperation, information sharing, and collaboration within DOT, across the Federal Government, and with transportation stakeholders. These coordination activities serve to eliminate unnecessary research duplication and to broaden the range of expertise brought to bear on transportation problems.

***Internal RD&T Coordination***

Led by RITA, the Department's internal coordination process tracks multiyear priorities with annual budgets and goals. RITA works with the other DOT operating administrations to define Department-wide priorities, ensure RD&T program effectiveness, and prevent research duplication. To assist RITA with RD&T planning, the Department recently established the RD&T Planning Council and the RD&T Planning Team.



### ***Interagency Coordination***

DOT leads transportation RD&T in the Federal Government. At the cabinet level, the Department coordinates transportation research through the White House Office of Science and Technology Policy and the National Science and Technology Council. In addition, the Department's operating administrations work directly with agencies in areas of mutual interest to avoid duplication and leverage research investments. Among the agencies with which the Department actively cooperates are the Departments of Commerce, Defense, Energy, Homeland Security; and Interior; the Environmental Protection Agency; the National Aeronautics and Space Administration; and the National Science Foundation.

### ***Coordination with Stakeholders***

Stakeholder consultation and engagement are critical elements of all RD&T activities. Such efforts avoid duplication, uphold the quality of research, and ensure that the Department's RD&T programs are wise public investments. Within the operating administrations, stakeholder input and review are essential for establishing RD&T priorities, programmatic activities, and performance metrics. Table E-8 summarizes these stakeholder activities.

**Table E-8. Operating Administration Stakeholder Activities**

| <b>Operating Administration</b> | <b>Primary RD&amp;T Coordination Activities</b>  |
|---------------------------------|--|
| <i>FAA</i>                      | Research, Engineering, and Development Advisory Committee<br>Commercial Space Transportation Advisory Committee                            |
| <i>FHWA</i>                     | Research and Technology Coordinating Committee<br>Other Broad Interaction with Stakeholder Organizations                                   |
| <i>FMCSA</i>                    | Annual Stakeholder Forums<br>Ongoing Stakeholder Input to Program Plans and Activities   |
| <i>FRA</i>                      | Committee for Review of FRA Research, Development, and Demonstration Programs<br>Research Guidance from Internal and External Stakeholders |
| <i>FTA</i>                      | Transit Research Analysis Committee  |
| <i>MARAD</i>                    | Marine Transportation System National Advisory Council<br>Cooperative Research Programs with Industry                                      |
| <i>NHTSA</i>                    | Public Meetings with Stakeholders  |
| <i>PHMSA</i>                    | Pipeline Safety R&D Forums and Blue Ribbon Panel<br>Coordination with Stakeholders on Hazardous Materials Safety Research                  |

| Operating Administration | Primary RD&T Coordination Activities   |
|--------------------------|--|
| RITA                     | Consultation with Internal and External Stakeholders for RD&T Coordination<br>Advisory Council for Transportation Statistics |

### Research Partnerships

In addition to coordinating research with other Federal agencies and with transportation stakeholders, the Department actively pursues partnerships with universities, State and local agencies, industry, and other organizations. Table E-9 lists the primary partnership activities, DOT programs, and operating administrations and partners.

**Table E-9. DOT Research Partnerships**

| Partnership Activity                         | DOT Program   | Operating Administrations and Partners  |
|--|---|---|
| <i>University Research</i>                   | Center for Commercial Deployment of Transportation Technologies | MARAD, Defense Department, Industry, California State University at Long Beach          |
|  | University Research Program                                     | FRA, Universities   |
|  | Global Maritime and Transportation School                       | MARAD, Industry, U.S. Merchant Marine Academy   |
|  | Joint University Program  | FAA, NASA, Massachusetts Institute of Technology, Ohio University, Princeton University |
|  | Renewable Energy Transportation Laboratory                      | MARAD, U.S. Merchant Marine Academy, Industry   |
|  | Transportation Centers of Excellence                            | FAA, Industry, Universities   |
|  | University Transportation Centers                               | RITA, FHWA, FTA, Universities, State DOTs, Industry                                     |
| <i>Cooperative Research and Partnerships</i> | Airport Cooperative Research Program                            | FAA, Airport Authorities, Industry  |
|  | Cargo Handling Cooperative Program                              | MARAD, Marine Freight and Intermodal Industries   |

| Partnership Activity | DOT Program   | Operating Administrations and Partners   |
|----------------------|---|--|
|                      | Commercial Remote Sensing and Spatial Technologies Program      | RITA, Universities, Industry, Federal, State, and Local Agencies                           |
|                      | Hazardous Materials Transportation Cooperative Research Program | PHMSA, FAA, FMCSA, FRA, Industry, Other Agencies   |
|                      | Marine Transportation System                                    | MARAD, Industry, Federal, State, and Local Agencies  |
|                      | National Cooperative Freight Transportation Research            | RITA, Industry, Other Freight Stakeholders   |
|                      | National Cooperative Highway Research Program                   | FHWA, State DOTs   |
|                      | Ship Operations Cooperative Program                             | MARAD, Industry  |
|                      | Ship Structure Committee  | MARAD, Industry  |
|                      | Short Sea Shipping Cooperative Program                          | MARAD, Industry  |
|                      | Transit Cooperative Research Program                            | FTA, Transit Industry  |
|                      | Transportation Pooled-Fund Program                              | FHWA, State DOTs, Local Agencies, Foreign Governments, Industry, Universities, Foundations |

## TRANSPORTATION RESEARCH BOARD REVIEW AND RECOMMENDATIONS

[to be added]

## CONCLUSIONS AND FUTURE DIRECTIONS

[to be added]



## Acronyms and Abbreviations

[to be added]

# 1 INTRODUCTION

The U.S. Department of Transportation (DOT) provides global leadership to ensure a safe, secure, efficient, and interconnected transportation system for the American public. To this end, the Department's Research, Development, and Technology (RD&T) programs foster innovations to guarantee safety while easing transportation congestion, reducing environmental degradation, and ensuring swift response to, and rapid recovery from, disasters and emergencies. DOT's RD&T investments leverage those of research partners to stimulate innovation through targeted research, development, and technology implementation activities. As stated in the Safe, Accountable, Flexible, and Efficient Transportation Equity Act—A Legacy for Users (SAFETEA-LU), these activities are a basic Federal responsibility when they are of national significance, when there is a clear public benefit and private sector investment is less than optimal, when they support a stewardship role in assuring the efficient use of Federal resources, and when they present the best means to support national policy goals.<sup>4</sup>

**Secretary's Vision  
for Transportation**

"Safer, Simpler,  
Smarter  
Transportation  
Solutions"

*DOT Strategic Plan  
2006-2011*

## Purpose and Scope

This DOT *Strategic RD&T Plan 2006-2010* presents the Department's strategy for RD&T over the next five years and beyond. It supports the broader *DOT Strategic Plan* and responds to requirements in SAFETEA-LU for a five-year strategic plan to guide transportation research activities. The plan describes the strategic and organizational goals that are the primary purposes for Departmental RD&T; the RD&T strategies the Department will pursue to achieve these goals; and, for each RD&T strategy, the anticipated funding levels and information the Department expects to gain. Importantly, the plan also identifies the emerging research priorities that the Department intends to pursue over the next several years. The plan incorporates the RD&T programs of all DOT operating administrations and considers how research by other Federal agencies, State DOTs, the private sector, and others contributes to DOT goals and how unnecessary duplication is avoided.

## Plan Development

This *Strategic RD&T Plan* was developed as part of an ongoing process involving all DOT operating administrations that incorporates multiyear strategic RD&T planning, annual program planning, and budget and performance planning across the Department. Two internal Departmental planning bodies lead this process:

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<sup>4</sup> Sec. 5201 (b)(a)(2).

*RD&T Planning Council.* The RD&T Planning Council ensures crossmodal collaboration and coordination of RD&T at the highest levels within DOT and with external entities. The Council is chaired by the Administrator of the Research and Innovative Technology Administration (RITA) and comprises the heads of the operating administrations, the Under Secretary for Policy, and other senior DOT leaders.

*RD&T Planning Team.* The RD&T Planning Team assists the RD&T Planning Council in ensuring crossmodal collaboration and coordination of RD&T. It is chaired by RITA's Associate Administrator for Research, Development, and Technology and includes the Associate Administrators for RD&T in the operating administrations.

Through a broad Department-wide process, the RD&T Planning Council has identified a set of RD&T strategies and emerging research priorities that will advance DOT goals and guide RD&T investments over the next five years and beyond. As described in Section 2, these RD&T strategies and research priorities provide the framework for this plan and for RD&T across the Department.

As required by SAFETEA-LU, the Transportation Research Board (TRB) of the National Research Council has reviewed this plan. The plan also incorporates input from a range of stakeholders, including State and local transportation agencies, not-for-profit institutions, academia, and the private sector. (See Appendixes A and B.) This review process and outreach will continue as DOT revises the plan to reflect changing priorities, operating administration mission requirements, and customer needs.

## Contents

The remaining chapters of this *Strategic RD&T Plan* cover the following:

*Chapter 2:* strategic planning framework for the Department's RD&T programs.

*Chapters 3 through 8:* RD&T strategies, programs, and milestones that support DOT's strategic goals.

*Chapter 9:* RD&T coordination.

*Appendix A:* summary of letter report from the TRB review committee.

*Appendix B:* stakeholder input.

*Appendix C:* RD&T funding.

*Appendix D:* links to operating administration RD&T advisory committees and plans.

## 2 Strategic Planning Framework

The overall aim of the Department's RD&T is to anticipate and respond to changes in the complex transportation environment and to stimulate transportation innovations on behalf of the American public. The Department conducts RD&T to advance national transportation goals and to fulfill the specific mission requirements of its operating administrations. These investments are balanced between short-term applied RD&T and longer-term research, and address critical gaps in areas not likely to be addressed by other Federal agencies or industry.

### DOT Mission and Goals

Although DOT's operating administrations have wide-ranging duties related to operating or overseeing various transportation sectors, they share a commitment to fulfill national objectives, as embodied in the Department's mission and by the following six strategic and organizational goals:

#### *Strategic Goals*

- *Safety.* Enhance public health and safety by working toward the elimination of transportation-related deaths and injuries.
- *Reduced Congestion.* Reduce congestion and other impediments to using the Nation's transportation system.
- *Global Connectivity.* Facilitate an international transportation system that promotes economic growth and development.
- *Environmental Stewardship.* Promote transportation solutions that enhance communities and protect the natural and built environment.
- *Security, Preparedness and Response.* Balance transportation security requirements with the safety, mobility, and economic needs of the Nation and be prepared to respond to emergencies that affect the viability of the transportation sector.

#### *Organizational Goal*

- *Organizational Excellence.* Advance the Department's ability to manage for results and achieve the goals of the President's Management Agenda.

### External Factors

The Department's strategic goals serve as the primary purposes for all of its diverse RD&T activities. Over the next several years, a number of external factors will affect the Department's ability to achieve these goals, some of which will create particular challenges for RD&T:

#### DOT Mission

"Develop and administer policies and programs that contribute to providing fast, safe, efficient, and convenient transportation at the lowest cost consistent with the national objectives of general welfare, economic growth and stability, the national security, and the efficient use and conservation of the resources of the United States."

DOT Strategic Plan  
2006-2011



### ***Globalization***

People around the world are more connected to one another than ever before. International travel is more frequent and international communication is commonplace. Goods and services produced in one part of the world are increasingly available in all parts of the world. Although these links are not new, they are more pervasive than ever before.

As an external factor, globalization reinforces the need for highly efficient connections where U.S. and international transportation systems meet. In the near term, there are likely to be changes in manufacturing locations overseas. As traditional low-cost manufacturing countries increase their standards of living, manufacturing may switch to other parts of the world. These changing trade patterns may lead to shifts in the use of U.S. ports and inland distribution systems. As a result, existing ports and intermodal facilities may be bypassed, while ports and systems now currently underutilized may need significant expansion. Globalization will demand flexibility in the transportation network, and flexibility will demand investments in transportation infrastructure and research.

### ***The Economy***

Cyclical and long-term changes in economic activity have a direct impact on personal travel and shipment of goods, affecting the demand for transportation infrastructure and services and transportation safety issues. For example, growth and decline in the economy present factors that increase pipeline safety risk in certain ways. Economic growth normally brings an increase in commercial and residential development, which increases the probability of excavation or outside force damage to pipelines. On the other hand, economic and budget pressures can negatively influence the priorities of pipeline safety partners for implementing and enforcing safety measures, while financial pressures on the industry can diminish the resources available to support safe operating and maintenance practices.

An expanding economy would increase truck and bus traffic, challenging DOT safety and congestion goals. Truck and bus traffic has been growing at a slightly faster rate than overall vehicle traffic. In the future, large trucks and buses likely will be an increasing part of traffic congestion. Moreover, a number of safety issues—including driver fatigue and equipment safety—will increase motor carrier safety risks and require solutions developed through RD&T.

### ***Demographic and Lifestyle Changes***

Demographic trends will work against the Department's ability to achieve its safety and congestion goals. With respect to safety, most transportation-related fatalities and injuries occur on the Nation's roads and highways, and demographic trends will make it even more difficult to reduce these numbers. Within the next 25 years, the U.S. population is estimated to grow to 364 million, up from 282 million in 2000. Vehicle miles of travel are expected to increase steadily, about 160 percent from 2000 to 2030, leading to much higher numbers of highway crashes, fatalities, and injuries.

Protecting segments of the population who remain at heightened risk, including teenage and older drivers and rural residents, will require innovative strategies and approaches, as will the steady influx of immigrants from around the world. Moreover, with their active lifestyles, increased discretionary incomes, longer life spans, and busier schedules, most demographic groups will travel at considerably higher rates than their current cohorts, increasing exposure to crash risks. Finally, increased congestion and longer commuting times will contribute to growing driver frustration, increasing the occurrence of aggressive driving incidents.

Yet another factor affecting safety will be the growing demand for truck and bus drivers. Potential driver shortages may tempt some motor carriers to use a higher percentage of new or unskilled drivers, adversely affecting efforts to reduce large truck and bus-related crashes and requiring safety countermeasures.

### ***Climate Change***

Over time, climate change could affect the Nation's transportation system. Gradual climate change is probably not a threat to DOT's ability to achieve its strategic goals, but rapid climate change would introduce new challenges, including those for Departmental RD&T.

Damage to large segments of roadways, tunnels, bridges, coastal waterways, rail movements, and transit services are all plausible risks of climate change. RD&T strategies will help assess the risks, and help to develop contingent mitigation plans.

### ***Transportation Fuel***

Both fuel availability and the movement to new types of fuel will be key external factors now and in the future.

The availability of the fossil fuels currently used by most transportation will be affected by both supply and demand. In the near term, the main impact of fuel on transportation will be to increase costs, and these inflationary costs will be passed on throughout the economy. If the gap between supply and demand becomes big enough, there will start to be fuel shortages and lines at gas stations—temporary at first and possibly chronic later on.

At least part of the answer to our dependence on fossil fuels is movement to other types of fuel. Hybrid cars are helping, and fit in well with the current transportation system. However, widespread use of other fuels will have a more fundamental effect on the transportation system. For example, widespread use of hydrogen-fueled cars will require a nationwide infrastructure to fuel and repair these vehicles safely, conveniently, and at reasonable cost. These and related challenges will require a sustained research effort in partnership with other agencies and the Department's stakeholders.

### ***Obstacles to Intermodalism***

Persistent obstacles to efficient intermodal connections, such as the high cost of intermodal infrastructure projects and the stovepipe organizational structure of transportation agencies, will continue to impede abilities to improve U.S. connection points to the global transportation network. As a result, the intermodal network will continue to experience erratic service reliability. Intermodal congestion will worsen and capacity constraints will slow the ability of the transportation network to recover from any adverse events, such as Hurricane Katrina. Overcoming these obstacles will require investments in intermodal technology and policy research.

### ***Declining Revenue in Transportation Trust Funds***

The gap between increased transportation costs and declining revenue in transportation trust funds is an external factor that will hinder the Department's ability to modernize current transportation systems and prepare for increased capacity in the future. Trust fund revenues pay for improvements to the Nation's transportation network; for example, the move to a modern, technology-driven aviation system requires sustained, multiyear investments. Similarly, reducing highway congestion requires significant infrastructure and technology investments. The shortfall in transportation trust funds will constrain the Department's ability to achieve its strategic goals through investments in RD&T and will require additional research on financing alternatives.

### ***Constraints on Expanding Capacity***

The transportation sector's ability to respond to growth in demand through increased capacity is constrained by yet another factor—local opposition to infrastructure improvements, also known as "NIMBY" (Not In My Back Yard). There is an increasingly well-organized and vocal opposition to the perceived negative impacts of new and expanded railroads, highways, and airports, characterized by demands for mitigation measures and constraints on facilities. These pressures, coupled with high-density development along rail corridors and record rail traffic, have also resulted in demands for hazmat pre-notification and rerouting. Moreover, constraints on pipeline capacity—due to difficulties in obtaining permits required to build new facilities—increase operating pressures for existing pipelines and reduce the resiliency of the system that would otherwise be available through rerouting. Addressing such constraints will require research to more fully understand and mitigate transportation impacts and risks and to streamline review processes.

### ***Advances in Technology***

Current and emerging technologies will significantly help the Department to achieve its strategic goals and address the external factors cited above, but may also create new research challenges.

For highway safety, new technologies will add additional layers of safety to avoid and mitigate crashes. Technologies that could reduce crashes include computer simulators, biometrics, and smart card driver licenses. Dangerous breakdowns may be reduced through vehicle performance diagnostics, driver warnings, and vehicle self-help measures. Drivers may receive en route advance warnings about upcoming weather or road hazards, reducing weather-related crashes and incidents in which inattentive drivers strike roadside workers. When crashes occur, improvements in occupant protection—such as advanced vehicle structures, safety belt/ignition-interlock systems, and additional airbags—will reduce injuries and fatalities. Moreover, immediately after impact, onboard communications may automatically notify rescue services of a crash, its location, and the probable extent of injuries based on onboard sensor data. Such data could also help researchers to understand accident causal factors and lead to vehicle, roadway, and driver training improvements. Finally, the proliferation of traffic video surveillance in urban areas and mobile telephone communications will increase the chance of a 9-1-1 call and reduce response time by emergency personnel, while enhanced 9-1-1 technologies will spur similar improvements in rural and suburban communities.

Technological innovation could also ease transportation congestion and reduce environmental impacts. For example, Intelligent Transportation System (ITS) technologies and operational strategies could reduce congestion-related delay by up to 27 percent, fuel consumption by 24 percent, and emission of harmful pollutants by 25 percent if fully deployed. Other advances, such as hydrogen-fuel-based technologies, could significantly reduce harmful emissions and the Nation's longstanding dependence on fossil fuels.

Certain technologies may also create challenges for RD&T. For example, the increasing automation of transportation systems may have unintended safety consequences in terms of the human-machine interface, unanticipated system failures, and natural and human-caused events and disruptions.

## **RD&T Strategies**

Through the RD&T Planning Council, the Department has identified the critical RD&T strategies that will address these external factors and further DOT goals. These overarching strategies serve as the primary research topics for the Department's RD&T programs and activities. The Department's RD&T strategies for the next five years are as follows:

### ***Safety***

1. Sponsor and conduct research to understand and address the causal factors and risks in accidents, and to anticipate future safety risks in all transportation modes.
2. Sponsor and conduct research to determine the most effective ways of mitigating the consequences of transportation accidents and incidents in all modes.

3. Provide support to safety rulemaking by assessing the potential safety impacts of new transportation technologies, vehicles, concepts, designs, and procedures.

### ***Reduced Congestion***

1. Sponsor and conduct research to reduce urban and suburban traffic congestion, freight gateway congestion, and aviation system congestion.
2. Sponsor and conduct research to extend the life of the existing transportation system and improve the durability of infrastructure.
3. Sponsor and conduct research to advance the use of next generation technologies and to make effective use of combinations of modes in moving people and goods.
4. Sponsor and conduct research to improve the planning, operation, and management of surface transportation and aviation services and assets.
5. Sponsor and conduct research to improve transportation services for underserved areas and populations.
6. Advance the Nation's transportation workforce and research capability through capacity building, fellowships, grants, and cooperative research with universities, the private sector, and State and local governments.

### ***Global Connectivity***

1. Sponsor and conduct research leading to harmonized international standards, improved cross-border collaboration, and global leadership for U.S. transportation providers.

### ***Environmental Stewardship***

1. Sponsor and conduct research to understand the various impacts of transportation activities on the natural and built environment and communities, and to advance technologies and concepts to mitigate those impacts.
2. Sponsor and conduct research on ways to improve the environmental review process to achieve the timely delivery of transportation projects.

### ***Security, Preparedness and Response***

1. Sponsor and conduct research to reduce the vulnerability of transportation systems and to improve their ability to prepare for and recover from attacks, natural disasters, and emergencies.
2. Conduct and support research to develop technologies and procedures to secure hazardous materials shipments, and to assess the risks of hazmat events.

## ***Organizational Excellence***

1. Consistently apply the President's R&D Investment Criteria—relevance, quality, and performance—to all DOT-sponsored and in-house research.

Sections 3–8 of this *Strategic RD&T Plan* describe the specific research areas, programs, and milestones for implementing these RD&T strategies during the next five years.

## **Emerging Research Priority Areas**

To support the Department's goals and RD&T strategies, the RD&T Planning Council has identified six emerging research priorities to guide research investments both within and beyond the time period covered by this plan. Several of these priorities cut across transportation modes and operating administration mission requirements. The Department's emerging research priorities are as follows:

*Human–Automation Interaction.* Conduct and support research leading to an increased understanding of human-machine interactions related to safety performance.

*Application of Enhanced Transportation Safety Data and Knowledge.* Conduct and support efforts to convert the large quantities of data produced by applications of digital technology into useful knowledge that can improve transportation safety.

*Congestion Reduction Policy Research and Technologies.* Strengthen policy research and analysis into congestion reduction, congestion pricing, and innovative financing, and conduct RD&T to evaluate the effectiveness and market acceptance of traveler and traffic information technologies, products, and services.

*System Resilience and Global Logistics.* Conduct and support RD&T to identify freight bottlenecks and changing transportation patterns and to develop and implement technologies to enhance the efficiency of cargo flows.

*Next Generation Air Transportation System.* Provide the knowledge base to achieve greater aviation throughput and capacity; reduce user and service costs, including congestion; increase service productivity; and ensure a safe, secure, and environmentally compatible aviation system.

*Energy Efficiency and Alternative Fuels.* Conduct and support research to understand the impact of fuel prices and fuel efficiency on mobility, opportunities to improve fuel efficiency, transportation requirements associated with alternative fuel infrastructures, and safety impacts of alternative fuel vehicles.

Table 2-1 shows the relationship among the Department's strategic and organizational goals, RD&T strategies, and emerging research priorities.

Sections 3, 4, and 6 identify the RD&T programs supporting the emerging research priorities.

**Table 2-1. DOT Goals, RD&T Strategies, and Emerging Research Priorities**

| <b>DOT Goal</b>                            | <b>RD&amp;T Strategies</b>   | <b>Emerging Research Priorities</b>  |
|--|--|--|
| <i>Safety</i>                              | Understand Causal Factors and Risks<br><br>Mitigate Transportation Accidents<br>Support Rulemaking and Assess Safety Impacts   | Human-Automation Interaction<br>Enhanced Safety Data   |
| <i>Reduced Congestion</i>                  | Reduce Surface, Freight, and Aviation Congestion<br><br>Extend System Life and Improve Durability<br><br>Advance Use of Next Generation Technologies and Combinations of Modes<br><br>Improve Planning, Operations, and Management<br><br>Improve Services for Underserved Areas and Populations<br><br>Advance the Transportation Workforce and Research Capability | Congestion Reduction Policy Research and Technologies<br><br>System Resilience and Global Logistics<br>Next Generation Air Transportation System |
| <i>Global Connectivity</i>                 | Harmonize Standards and Support Leadership for U.S. Transportation Providers   |  |
| <i>Environmental Stewardship</i>           | Understand and Mitigate Transportation Impacts<br><br>Improve the Environmental Review Process   | Energy Efficiency and Alternative Fuels  |
| <i>Security, Preparedness and Response</i> | Reduce Transportation Vulnerability and Improve Emergency Response<br><br>Secure Hazardous Materials Shipments and Assess Risks  |  |
| <i>Organizational Excellence</i>           | Consistently Apply the R&D Investment Criteria   |  |

## Operating Administration Roles and Responsibilities

In addition to supporting broad DOT goals, RD&T strategies, and emerging research priorities, the Department's operating administrations conduct RD&T to advance modal priorities based on their mission requirements, interactions with

stakeholders, and understanding of transportation challenges, technologies, and operations. Among DOT administrations and offices, the following have missions that involve a supporting program of RD&T:

***Federal Aviation Administration (FAA)***

FAA's overall mission is to provide safe and efficient aviation and commercial space transportation systems. Key elements are the regulation of civil aviation and commercial space transportation to promote safety and the safe and efficient use of airports and airspace by civil and military users. This broad mission requires an extensive RD&T program carried out in cooperation with industry and other Federal agencies. Components of this program include research in space and air traffic system technology, aviation weather products, airport technology, aircraft safety, commercial space transportation safety, human factors, and mitigation of aircraft emissions and noise.

***Federal Highway Administration (FHWA)***

FHWA's mission is to enhance mobility through innovation, leadership, and public service. One of the agency's key roles is to be an innovator for a better future. Toward this end, FHWA provides leadership, expertise, and resources to continually improve the quality of the highway system and its intermodal connections. Cooperating with States and other partners, the agency coordinates Federal highway programs and conducts supporting research in highway safety, pavement and structures, congestion relief, planning, and the environment. Among the agency's major highway programs are the Federal-Aid Highway Program, which provides financial assistance to States to construct and improve the National Highway System, urban and rural roads, and bridges, and the Federal Lands Highway Program, which provides access to and within national forests, national parks, Indian reservations, and other public lands.

***Federal Motor Carrier Safety Administration (FMCSA)***

FMCSA has as its mission the reduction in the number and severity of commercial motor vehicle (CMV) crashes. The agency's research and technology (R&T) program supports this mission through the discovery, application, and dissemination of new knowledge, and the assessment, development, and promotion of new technologies. FMCSA R&T addresses the safety performance of drivers, carriers, and vehicles, and also includes crosscutting projects relating to crash problem assessment and program support.

***Federal Railroad Administration (FRA)***

FRA promulgates and enforces railroad safety regulations; administers financial assistance programs to railroads, including Amtrak; conducts research in support of improved railroad safety, operational efficiency, asset utilization, and capacity; fosters the development of high-speed-rail passenger service; and consolidates government support of rail transportation activities. FRA RD&T covers railroad system issues (safety, security, environment); human factors; rolling stock and



components; track and structures; track/train interaction; train control; grade crossings; hazardous materials; train occupant protection; and research and development facilities and equipment.

### ***Federal Transit Administration (FTA)***

The mission of FTA is to ensure personal mobility and community vitality by supporting high-quality public transportation. FTA accomplishes its mission through leadership, financial resources, and technical assistance. Research is focused on analyzing potential solutions to transit challenges, developing research projects to evaluate and test best practices and technologies, and working with the transit industry to implement those research solutions that are found to have significant return on investment. Conducted in partnership with the broader transit community, FTA research focuses on increasing transit ridership, improving safety and emergency preparedness, improving capital and operating efficiencies, and protecting the environment and promoting energy independence.

### ***Maritime Administration (MARAD)***

MARAD is responsible for developing and maintaining a U.S. merchant marine capable of moving the Nation's waterborne commerce and serving as a military auxiliary in time of war or national emergency. MARAD has programs to improve the efficiency and productivity of the U.S. maritime industry, including ports and intermodal transportation systems. While MARAD currently has no directly funded RD&T, the agency actively facilitates several industry-wide cooperative programs to advance innovations in marine operations.

### ***National Highway Traffic Safety Administration (NHTSA)***

NHTSA's mission is to reduce deaths, injuries, and economic losses resulting from motor vehicle crashes. To fulfill this mission, the agency establishes and enforces safety standards for new motor vehicles and equipment; provides highway safety grants to State and local governments; promotes use of safety belts, child safety seats, and airbags; provides information to consumers; and sets and enforces standards for fuel economy, odometers, and theft prevention. NHTSA conducts a supporting program of research in several critical areas. These include collecting and analyzing crash data trends, research on the safety impact of innovative technologies, injury causation and mitigation countermeasures, integrated safety from crash prevention to severity reduction, and driver behavioral safety.

### ***Office of the Secretary of Transportation (OST)***

OST has responsibility for formulating national transportation policies that affect various modes and help ensure achievement of Department-wide goals. OST research supports the development, evaluation, and improvement of these policies, and comprises work in economic and strategic analysis; safety, energy, and environment; freight and logistics; navigation and spectrum policy; aviation

and international policy; and security. Key priorities include improving the economic efficiency of the operation of, and investments in, the transportation system; encouraging diffusion of best practices in transportation safety; improving the sustainability of transportation through market-based solutions and new technologies that improve fuel economy and reduce greenhouse gases and air pollutant emissions; illuminating the economic relationship of freight investments to the national economy and developing financial strategies to accelerate economic investment in freight capacity; and encouraging the development of civilian Global Positioning System (GPS) and other positioning, navigation, and timing applications.

### ***Pipeline and Hazardous Materials Safety Administration (PHMSA)***

PHMSA's mission is to ensure the safe and secure transportation of hazardous materials by all modes. The agency has two major safety offices: the Office of Pipeline Safety, which ensures the safe, reliable, and environmentally sound operation of pipeline transportation, and the Office of Hazardous Materials Safety, which identifies evaluates, and mitigate risks to the safe and secure transportation of hazardous materials. PHMSA RD&T includes work in mission-critical areas, including pipeline operations, control, and monitoring; pipeline damage prevention; improved pipeline materials; hazardous materials packaging and shipping, including packaging design; hazmat emergency response, hazard identification, risk assessment, and risk management; hazmat consequence modeling; and hazardous materials transportation security.

### ***Research and Innovative Technology Administration (RITA)***

RITA's mission is to enable, facilitate, and expedite innovation in the transportation system to advance the transportation and economic objectives of the United States. RITA accomplishes the RD&T components of this mission by leading crossmodal research in the Department; planning, reviewing, and coordinating RD&T DOT-wide; leading the DOT RD&T Planning Council and Planning Team; and managing the Department's University Transportation Centers program. In addition, RITA's Bureau of Transportation Statistics plays a key role in gathering and improving the quality of the aviation, freight, and passenger flow data upon which much of the Department's research relies.

Chapters 3 through 8 discuss the specific activities and anticipated milestones for operating administrations' RD&T programs in relation to DOT goals, RD&T strategies, and emerging research priorities.



### 3 RD&T to Improve Transportation Safety

Safety is DOT's primary goal. The Department strives to improve the benefits of transportation while consistently reducing risks to the public's health and well-being. Over the next five years, DOT will conduct RD&T and work with stakeholders to ensure that the technologies and techniques necessary to identify and resolve safety issues are developed, made available, and enforced. As identified in [Section 2](#), the following RD&T strategies represent the primary research topics in support of improved transportation safety:

1. Sponsor and conduct research to understand and address the causal factors and risks in accidents and to anticipate future safety risks in all transportation modes.
2. Sponsor and conduct research to determine the most effective ways of mitigating the consequences of transportation accidents and incidents in all modes.
3. Provide support to safety rulemaking by assessing the potential safety impacts of new transportation technologies, vehicles, concepts, designs, and procedures.

The following sections summarize safety research areas, emerging research priorities, and primary RD&T activities for advancing these RD&T strategies. Appendix C shows anticipated funding levels for supporting RD&T programs for FY 2006 through 2010.

#### Understand and Address Causal Factors and Risks

A foremost concern for the Department's RD&T programs is to identify the causal factors in transportation accidents and incidents, particularly human factors; to anticipate future risks; and to develop and implement technologies, concepts, practices, and other prevention strategies with the potential to improve safety. The Department will implement this RD&T strategy through research in the following key areas: human factors and medical risks; vehicle, equipment, and infrastructure factors; operational factors; hazardous materials transportation; and safety data, information systems, and risk analysis. For each of the key areas, operating administration programs are summarized and key milestones listed for the next four fiscal years.

#### *Human Factors and Medical Risks*

Over the next five years, the following operating administration programs will address safety issues related to human factors, human error, and medical risks:

"We have a moral, as well as an economic, obligation to immediately address the problem of transportation safety."

*Secretary Norman Y. Mineta*

#### Safety RD&T

- Understand and Address Causal Factors and Risks
- Mitigate Accidents and Incidents
- Assess Impacts of New Technologies, Vehicles, Concepts, Designs, and Procedures

## FAA

*Aeromedical Research.* Improves the safety of passengers, aircrews, and other human assets in the National Airspace System (NAS) in support of FAA's regulatory guidelines. Research in this area will address forensic toxicology, biochemistry, bioinformatics, functional genomics, radiobiology, and environmental physiology. This program will also support Safety RD&T Strategies 2 and 3 and Reduced Congestion RD&T Strategy 6.

### **Emerging Research Priority: Human-Automation Interaction**

There is a need for research that will lead to an increased understanding of human-machine interactions related to safety performance. This crossmodal issue is particularly important in future transportation systems. An evolving knowledge base is needed to guide development of appropriate regulatory and certification processes and the training of system operators in all modes. A major additional concern is the possibility for unintended consequences resulting from system failures as well as unexpected natural and human-caused events and disruptions.

#### Key Supporting RD&T Programs:

- Air Traffic Control/Technical Operations Human Factors
- Flightdeck/Maintenance/System Integration Human Factors
- Produce Safer Drivers
- Rail Human Factors
- Crash Avoidance and Human/Vehicle Performance

*Air Traffic Control/Technical Operations Human Factors.* Ensures that the humans in the air traffic control system are productive and provide the required level of service within a minimum level of error. This program will support the development of guidelines, standards, reference handbooks, technical reports, checklists, tools, and informative briefings essential for implementation and enhancement of advanced operational concepts, systems, and subsystems.

*Flightdeck/Maintenance/System Integration Human Factors.* Develops more effective methods for aircrew, inspector, and maintenance technician training; develops more human-centered flight controls and displays; and increases human factors considerations in certifying new aircraft and in designing and modifying existing equipment. Through this program, FAA researchers will develop improved knowledge for certifying automation-based systems, enhancing task performance, and applying error management strategies.

## FHWA

*Safety Research and Innovation Deployment Program (Safety R&D).* Demonstrates the application of innovative technologies in highway safety and supports the deployment and evaluation of safety technologies and innovations at the State and local levels. In this research area, efforts will include the deployment of best practices in safety training and management. This program will also support Safety RD&T Strategy 2.

*Strategic Highway Research Program II (SHRP II) (Corporate Activities).* Conducts concentrated, results-oriented applied research focusing on solving top problems in the areas of highway safety, reliability, capacity, and renewal. Work

in the area of human factors will develop fundamental knowledge of crash factors that could lead to a sizable reduction in deaths and injuries. This program will also support Reduced Congestion RD&T Strategies 1, 2, and 4.

*Surface Transportation Environment and Planning Cooperative Research Program (STEP) (Planning and Environment).* Focuses on improving understanding of the complex relationship between surface transportation and the environment. In the area of human factors, the STEP will support safety-conscious planning of surface transportation systems and improvement processes. This program will also support Reduced Congestion RD&T Strategies 1, 3, 4, 5, and 6; the RD&T Strategy for Global Connectivity; and Environmental RD&T Strategies 1 and 2.

### **FMCSA**

*Produce Safer Carriers.* Seeks to improve the safety of commercial motor carriers. Building on previous efforts, the program will apply safety management principles; compile, communicate, and enable best management practices; and support FMCSA enforcement of carrier-related regulations.

*Produce Safer Drivers.* Helps ensure that commercial drivers are physically qualified, trained to perform safely, and mentally alert. Research will improve understanding of driver fatigue and other issues and assess various countermeasures, including roadside safety technologies, driving simulators, collision warning devices, and operational concepts. This program will also support Safety RD&T Strategy 2.

### **FRA**

*Grade Crossings.* Conducts research in grade crossing human factors to address two areas: why highway users have crashes with trains and why people trespass on railroad rights-of-way. In the first research area, the program will conduct field studies and laboratory simulations to examine how train conspicuity and the effectiveness of train horns affect train detection and how driver expectations and motivations affect their willingness to cross; in the second, FRA will continue to study the reasons why people trespass on railroad property, including a U.S.–Canadian study to determine how many trespasser deaths might be suicides.

*Human Factors.* Studies a variety of issues involving human error in railroad operations. The program will emphasize research on the Close Call pilot program, a fatigue model for use in improving rail crew scheduling, human factors issues for dispatchers, human-machine interface issues, remote-controlled locomotive interfaces, ballast ergonomics, and behavior-based safety approaches.

### **NHTSA**

*Crash Avoidance and Human/Vehicle Performance.* Evaluates driver-assistance technologies to ensure that the maximum safety benefits are derived. Research will determine which new technologies have the greatest potential to significantly reduce the number of crashes, and resulting injuries and fatalities, and develop and implement plans to facilitate their widespread deployment. Research into

advanced safety systems will develop suitable human factors guidelines for the driver-vehicle interface associated with many emerging safety technologies.

*Highway Safety Research.* Provides the scientific basis for developing effective programs to reduce the occurrence of crashes due to unsafe driving behaviors. The program will emphasize research in support of NHTSA's goals for reducing alcohol-related fatalities and increasing safety belt use, as well as special initiatives in child passenger safety; pedestrian, bicyclist, and motorcyclist safety; and elderly driver safety and mobility.

**Table 3-1. Key Milestones for Human Factors and Medical Risks**

| Research Product or Information Gained  | FY 07-08 | FY 09-10 |
|---|----------|----------|
| <i>Aeromedical Research</i>   |          |          |
| Epidemiological assessment of toxicological and biomedical factors in aviation accidents and incidents                  | X        | X        |
| Bioaeronautical results, reports, and recommendations to identify human fatigue using functional genomics technology    | X        | X        |
| <i>Air Traffic Control/Technical Operations Human Factors</i>   |          |          |
| New measures of air traffic controller performance for use in training and system development                           | X        |          |
| <i>Flightdeck/Maintenance/System Integration Human Factors</i>  |          |          |
| PC-based Human Factors Certification Job Aid for Parts 25 and 23 flight decks   | X        |          |
| Methods and criteria for systems and equipment to reduce the probability of error by system specialists and technicians | X        |          |
| Methods to improve training and procedures for flight deck distractions during critical flight phases                   | X        |          |
| <i>Safety Research and Innovation Deployment</i>  |          |          |
| Knowledge gained on human factor issues associated with use of the Highway Driving Simulator or Field Research Vehicle  | X        | X        |
| <i>Strategic Highway Research Program II</i>  |          |          |
| Implement and coordinate study design with TRB for selected projects  | X        | X        |
| <i>Surface Transportation Environment and Planning Cooperative Research</i>   |          |          |
| Support safety-conscious planning of systems and improvement processes  | X        | X        |
| <i>Produce Safer Carriers</i>   |          |          |
| Research to support FMCSA rulemaking activities   | X        |          |
| Determine the effects of controlled substance and alcohol use enforcement   | X        |          |
| Provide support for the Comprehensive Safety Analysis 2010 Initiative   | X        |          |

| Research Product or Information Gained   | FY 07-08 | FY 09-10 |
|--|----------|----------|
| <i>Produce Safer Drivers</i>   |          |          |
| Determine driver safety risk factors   | X        |          |
| Evaluate employer notification service for driver violations   | X        |          |
| Conduct a field operational test of an on-board monitoring suite for changing driver behavior  | X        |          |
| Validate truck simulators for training CMV drivers   | X        |          |
| Assess and refine fatigue risk management program  | X        |          |
| <i>Grade Crossings</i>   |          |          |
| <i>Human Factors—Rail</i>  |          |          |
| <i>Crash Avoidance and Human/Vehicle Performance</i>   |          |          |
| Conduct research to understand how vehicle technologies influence driver performance and how the driver-vehicle interface can be enhanced to reduce crash risk | X        | X        |
| <i>Highway Safety Research</i>   |          |          |
| Determine incidence of driver drug use (illicit, prescription, and over-the-counter) and assess potential role in crashes                                      | X        | X        |
| Update and maintain model specifications and Conforming Product Lists for evidential breath test, screening, and ignition interlock devices                    | X        | X        |
| Assess the extent of breath test refusals, ways to increase compliance, and the effects on prosecution and adjudication  | X        | X        |
| Evaluate high-visibility alcohol enforcement techniques  | X        | X        |
| Research fitness-to-drive screening tests and rehabilitation programs for older drivers  | X        | X        |
| Investigate the role of multiple medications in crash risks  | X        | X        |
| Determine effects of motorcycle helmet use law reinstatement, techniques to determine crash causation, and low BAC levels on riding performance                | X        |          |
| Initiate tracking of travel speeds on different roadway types  | X        |          |
| Evaluate automated speed enforcement in school zones   | X        |          |
| Evaluate rational speed limit demonstration programs   | X        |          |
| Evaluate mobilizations to increase safety belt use, nighttime belt use, and programs to increase use of child restraints                                       | X        | X        |

### ***Vehicle, Equipment, and Infrastructure Factors***

Research in this area addresses the safety performance of aircraft and vehicles; crash avoidance and human-vehicle interaction; safety characteristics of highways, rail, pipelines, and other infrastructure; and safety applications of Intelligent Transportation Systems (ITS). Work will include the following RD&T programs:



## FAA

*Advanced Materials/Structural Safety.* Assesses and addresses the safety implications of new and present day composites, alloys, and other materials, and associated structures and fabrication techniques. Researchers will develop analytical and test methods to understand how design, load, and damage can affect composite structures and develop maintenance and repair methods. This program will also support Safety RD&T Strategies 2 and 3.

*Aging Aircraft.* Reduces the number of accidents and incidents associated with the failure of aircraft structures, components, and systems. The program will develop the knowledge, inspection tools, and techniques to prevent or mitigate the effects of safety hazards associated with the aging of airframe structures, engine components, and mechanical and electrical systems.

*Aircraft Catastrophic Failure Prevention Research.* Develops technologies and methods to assess risk and prevent occurrence of potentially catastrophic defects, failures, and malfunctions in aircraft, aircraft components, and aircraft systems. In particular, researchers will assess the use of advanced materials to protect passengers and aircraft critical systems in the event of catastrophic engine failures, and develop and publish guidelines for the use of explicit finite element analysis for analyzing engine failures.

*Airport Technology Research – Safety.* Helps to achieve the overall FAA goal of reducing aviation accidents by improving airport safety. RD&T activities will seek to improve airport lighting and marking, reduce wildlife hazards, improve airport fire and rescue capabilities, and reduce surface accidents. This program will also support Safety RD&T Strategy 3 and the RD&T Strategy for Global Connectivity.

*Fire Research and Safety.* Develops technologies, procedures, test methods, and criteria to prevent accidents caused by hidden in-flight fires and fuel tank explosions and to improve survivability during a post-crash fire. Research will focus on near-term improvements in aircraft fuel tank explosion protection, fire detection and suppression systems, and interior materials fire-test methods and criteria. This program will also support Safety RD&T Strategies 2 and 3 and the RD&T Strategy for Global Connectivity.

*Propulsion and Fuel Systems.* Enhances the airworthiness, reliability, and performance of civil turbine and piston engines, propellers, fuels, and fuel management systems. Researchers will also work with fuel, airframe, and engine manufacturers to test new unleaded fuels as they become available.

*Unmanned Aircraft Systems Research.* Investigates current technological capabilities to sense potential traffic conflicts. Research will determine system characteristics and limitations to enable see-and-avoid capabilities; review safety implications of system impediments to command, control, and communications; assess data concerning flight termination systems; and evaluate historical and current technology development. This program will also support Safety RD&T Strategy 3.

## FHWA

*Center for Excellence in Rural Safety (Safety R&D).* Provides research, training, and outreach on innovative uses of technology to enhance rural safety and economic development, assess local community needs, and improve access to mobile emergency treatment. Among other activities, the program will address the online and seminar training needs of rural transportation practitioners and policy makers.

*Center for Surface Transportation Safety (Safety R&D).* Develops and disseminates advanced transportation safety techniques and innovations in both rural areas and urban communities. The center will use a controlled access highway with state-of-the-art features to test safety devices and techniques that enhance driver performance, to examine advanced pavement and lighting systems, and to develop techniques to address older driver and fatigue issues.

*Cooperative Intersection Collision Avoidance (ITS JPO in partnership with NHTSA).* Helps to save lives by reducing crossing-path crashes. In this initiative, DOT will work in partnership with automotive manufacturers and State and local transportation agencies to pursue an optimized combination of infrastructure- and vehicle-based collision avoidance systems.

*Integrated Vehicle-Based Safety Systems (ITS JPO in partnership with NHTSA).* Addresses the 2.6 million rear-end, run-off-the-road, and lane-change crashes that occur every year. This initiative will seek to establish partnerships with the automotive, commercial vehicle, and transit vehicle industries to accelerate the introduction of integrated vehicle-based safety systems into the Nation's vehicle fleet.

*Safety Research and Innovation Deployment Program (Safety R&D).* Demonstrates the application of innovative technologies in highway safety and supports the deployment and evaluation of safety innovations at the State and local levels. In this research area, work will include the deployment of best practices in highway planning and design. This program will also support Safety RD&T Strategy 2.

*Vehicle-Infrastructure Integration (ITS JPO in partnership with NHTSA).* Researches the use of vehicles to anonymously transmit information on traffic and road conditions from every major road in the transportation network. With respect to safety, this initiative will address the 21,000 deaths that occur annually as a result of roadway departures and intersection-related incidents by working toward the deployment of advanced vehicle and infrastructure systems designed to prevent roadway departures and enhance intersection safety. This program will also support Reduced Congestion RD&T Strategy 1.

## FMCSA

*Improve Safety of Commercial Motor Vehicles.* Improves truck and motor coach safety performance through applications of technology. This program will evaluate vehicle designs to improve driver health and safety, assess the impact of new vehicle technology, and evaluate and seek to increase the use of safety countermeasures such as onboard monitoring systems.

## FRA

*Integrated Track Stability Assessment and Monitoring System.* Provides a grant to Marshall University and the University of Nebraska to develop remote sensing technologies that can be integrated and deployed in a mobile inspection vehicle to monitor rail track. (This project will be completed in FY 2006.)

*Railroad System Issues.* Provides for research in railroad systems safety for equipment and track, railroad systems, and locomotives. In this research area, the program will address the inspection techniques, methodologies, and equipment necessary to ensure early and reliable detection of defects and unsafe conditions. This program will also support Safety RD&T Strategy 2 and Security RD&T Strategies 1 and 2.

*Rolling Stock and Components.* Researches on-board condition monitoring systems (OBCMS), wayside monitoring systems, and material and design improvements. Research will also focus on demonstrating an Advanced Concept Train (ACT), which will consist of the OBCMS along with advanced couplers; advanced hand brakes; advanced angle cocks; brake sensors; condition monitoring sensors; a communication system to transmit sensor data to the locomotive (and perhaps to wayside monitoring systems); and an internet-accessible site in which the data may be accessed by maintenance facilities.

*Track and Structures.* Conducts research on rail inspection techniques, material and component reliability, track and structure design and performance, and track stability data processing and feedback. Working in cooperation with the railroad industry and suppliers, the program will continue development of automated systems for rail defect detection, high-speed video joint bar inspection, and track geometry inspection. This program will also support Reduced Congestion RD&T Strategy 2.

*Track and Train Interaction.* Researches the interaction among the train suspension system, wheels, and track to determine the influence of track geometry, wheel and rail profile, rail lubrication, and vehicle and track parameters on safety and performance. The program will seek to understand the causes of derailments, develop solutions to prevent them, and enhance FRA's vehicle and track performance modeling and simulation capabilities.

*Train Control.* Develops train control standards and equipment for locomotives. The focus of the program will be on developing various train control segments and related telecommunications needed to implement a nationwide positive train control system. This program will also support Reduced Congestion RD&T Strategy 3.

## FTA

*Identify Solutions to Improve Transit Safety (Improve Safety and Emergency Preparedness).* Assists States, local transit authorities, and the transit industry through safety technical assistance and improved technology and training programs. In this research area, FTA will evaluate the impact of new vehicle and infrastructure technologies and work with other DOT operating administrations to test the fire safety of composites and interior materials and to improve railroad

grade crossing technologies. This program will also support Safety RD&T Strategy 2.

## **NHTSA**

*Crash Avoidance Initiative.* Analyzes crash data to identify safety problems and benefits of new electronic technologies and develops methodologies and performance criteria to test and evaluate these technologies.

*Heavy Vehicles.* Develops the scientific basis for improving heavy vehicle safety. The program will make heavy vehicles less prone to crashes through improvements in their braking, handling, and visibility characteristics; by mitigating the consequences of collisions that occur between heavy trucks and other vehicles; and by improving driver performance through use of advanced technologies.

*Pneumatic Tire Research.* Seeks to reduce passenger vehicle and truck crashes due to aging or under inflated tires by developing test procedures and performance requirements.

## **OST**

*Navigation and Spectrum Policy.* Supports the formulation of positioning, navigation, and spectrum policy and the civilian management and use of the GPS. This effort will coordinate performance monitoring of the GPS civil signal with all civilian agencies, assure uninterrupted access to radio spectrum for safety-of-life radionavigation services and systems, and support the development and launch of GPS satellites with the new L5 "safety of life" signals. This program will also support Reduced Congestion RD&T Strategies 3 and 4 and the RD&T Strategy for Global Connectivity.

*Safety, Energy, and Environment.* Conducts policy research to support the formulation and recommendation of Departmental policies, plans, and guidelines related to public health and safety. Efforts in this area will assess the effectiveness of various techniques for accelerating application and adoption of safety technologies. This program will also support Reduced Congestion RD&T Strategies 1 and 5 and Environmental RD&T Strategy 1.

## **PHMSA**

*Pipeline Safety R&D.* Improves pipeline inspection and analysis tools and strengthens the industry's ability to effectively manage pipeline integrity. Research will address promising technologies for improving pipeline safety, including better corrosion detection technology and direct assessment techniques; improved tools for preventing and detecting damage and leaks; and materials that can better withstand third-party damage, corrosion, and cracking. This program will also support Environmental RD&T Strategy 1.

**Table 3-2. Milestones for Vehicle, Equipment, and Infrastructure Factors**

| <b>Research Product or Information Gained</b>  | <b>FY 07-08</b>       | <b>FY 09-10</b>    |
|--|-----------------------|--------------------|
| <i>Advanced Materials/Structural Safety</i><br>Knowledge base for the safe use of advanced materials in aircraft   | X                     |                    |
| <i>Aging Aircraft</i><br>New technologies and tools to ensure the continued airworthiness of aircraft structures, components, and systems  | X                     |                    |
| <i>Aircraft Catastrophic Failure Prevention</i><br>Guidelines for the use of explicit finite element analysis for analyzing engine failures  | X                     |                    |
| <i>Airport Technology</i><br>Improved visual guidance systems to reduce runway incursions<br>Improved airport design methods and improved runway friction  | X<br>X                | X<br>X             |
| <i>Fire Research and Safety</i><br>Improved fire-test criteria for hidden materials  | X                     |                    |
| <i>Propulsion and Fuel Systems</i><br>Tools, guidelines, and data to support improvements in turbine engine certification requirements   | X                     |                    |
| <i>Unmanned Aircraft Systems</i><br>Identify, assess, develop, and test flight termination technologies and procedures<br>Perform risk assessments<br>Develop risk management concepts, models, and tools<br>Develop and analyze methodologies for safety management of operations<br>Conduct flight test research program | X<br>X<br>X<br>X<br>X | <br><br><br>X<br>X |
| <i>Center for Excellence in Rural Safety</i><br>Disseminate safety countermeasures to counties and localities  | X                     | X                  |
| <i>Center for Surface Transportation Safety</i><br>Research results on examination of advanced roadway delineation and lighting systems  | X                     | X                  |
| <i>Cooperative Intersection Collision Avoidance</i><br>Field-tested countermeasures for crashes from signal and stop sign violations<br>Field-tested countermeasures for crashes from stop sign gap acceptance<br>Field-tested countermeasures for crashes from signalized, unprotected left turns                         |                       | <br>X<br>X<br>X    |
| <i>Integrated Vehicle-Based Safety Systems</i><br>Field operational test   |                       | X                  |

| <b>Research Product or Information Gained</b>  | <b>FY 07-08</b> | <b>FY 09-10</b> |
|--|-----------------|-----------------|
| <i>Safety Research and Innovation Deployment</i>   |                 |                 |
| Improved safety analysis methods for intersections or highway interchanges                             | X               | X               |
| Evaluation of alternative highway safety countermeasures for priority treatments decided by the states | X               | X               |
| <i>Vehicle-Infrastructure Integration</i>  |                 |                 |
| Field operational test   | X               |                 |
| <i>Improve Safety of Commercial Motor Vehicles</i>   |                 |                 |
| Research hazardous materials cargo tank design   | X               |                 |
| Promote the implementation of technology-based solutions by the motor carrier industry                 | X               |                 |
| Conduct a field operational test of indirect viewing systems   | X               |                 |
| Research cargo tanks in lethal service   | X               |                 |
| <i>Railroad System Issues</i>  |                 |                 |
| <i>Rolling Stock and Components</i>  |                 |                 |
| <i>Track and Structures</i>  |                 |                 |
| <i>Track and Train Interaction</i>   |                 |                 |
| <i>Train Control</i>   |                 |                 |
| <i>Identify Solutions to Improve Transit Safety</i>  |                 |                 |
| Demonstrate methods, techniques, and technologies to improve safety                                    | X               | X               |
| Update FTA Subway Environmental Simulation Software  | X               |                 |
| Fire materials testing   | X               |                 |
| <i>Crash Avoidance Initiative</i>  |                 |                 |
| Develop and validate crash avoidance test procedures   |                 | X               |
| <i>Heavy Vehicles</i>  |                 |                 |
| Complete safety benefits evaluation of truck tractor and semi-trailer stability control technologies   | X               |                 |
| Develop performance requirements and objective tests for tractor-trailer stability control             |                 | X               |
| Complete safety benefits evaluation for straight truck stability control technology                    |                 | X               |
| <i>Pneumatic Tire Research</i>   |                 |                 |
| Complete tire aging research   | X               |                 |
| <i>Navigation and Spectrum Policy</i>  |                 |                 |
| <i>Safety, Energy, and Environment</i>   |                 |                 |
| <i>Pipeline Safety</i>   |                 |                 |
| Improvements in pipeline damage prevention and leak detection  | X               | X               |
| Improvements in pipeline operations, controls, and monitoring  | X               | X               |
| Improvements in material performance and other pipeline safety issues                                  | X               | X               |

### ***Operational Factors***

This research seeks to understand and address the operational elements involved in transportation accidents and incidents, particularly those related to weather events, runway incursions, grade crossings, and derailments. Specific RD&T programs will include:

#### **FAA**

*Advanced Technology Development and Prototyping.* Improves operational safety through the following research activities:

- *General Aviation and Vertical Flight Technology*—Will emphasize the direct needs of light general aviation airplanes, helicopters, and tilt rotor aircraft.
- *Runway Incursion Reduction*—Will select and evaluate runway incursion reduction technologies to validate their technical performance and operational suitability.
- *Safer Skies*—Will develop guidance materials and revisions to Advisory Circulars, Aeronautical Information Manuals, Handbook Bulletins for Air Transportation, and Notices to Airmen.
- *Safe Flight 21 – Alaska Capstone*—Will improve aviation system safety in Alaska through the introduction of new communications, navigation, and surveillance technologies.
- *Wind Profiling and Weather Research*—Will generate turbulence advisories and wind information used by commercial and general aviation pilots in the Juneau area. (This project will be completed in FY 2008.)

*Atmospheric Hazards/Digital System Safety.* Reduces aviation's vulnerability to in-flight icing and other atmospheric hazards. The program will develop and test technologies to detect frozen contamination, predict anti-icing fluid failure, and ensure safe operations in atmospheric icing conditions; and develop technologies, advisories, and guidance materials to ensure safe operation in electromagnetic hazards resulting from electromagnetic interference, cosmic radiation, high-intensity radiated fields, and lightning. This program will also support Safety RD&T Strategy 3.

*Weather Program.* Strives to reduce the number of accidents associated with weather and to minimize the impacts of adverse weather events on NAS operational capacity. Research will increase safety and capacity by developing new technologies for providing accurate, accessible, and efficient weather observations, warnings, and forecasts. This program will also support Reduced Congestion RD&T Strategy 4.

#### **FHWA**

*Exploratory Advanced Research (Corporate Activities).* Addresses longer-term, higher-risk research with potentially dramatic breakthroughs for improving the safety aspects of highway and intermodal transportation systems. Among the topics that the program will address are bicycle and pedestrian safety. This program will also support Reduced Congestion RD&T Strategies 2, 3, and 4 and Environmental RD&T Strategy 1.

## FRA

*Grade Crossings.* Provides for the continued installation of crossing warning systems in designated high-speed corridors and demonstrates innovative grade crossing systems. The program will investigate improvements to existing systems, develop new components and systems, and resolve grade crossing problems such as false and mixed activations.

*Train Control.* Assists States, railroads, and suppliers to develop and deploy positive train control systems as a safety overlay to prevent train collisions, overspeed derailments, and roadway worker injuries due to operational errors. This program will also support Reduced Congestion RD&T Strategy 3.

## FTA

*Identify Solutions to Improve Transit Safety (Improve Safety and Emergency Preparedness).* Assists States, local transit authorities, and the transit industry through safety technical assistance and improved technology and training programs. In this area, the program will provide training to the transit workforce on accident prevention and investigation, bus operator safety, and industrial safety. This program will also support Safety RD&T Strategy 2.



**Table 3-3. Milestones for Operational Factors**

| <b>Research Product or Information Gained</b>   | <b>FY 07-08</b> | <b>FY 09-10</b> |
|---|-----------------|-----------------|
| <i>General Aviation and Vertical Flight Technology</i><br>Develop pilot and inspector guidance for enhanced vision for light general aviation aircraft<br>Develop pilot and inspector guidance for helicopter and light general aviation synthetic vision displays                        | X               | X               |
| <i>Runway Incursion Reduction</i><br>Develop runway take-off hold lights<br>Evaluate low-cost surface surveillance systems  | X<br>X          |                 |
| <i>Safer Skies</i><br>Develop and implement interventions for commercial and general aviation for runway incursion, approach and landing, loss of control, and weather<br>Develop policy, regulations, and certification guidelines and standards for unmanned aircraft system operations | X<br>X          | X<br>X          |
| <i>Safe Flight 21</i><br>Develop and demonstrate a prototype satellite communication system that will complement ground-based receivers<br>Test surveillance of mixed-equipped (transponder and Automatic Dependent Surveillance-Broadcast) aircraft                                      | X<br>X          |                 |
| <i>Atmospheric Hazards/Digital System Safety</i><br>Publish guidance for the mitigation of electromagnetic hazards<br>Develop and validate technologies, tools, methodologies, and procedures regarding ice contamination of aircraft   | X<br>X          |                 |
| <i>Weather Program</i><br>Develop and make available electronically high-glance-value weather products with longer forecast lead times and increased accuracy   |                 | X<br>(2015)     |
| <i>Exploratory Advanced Research</i><br>Explore data acquisition and analysis techniques for improved system monitoring and operational performance   | X               | X               |
| <i>Grade Crossings</i>  |                 |                 |
| <i>Train Control</i>  |                 |                 |
| <i>Identify Solutions to Improve Transit Safety</i><br>Provide training at the Transportation Safety Institute<br>Update safety clearinghouse and website   | X<br>X          | X               |

***Hazardous Materials Transportation***

RD&T programs in this area seek to identify and mitigate the risks inherent in the transportation of hazardous materials. Over the next five years, these efforts will include the following:

**FMCSA**

*Advance Safety Through Information-based Initiatives.* Improves the safety and productivity of commercial motor vehicle operations through the application of information systems and technologies. In this research area, the program will assess factors related to serious crashes involving hazardous materials.

**FRA**

*Hazardous Materials Transportation.* Conducts research in hazardous materials transportation safety, damage assessment and inspection, and tank car safety. Research will focus on tank car thermal protection, gasket materials, and operating environments; fitting protection; and evaluation of emergency breathing equipment for train crews. This program will also support Environmental RD&T Strategy 1.

**OST**

*Safety, Energy, and Environment.* Conducts policy research to support the formulation and recommendation of Departmental policies, plans, and guidelines related to public health and safety. Efforts in this area will address policies for coordinating hazardous materials inspection and enforcement between DOT's operating administrations and the economic and safety regulation of petroleum products pipelines. This program will also support Reduced Congestion RD&T Strategies 1 and 5 and Environmental RD&T Strategy 1.

**PHMSA**

*Hazardous Materials Safety R&D.* Provides the foundation for PHMSA's hazardous material regulatory, enforcement, and emergency response actions. The program will research the risks surrounding the transportation of hazardous materials and identify ways to minimize those risks and mitigate the consequences of such an incident, including packaging design and testing, database development, emergency response, hazard identification, human factors, root-cause analysis, and consequence modeling. This program will include Hazardous Materials Transportation Cooperative Research, an FHWA-funded pilot program administered by the National Research Council, and will also support the RD&T Strategy for Global Connectivity, Environmental RD&T Strategy 1, and Security RD&T Strategy 2.

**Table 3-4. Milestones for Hazardous Materials Transportation**

| Research Product or Information Gained                      | FY 07-08 | FY 09-10 |
|---|----------|----------|
| <i>Advance Safety Through Information-Based Initiatives</i> |          |          |
| Expand crash analysis of series hazmat incidents            | X        |          |
| Enhance hazmat shipper prioritization algorithm             | X        |          |
| <i>Hazardous Materials Transportation—Rail</i>              |          |          |
| <i>Safety, Energy, and Environment</i>                      |          |          |

| Research Product or Information Gained  | FY 07-08 | FY 09-10 |
|---|----------|----------|
| <i>Hazardous Materials Safety</i>   |          |          |
| Hazardous Materials Transportation Cooperative Research Program                               | X        | X        |
| Develop risk management and risk analysis tools   | X        | X        |
| Enhance databases   | X        | X        |
| Conduct root-cause analysis of hazardous materials incidents                                  | X        | X        |
| Assess nondestructive testing techniques and methodologies                                    | X        | X        |
| Develop 2008 Emergency Response Guidebook   | X        |          |
| Identify hazards  | X        | X        |
| Survey advanced technologies with potential application to hazardous materials transportation |          | X        |
| Conduct performance-oriented package testing  | X        | X        |
| Evaluate and enhance emergency response capabilities  | X        | X        |

***Safety Data, Information Systems, and Risk Analysis***

This broad research area encompasses DOT efforts in safety data collection and analysis, risk analysis and risk management, and automated safety information systems. It will encompass the following RD&T activities during the next five years:

**Emerging Research Priority: Application of Enhanced Safety Data and Knowledge**

Application of digital technology throughout the transportation enterprise produces large quantities of safety-relevant data. The research challenge is to convert these data into useful knowledge that can improve transportation safety. The objective is to provide decision makers—aviation, vehicle safety, rail, motor carrier, hazardous materials, and pipeline safety inspectors—with the information they need to make better safety decisions.

Key Supporting RD&T Programs:

- Aviation Safety Risk Analysis
- Safety Research and Innovation Deployment
- Transportation Safety Information Management System
- Advance Safety through Information-Based Initiatives
- Railroad System Issues
- Improve Transit Safety
- Data Analysis Program
- Early Fatality Notification System
- Fatality Analysis Reporting System
- National Automotive Sampling System
- National Motor Vehicle Crash Causation Survey
- Special Crash Investigations
- State Data Program
- Hazardous Materials Safety R&D

**FAA**

*Aviation Safety Risk Analysis.* Improves safety by developing risk management methodologies, tools, technical information, procedures, and practices. In

collaboration with industry, researchers will ensure that risk management decision support tools are properly defined, developed, tested, and evaluated prior to implementation and that changes to regulations, advisory materials, and procedures are implemented in a timely manner.

#### **FHWA**

*Safety Research and Innovation Deployment Program (Safety R&D).*

Demonstrates the application of innovative technologies in highway safety and supports the deployment and evaluation of safety innovations at the State and local levels. In this research area, the program will analyze data contained in the Highway Safety Information System. This program will also support Safety RD&T Strategy 2.

*Transportation Safety Information Management System (Safety R&D).* Further develops software applications for the collection, integration, management, and dissemination of safety data from—and for use among—State and local safety and transportation agencies. Data will include driver licensing, vehicle registration, emergency management systems, injury surveillance, roadway inventories, and motor carrier databases.

#### **FMCSA**

*Advance Safety Through Information-Based Initiatives.* Applies information systems and technologies to improve the safety and productivity of commercial motor vehicle operations. A key effort will be to continue national deployment of and to expand Commercial Vehicle Information Systems and Networks (CVISN) capabilities.

#### **FRA**

*Grade Crossings.* Provides for the continued installation of crossing warning systems in designated high-speed corridors and demonstrates innovative grade crossing systems.

*Railroad System Issues.* Provides for research in railroad systems safety for equipment and track, railroad systems, and locomotives. The program will include risk analysis on accident frequency, distribution, patterns, and consequences and maintain a Geographic Information System (GIS) database for information on railroad networks. This program will also support Safety RD&T Strategy 2 and Security RD&T Strategies 1 and 2.

*Train Control.* As required by Federal regulations, develops risk assessment methods for determining that any new microprocessor-based train control system is equal to or better than conventional systems as base cases, in terms of risk mitigation and accident prevention. This program will also support Reduced Congestion RD&T Strategy 3.

#### **FTA**

*Identify Solutions to Improve Transit Safety (Improve Safety and Emergency Preparedness).* Assists States, local transit authorities, and the transit industry through safety technical assistance and improved technology and training

programs. The program will support an enhanced safety and security data analysis process and produce the Transit Safety and Security Statistics Report. *This program will also support Safety RD&T Strategy 2.*

## **NHTSA**

*Data Analysis Program.* Provides timely and pertinent safety data analyses and supports public communication campaigns. By providing safety information to both internal and external customers, this program will continue to assist NHTSA with its mission of reducing crash fatalities and injuries.

*Early Fatality Notification System.* Will provide real- or near-real-time data on the number of fatalities resulting from motor vehicle crashes. This data will allow NHTSA to provide timely information to Congress, assist States in their safety programs, and inform the public about the state of highway safety.

*Fatality Analysis Reporting System (FARS).* Provides a census of all fatal highway crashes in the 50 states, District of Columbia, Puerto Rico, and the Virgin Islands. FARS data will serve as the basis for the majority of NHTSA's data-driven programs over the next five years.

*National Automotive Sampling System (NASS).* Provides NHTSA and other users with nationally representative data on motor vehicle crashes. Through the NASS General Estimates System and Crashworthiness Data System, this program will continue to assist the agency in assessing motor vehicle crash trends and the interaction of occupants and vehicles in real-world crashes.

*National Motor Vehicle Crash Causation Survey.* Provides researchers with the scientific data needed to identify the specific factors or events that lead up to a crash. These data will be useful in identifying the most beneficial crash-avoidance technologies and in evaluating the potential of emerging countermeasures.

*Special Crash Investigations.* Collects and examines data from thousands of crashes to identify vehicle problems early on. A specific focus of the program will be to continue the collection and analysis of data on crashes involving vehicles equipped with advanced occupant protection systems to determine how well they perform in real-world crashes.

*State Data Program.* Works with State agencies to expand the inventory and availability of state-level crash and medical outcome data. This program will continue to complement NHTSA's national data systems by providing crucial information about the medical and financial burdens of highway crashes and as a supplementary source of crash data used in defect analysis and new technology evaluation.

**Table 3-5. Milestones for Safety Data, Information Systems, and Risk Analysis**

| Research Product or Information Gained   | FY 07-08 | FY 09-10 |
|--|----------|----------|
| <i>Aviation Safety Risk Analysis</i>   |          |          |
| Prototypes for enhanced risk management decision support systems   | X        |          |
| <i>Safety Research and Innovation Deployment</i>   |          |          |
| Reports from studies using Highway Safety Information System data  | X        | X        |
| Specifications for a Digital Highway Measurement System that records roadway data at state-of-the-art precision levels | X        | X        |
| <i>Transportation Safety Information Management System</i>   |          |          |
| <i>Advance Safety Through Information-Based Initiatives</i>  |          |          |
| Support the deployment of expanded CVISN capabilities by States, the motor carrier industry, and other stakeholders    | X        |          |
| <i>Grade Crossings</i>   |          |          |
| <i>Railroad System Issues</i>  |          |          |
| <i>Train Control</i>   |          |          |
| <i>Identify Solutions to Improve Transit Safety</i>  |          |          |
| Collect data for Transit Safety and Security Statistics Report   | X        | X        |
| <i>Data Analysis Program</i>   |          |          |
| Publish traffic safety data in a timely manner   | X        | X        |
| <i>Early Fatality Notification System</i>  |          |          |
| Publish traffic safety data in a timely manner   | X        | X        |
| <i>Fatality Analysis Reporting System</i>  |          |          |
| Publish traffic safety data in a timely manner   | X        | X        |
| <i>National Automotive Sampling System</i>   |          |          |
| Publish traffic safety data in a timely manner   | X        | X        |
| <i>National Motor Vehicle Crash Causation Survey</i>   |          |          |
| Publish traffic safety data in a timely manner   | X        | X        |
| <i>Special Crash Investigations</i>  |          |          |
| Publish traffic safety data in a timely manner   | X        | X        |
| <i>State Data Program</i>  |          |          |
| Publish traffic safety data in a timely manner   | X        | X        |

## Mitigate the Consequences of Accidents and Incidents

A primary objective for the Department is to support the development of technologies, standards, and procedures that mitigate the consequences of accidents and incidents that occur. In particular, DOT seeks to minimize crash-related fatalities and injuries. Over the next five years, RD&T in two primary research areas will advance this Departmental strategy: emergency response and operations, and crashworthiness and occupant protection.

### *Emergency Response and Operations*

The objective of this research is to reduce fatalities and injuries through more effective incident and emergency response. The following RD&T programs will support this area:

#### **FHWA**

*Emergency Transportation Operations (ITS JPO)*. Improves operational technology and practices to enable the safe and effective movement of people and goods during emergency evacuation situations (both with and without notice). The program will address the application of ITS technologies to improve notice and no-notice evacuation planning and execution, with an orientation that includes both decisionmakers and evacuees. This program will also support Reduced Congestion RD&T Strategy 1 and Security RD&T Strategy 1.

*Next-Generation 911 (ITS JPO)*. Aims to establish the foundation for public emergency communications services in a wireless mobile society. This ITS initiative will enable an enhanced 9-1-1 system that permits the transmission of voice, data, or video from any communication device to Public Safety Answering Points and onto emergency responder networks. This program will also support Security RD&T Strategy 1.

#### **FTA**

*Identify Solutions to Improve Transit Emergency Preparedness (Improve Safety and Emergency Preparedness)*. Assists States, transit authorities, and the industry through safety technical assistance and improved technology and training. Research will address methods, techniques, technologies, and training to improve emergency preparedness, including a web-based approach to managing emergency incidents. This program will also support Security RD&T Strategy 1.

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### Safety RD&T

- Understand and Address Causal Factors and Risks
- **Mitigate Accidents and Incidents**
- Assess Impacts of New Technologies, Vehicles, Concepts, Designs, and Procedures

**Table 3-6. Milestones for Emergency Response and Operations**

| Research Product or Information Gained  | FY 07-08 | FY 09-10 |
|---|----------|----------|
| <i>Emergency Transportation Operations</i><br>Real-time evacuation tool evaluation and technology transfer  | X        |          |
| <i>Next-Generation 911</i><br>Evaluation of next generation 9-1-1 framework and transition plan   | X        |          |
| <i>Identify Solutions to Improve Transit Emergency Preparedness</i><br>See milestones for "Preparedness and Response" under Security RD&T Strategy 1. |          |          |

### ***Crashworthiness and Occupant Protection***

This critical area looks at assuring the crashworthiness of aircraft and vehicles and protecting occupants from injuries when accidents and incidents occur. The following RD&T programs will address this research area:

#### **FAA**

*Advanced Materials/Structural Safety.* Assesses and addresses the safety implications of new and present day composites, alloys, and other materials, and associated structures and fabrication techniques. Researchers will develop analytical and test methods to understand how design, load, and damage can affect composite structures and to develop maintenance and repair methods. This program will also support Safety RD&T Strategies 1 and 3.

*Aeromedical Research.* Improves the safety of passengers, aircrews, and other human assets in the NAS in support of FAA's regulatory guidelines. Research will address biodynamic crash protection, particularly the mechanisms and benefits of improved crash survival systems such as seat designs, restraint systems, airbags, and other advanced safety technology. This program will also support Safety RD&T Strategies 1 and 3 and Reduced Congestion RD&T Strategy 6.

*Fire Research and Safety.* Develops technologies, procedures, test methods, and criteria to prevent accidents caused by hidden in-flight fires and fuel tank explosions and to improve survivability during a post-crash fire. Research will focus on near-term improvements in fire detection and suppression systems and fire-test methods and the development of criteria for interior materials. This program will also support Safety RD&T Strategies 1 and 3 and the RD&T Strategy for Global Connectivity.

#### **FHWA**

*Safety Research and Innovation Deployment Program (Safety R&D).* Demonstrates the application of innovative highway safety technologies and supports the deployment and evaluation of these innovations. A portion of



program funding will be allocated to assess roadside hardware used to mitigate crash severity. This program will also support Safety RD&T Strategy 1.

#### **FMCSA**

*Produce Safer Drivers.* Ensures that commercial drivers are physically qualified, trained to perform safely, and mentally alert. One element of this research and technology program will be to enhance the use of safety belts within the trucking industry. This program will also support Safety RD&T Strategy 1.

#### **FRA**

*Railroad System Issues.* Provides for research in railroad systems safety for equipment and track, railroad systems, and locomotives. In this area, the program will address passenger car fire safety. This program will also support Safety RD&T Strategy 1 and Security RD&T Strategies 1 and 2.

*Train Occupant Protection.* Conducts research on locomotive and passenger car safety. The program will emphasize research on rail car crashworthiness, including crash energy management designs for both single and bi-level rail cars.

#### **FTA**

*Identify Solutions to Improve Transit Safety (Improve Safety and Emergency Preparedness).* Assists states, local transit authorities, and the transit industry through safety technical assistance and improved technology and training programs. Research will address such topics as the crashworthiness of light rail vehicles. This program will also support Safety RD&T Strategy 1.

#### **NHTSA**

*Human Injury Research.* Applies engineering principles to the study of the tolerance of the human body to impact. The program will employ testing and computer simulation to deduce the mechanisms of injury to affected body regions and to apply understanding of these mechanisms to the development of new injury criteria, test methods, and test devices—such as automotive crash test dummies—that lead to countermeasures to reduce injury.

*Safety Systems.* Seeks to reduce serious injuries resulting from motor vehicle crashes and to support rulemaking mandates in SAFETEA-LU. Research will identify and clarify the crash injury problem, analyze the benefits of specific countermeasures, and develop objective tests for countermeasures offering the greatest safety benefits; with the advent of new technologies it will be possible to approach safety countermeasure development in an integrated fashion from crash prevention to severity reduction and crash protection.

**Table 3-7. Milestones for Crashworthiness and Occupant Protection**

| <b>Research Product or Information Gained</b>  | <b>FY 07-08</b> | <b>FY 09-10</b> |
|--|-----------------|-----------------|
| <i>Advanced Materials/Structural Safety</i><br>Report on neck injury certification criteria for side-facing seats  | X               |                 |
| <i>Aeromedical Research</i><br>Bioaeronautical results, reports, and recommendations to define mechanisms and benefits of improved crash survival systems              | X               | X               |
| Enhanced escape slide/system performance, evacuation processes, and survivability technology   | X               | X               |
| <i>Fire Research and Safety</i><br>Criteria for effective use of hand-held or fixed extinguishing systems to put out in-flight fires                                   | X               |                 |
| <i>Safety Research and Innovation Deployment</i><br>Assess roadside hardware crashworthiness   | X               | X               |
| <i>Produce Safer Drivers</i><br>Develop low-cost technology to require safety belt use to operate a CMV  | X               |                 |
| <i>Railroad System Issues</i><br>Update fire safety standards for rail passenger cars  | X               |                 |
| Develop emergency evacuation procedures using the new rollover rig   |                 | X               |
| <i>Train Occupant Protection</i><br>Develop crash energy management design for bi-level car  |                 | X               |
| Develop seat and interior design for rail passenger car  | X               |                 |
| <i>Identify Solutions to Improve Transit Safety</i><br>Examine light rail and commuter rail crashworthiness improvements   |                 | X               |
| <i>Human Injury Research</i><br>Identify injury risks for vulnerable automobile occupants and create injury criteria for advanced side impact dummies                  | X               | X               |
| Develop finite element computer model and associated software to assess brain injury mechanisms  | X               | X               |
| <i>Safety Systems</i><br>Develop test and evaluation procedures for remote sensing occupant protection systems through cooperative research with industry stakeholders | X               | X               |
| Develop test and evaluation procedures for enhancing frontal vehicle-vehicle compatibility   | X               | X               |
| Develop test and evaluation procedures for preventing occupant ejection in rollovers   | X               |                 |

## Assess Impacts of New Technologies, Vehicles, Concepts, Designs, and Procedures

This RD&T strategy directly supports the regulatory missions of the Department's operating administrations by ensuring the safety of new and emerging aircraft, vehicles, airports, commercial space operations, and digital systems. RD&T activities will support safety rulemaking and assess novel technologies and concepts before they are introduced into transportation operations. For each of the key areas, operating administration programs are summarized and key milestones listed for the next four fiscal years.

### *Safety Rulemaking and Advanced Technologies*

Over the next five years, the following operating administration programs will directly support the Department's responsibilities for ensuring the safety of transportation technologies, operations, and procedures:

#### **FAA**

*Advanced Materials/Structural Safety.* Assesses and addresses the safety implications of new and present day composites, alloys, and other materials, and associated structures and fabrication techniques. Researchers will develop analytical and test methods to understand how design, load, and damage can affect composite structures and develop maintenance and repair methods. This program will also support Safety RD&T Strategies 1 and 2.

*Aeromedical Research.* Improves the safety of passengers, aircrew, and other human assets in the NAS in support of FAA's regulatory guidelines. In this area, the program will assess the impact of rapidly evolving medical diagnostics, treatments, and therapeutics technology on existing airman medical certification standards designed to ensure aviation safety. This program will also support Safety RD&T Strategies 1 and 2 and Reduced Congestion RD&T Strategy 6.

*Airport Technology Research – Safety.* Develops standards and guidance material for airport design, construction, and maintenance. In particular, the program will develop guidance material for improving airport lighting and marking to help reduce surface accidents and runway incursions; for improving aircraft rescues and firefighting; and for new techniques for wildlife mitigation. This program will also support Safety RD&T Strategy 1 and the RD&T Strategy for Global Connectivity.

*Atmospheric Hazards/Digital System Safety.* Reduces aviation's vulnerability to in-flight icing and other atmospheric hazards. Researchers will develop and test technologies to detect frozen contamination, predict anti-icing fluid failure, and ensure safe operations in atmospheric icing conditions; develop technologies and advisory and guidance materials to ensure safe operation in electromagnetic hazards; and ensure the safe operation of emerging, highly complex software-based digital flight controls and avionics systems. This program will also support Safety RD&T Strategy 1.

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#### **Safety RD&T**

- Understand and Address Causal Factors and Risks
- Mitigate Accidents and Incidents
- **Assess Impacts of New Technologies, Vehicles, Concepts, Designs, and Procedures**

*Commercial Space Transportation.* Ensures safety of the public during a commercial launch or re-entry activity and encourages, facilitates, and promotes U.S. commercial space transportation. The program will research the operations and maintenance activities of reusable launch vehicle (RLV) developers, providing information that will be valuable in developing commercial human space flight safety regulations.

*Fire Research and Safety.* Develops technologies, procedures, test methods, and criteria to prevent accidents caused by hidden in-flight fires and fuel tank explosions and to improve survivability during a post-crash fire. Research will focus on near-term improvements in aircraft fuel tank explosion protection, fire detection and suppression systems, and interior materials fire test methods and criteria, as well as long-range research to develop the enabling technology for ultra-fire-resistant cabin materials. This program will also support Safety RD&T Strategies 1 and 2 and the RD&T Strategy for Global Connectivity.

*Unmanned Aircraft Systems Research.* Investigates current technological capabilities to sense potential traffic conflicts. Research will determine system characteristics and limitations to enable see-and-avoid capabilities; review safety implications of system impediments to command, control, and communications; assess data concerning flight termination systems; and evaluate historical and current technology development. This program will also support Safety RD&T Strategy 1.

## NHTSA

*Advanced Technologies Research.* Systematically evaluates new safety technologies in real-world crash scenarios. The program will conduct research, testing, and analysis of new technologies and develop deployment strategies. This activity will be funded through other NHTSA RD&T programs and does not appear in the funding tables in Appendix C.

*Hydrogen Initiative.* Seeks to ensure that hydrogen internal combustion engine and fuel-cell-powered vehicles attain a level of safety comparable to other vehicles. NHTSA will conduct risk assessments of hydrogen-fueled vehicles to quantify potential failures that could indicate unsafe conditions. This program will also support Environmental Stewardship RD&T Strategy 1.

*Plastic and Composite Vehicles.* In partnership with industry, develops an automotive safety roadmap for incorporating plastics and composite materials into automotive designs. (This project will be completed in FY 2006.)

## RITA

*Hydrogen Fuels Safety R&D (Multimodal RD&T)*—Executes, coordinates, and identifies research, development, demonstration, and testing of technologies that have multimodal transportation applications. The program will support the President's Hydrogen Initiative through work with other agencies to evaluate hydrogen delivery infrastructure concepts, transportation and vehicle fuel system containers and components, and in-service inspection technologies, and will also support the development of appropriate consensus codes and standards. This program will also support Environmental Stewardship RD&T Strategy 1.

*Hydrogen Powered Research.* Supports a hydrogen-powered transportation research initiative at the University of Montana. RITA will manage this grant, which will be funded through FHWA's RD&T program. This program will also support Environmental Stewardship RD&T Strategy 1.

**Table 3-8. Milestones for Safety Rulemaking and Advanced Technologies**

| Research Product or Information Gained   | FY 07-08 | FY 09-10 |
|--|----------|----------|
| <i>Advanced Materials/Structural Safety</i><br>Neck injury certification criteria for side-facing seats  | X        |          |
| <i>Aeromedical Research</i><br>Advanced molecular biochemical techniques to enhance aviation forensic toxicology analysis                                | X        | X        |
| <i>Airport Technology</i>  |          |          |
| <i>Atmospheric Hazards/Digital System Safety</i><br>Guidelines for testing, evaluation, and certification of digital flight controls and avionic systems | X        |          |
| <i>Commercial Space Transportation</i><br>Research to support human space flight safety rulemaking   |          | X        |
| <i>Fire Research and Safety</i><br>Research and tests in support of new FAA rule establishing reduced flammability limits for fuel tanks                 | X        |          |
| Fire-test criteria for structural composites to ensure the same level of fire safety as metallic structures  | X        |          |
| <i>Unmanned Aircraft Systems Research</i><br>Define airworthiness assurance requirements   |          | X        |
| <i>Hydrogen Initiative</i><br>Develop safety test and evaluation procedures for hydrogen vehicles  |          | X        |
| <i>Hydrogen Fuels Safety</i>   |          |          |
| <i>Hydrogen Powered Research</i><br>Distribute and update safety materials and provide safety training through the Hydrogen Safety Training Center       | X        |          |
| Identify methods to integrate hydrogen distribution and storage for a hydrogen-powered magnetic levitation monorail system                               | X        |          |
| Continue palladium membrane development for hydrogen production  | X        |          |

## 4 RD&T to Reduce System Congestion

Growing congestion in U.S. transportation systems poses a substantial threat to the economy and to the quality of life of millions of Americans. In 2003 alone, congestion in the top 85 U.S. urban areas caused 3.7 billion hours of travel delay and 2.3 billion gallons of wasted fuel, for a total cost of \$63 billion. Congestion also can contribute to air pollutant emissions. The Department's RD&T programs will seek to improve our quality of life and enhance economic development by reducing congestion, preserving the existing transportation system, and improving the durability and extending the life of transportation infrastructure.

Six RD&T strategies represent the primary research topics that will contribute to reducing congestion and other transportation impediments:

1. Conduct and sponsor research to reduce urban and suburban traffic congestion, freight gateway congestion, and aviation system congestion.
2. Conduct and sponsor research to extend the life of the existing transportation system and improve the durability of infrastructure.
3. Conduct and sponsor research to advance the use of next generation technologies and to make effective use of combinations of modes in moving people and goods.
4. Conduct and sponsor research to improve the planning, operation, and management of surface transportation and aviation services and assets.
5. Conduct and sponsor research to improve transportation services for underserved areas and populations.
6. Advance the Nation's transportation workforce and research capability through capacity building, fellowships, grants, and cooperative research with universities, the private sector, and State and local governments.

The following sections summarize system congestion research areas, emerging research priorities, primary RD&T activities for advancing these RD&T strategies, and program milestones. Appendix C shows anticipated funding levels for the supporting RD&T programs for FY 2006 through 2010.

### Reduce Traffic, Freight, and Aviation Congestion

Among the Department's highest priorities, this RD&T strategy is a critical element of the six-point plan identified in the DOT May 2006 *National Strategy to Reduce Congestion on America's Transportation Network*. The plan lays out a broad RD&T agenda, including design and deployment of the Next Generation Air Transportation System and other research leading to increased aviation capacity; operational and technological improvements, such as ITS, that increase information dissemination and improve incident response; and expansion of Bus Rapid Transit services. RD&T will focus on two primary aspects of congestion in

"Transportation is key to the productivity, and therefore the success, of virtually every business in America. Congestion and delay not only waste our time as individuals, they also burden our businesses and our entire economy with inefficiency and higher costs."

Secretary Norman Y. Mineta

support of the Departmental goal and this RD&T strategy: reducing recurring congestion and reducing non-recurring congestion.

### ***Reducing Recurring Congestion***

This research seeks to reduce recurring causes of congestion and bottlenecks through more efficient use of airspace, improved aviation and highway operations, and enhanced transit services. The following programs will address these and related areas:

#### **FAA**

*Advanced Technology Development and Prototyping.* Reduces aviation system congestion through the following research activities:

- **Airspace Management Laboratory**—Will identify issues and perform analyses in support of airspace assessment and redesign activities, including the development of data management and simulation tools for the evaluation of airspace design alternatives. This project will also support Reduced Congestion RD&T Strategy 4.
- **Airspace Redesign**—Will increase system capacity and reduce congestion by removing as many airspace constraints as possible.
- **NAS Requirements**—Will ensure the ongoing success of FAA projects intended to decrease avoidable weather delays and reduce accidents caused by adverse weather through implementation of new weather products.
- **Operations Concept Validation**—Will document and validate an overall concept, or “target system,” for the future management and control of NAS operations.
- **System Capacity Planning and Improvement**—Will provide measurement tools, procedural recommendations, technologies, and problem-solving methodologies to enhance capacity and alleviate aviation system congestion, delays, and operational inefficiencies. This project will also support Reduced Congestion RD&T Strategy 4.

*National Plan for Transformation of Air Transportation – Joint Program and Development Office (JPDO).* Leads the development and implementation of the Next Generation Air Transportation System to increase the safety, capacity, efficiency, and security of U.S. air transportation. The program will integrate capabilities across Federal agencies to meet defense, commerce, and homeland security requirements. This program will also support Reduced Congestion RD&T Strategy 3.

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### **Congestion Reduction RD&T**

- **Reduce Traffic, Freight, and Aviation Congestion**
- **Extend System Life and Improve Durability**
- **Advance Use of Next Generation Technologies and Combinations of Modes**
- **Improve Planning, Operations, and Management**
- **Improve Services for Underserved Areas and Populations**
- **Advance the Transportation Workforce and Research Capability**

### Emerging Research Priority: Congestion Reduction Policy Research and Technologies

Strengthened policy research and analysis in the area of congestion reduction, congestion pricing, and innovative infrastructure financing is needed to better inform policy-makers with respect to such topics as the degree to which congestion levels have declined in areas with time-varying highway tolls; the operational implications of simultaneously offering tolled and unpriced highways in the same corridor; the conditions under which tolls or other forms of user charges generate adequate revenues to finance the necessary infrastructure investment; behavioral responses of travelers to having multiple choices; and the degree to which the interests of the traveling public are protected when innovative infrastructure financing agreements are in place.

Research to evaluate the effectiveness and market acceptance of traveler and traffic information technologies, products, and services is also critical. Moreover, it is important that DOT, through its ITS program, work with public agencies, industry, and transit properties to develop data collection methods and evaluate protocols to assess the effectiveness of existing in-vehicle traffic and guidance systems, commercial traffic information systems, and transit information web sites.

#### Key Supporting RD&T Programs:

- Integrated Corridor Management
- Surface Transportation Congestion Relief Solutions
- Surface Transportation Environment and Planning
- Vehicle-Infrastructure Integration
- Increase Transit Ridership
- Improve Transit Operational Efficiency
- Economic and Strategic Analysis
- Emergency Transportation Operations
- Clarus
- Road Weather Research and Development
- Strategic Highway Research Program II

## FHWA

*Integrated Corridor Management Systems (ITS JPO)*. Assists agencies in implementing Integrated Corridor Operations through supporting analytical tools, approaches, and technical standards. The program will demonstrate the value of Integrated Corridor Management for operating and optimizing an entire system as opposed to individual networks. This program will also support Reduced Congestion RD&T Strategy 3.

*Surface Transportation Congestion Relief Solutions (Operations R&D)*. Develops information to assist State transportation departments and Metropolitan Planning Organizations (MPOs) in measuring and addressing surface transportation congestion problems. The program will consist of research programs that will develop and apply transportation system congestion measurement and reporting methods and develop analytical tools and methods that lead to better congestion management and decisionmaking.

*Surface Transportation Environment and Planning Cooperative Research Program (Planning and Environment)*. Focuses on improving understanding of the complex relationship between surface transportation and the environment.



To reduce congestion, the program will support research to improve the planning, operation, and management of surface transportation services and assets. This program will also support Reduced Congestion RD&T Strategies 3, 4, 5, and 6; Safety RD&T Strategy 1; the RD&T Strategy for Global Connectivity; and Environmental RD&T Strategies 1 and 2.

*Vehicle-Infrastructure Integration (ITS JPO).* Researches the use of vehicles to anonymously transmit information on traffic and road conditions from every major road in the transportation network. With respect to this RD&T strategy, this initiative will give transportation agencies the information they need to implement active strategies to relieve congestion and allow motorists to share information and make informed decisions regarding travel routes, times, and modes. This program will also support Safety RD&T Strategy 1.

#### **FTA**

*Identify Best Practices and Technologies to Increase Transit Ridership (Increase Transit Ridership).* Identifies best practices and technologies to increase transit ridership, barriers to adopting these practices and technologies, and solutions for overcoming them. The program will demonstrate and evaluate methods, techniques, and technologies to increase ridership and identify best practices for improving transit services across the country. This program will also support Reduced Congestion RD&T Strategy 4.

*Identify Methods and Technologies to Improve Transit Operational Efficiency (Improve Capital and Operating Efficiencies).* Researches and demonstrates methods to improve bus and heavy-rail efficiency. Examines operational delivery strategies, such as Bus Rapid Transit, which involve fleet operations and Intelligent Transportation Systems. This program will also support Reduced Congestion RD&T Strategy 4.

#### **OST**

*Economic and Strategic Analysis.* Analyzes the economic implications of public and private transportation policy issues. This program will build on earlier work to improve the economic analysis of congestion pricing. This program will also support Reduced Congestion RD&T Strategy 4.

*Safety, Energy, and Environment.* Uses simulation, modeling, and other analytical techniques to calculate safety outcomes from congestion mitigation and conducts research to better understand the effects of road pricing and other congestion reduction schemes on driving cycles, fuel consumption, and emissions. The program will identify and recommend measures that offer the greatest benefits for reducing congestion while improving safety outcomes, and develop a set of emission factors and fuel consumption rates for various categories of vehicles that can be used to calculate the effects of congestion mitigation measures. This program will also support Reduced Congestion RD&T Strategy 5, Safety RD&T Strategy 1, and Environmental Stewardship RD&T Strategy 1.

**Table 4-1. Milestones for Reducing Recurring Congestion**

| <b>Research Product or Information Gained</b>  | <b>FY 07-08</b> | <b>FY 09-10</b> |
|--|-----------------|-----------------|
| <i>Airspace Management Laboratory</i>  |                 |                 |
| Analyze, deploy, and enhance traffic data and metrics products                             | X               | X               |
| Analyze and enhance decision-support tools   | X               | X               |
| Create a fully integrated aeronautical information management system                       | X               | X               |
| <i>Airspace Redesign</i>   |                 |                 |
| Regional airspace optimization and redesign  | X               | X               |
| High-altitude airspace redesign  | X               | X               |
| Oceanic airspace redesign  | X               | X               |
| <i>NAS Requirements</i>  |                 |                 |
| Six-to-twelve-hour freezing precipitation forecast ability                                 | X               |                 |
| <i>Operations Concept Validation</i>   |                 |                 |
| Feasibility study on the virtual tower concept   | X               | X               |
| Updated Radio Technical Commission for Aeronautics NAS Concept of Operations               | X               |                 |
| FAA inputs to support future concepts and modernization                                    | X               | X               |
| <i>System Capacity Planning and Improvement</i>  |                 |                 |
| Updated capacity benchmark study   | X               | X               |
| Modeling and simulation of new large aircraft ground movements                             | X               | X               |
| Metrics for the 35 Operational Evolution Plan airports                                     | X               | X               |
| Future airport capacity study  | X               | X               |
| <i>National Plan for Transformation of Air Transportation</i>                              |                 |                 |
| Update and carry out an integrated plan for the Next Generation Air Transportation System  | X               | X               |
| <i>Integrated Corridor Management</i>  |                 |                 |
| Analysis, modeling, and simulation of selected pioneer sites                               |                 | X               |
| <i>Surface Transportation Congestion Relief</i>  |                 |                 |
| Signal timing and ramp metering adjustment with VII data                                   |                 | X               |
| Adaptive Control Systems Lite for Networks   | X               |                 |
| Establish a standard of practice for metropolitan area traffic management                  | X               |                 |
| <i>Surface Transportation Environment and Planning Cooperative Research</i>                |                 |                 |
| Improved planning, operation, and management of surface transportation services and assets | X               | X               |
| <i>Vehicle-Infrastructure Integration</i>  |                 |                 |
| Field operational test   | X               |                 |
| <i>Identify Best Practices and Technologies to Increase Transit Ridership</i>              |                 |                 |
| Demonstrate and evaluate methods and technologies to increase ridership                    | X               | X               |
| <i>Identify Methods and Technologies to Improve Transit Operational Efficiency</i>         |                 |                 |
| Update characteristics of bus rapid transit systems  | X               |                 |
| Develop bus rapid transit design guidelines manual for transit agencies                    |                 | X               |
| <i>Economic and Strategic Analysis</i>   |                 |                 |

| Research Product or Information Gained | FY 07-08 | FY 09-10 |
|--|----------|----------|
| Safety, Energy, and Environment        |          |          |

***Reducing Non-recurring Congestion***

RD&T in this area looks at non-recurring congestion caused by weather, traffic incidents, and work zones. Over the next five years it will encompass the following programs:

**FAA**

*Advanced Technology Development and Prototyping.* Addresses non-recurring congestion caused by wake turbulence and other weather events. In particular, the program will develop technology and procedures to increase the use of parallel runways in adverse weather conditions. (This program will be completed in FY 2007.)

*Wake Turbulence.* Increases the capacity of terminal airspace during inclement weather by developing modifications to air traffic control wake turbulence mitigation procedures. This program will reduce delays during less than visual flight rules conditions, implement new wake turbulence separation standards and procedures that will improve airport arrival and departure rates, and determine wake turbulence separations required with the design of more efficient airspace routes and the introduction of new aircraft designs.

**FHWA**

*Emergency Transportation Operations (ITS JPO).* Improves operational technology and practices to enable the safe and effective movement of people and goods during emergency evacuation situations (both with and without notice). The program will address the application of ITS technologies to improve notice and no-notice evacuation planning and execution, with an orientation that includes both decisionmakers and evacuees. This program will also support Safety RD&T Strategy 2 and Security RD&T Strategy 1.

*Nationwide Surface Transportation Weather Observing and Forecasting System (Clarus) (ITS JPO).* Supports a partnership to develop and demonstrate an integrated surface transportation weather observing, forecasting, and data management system. The program will make use of the over 2,100 environmental sensor stations that are already deployed along America's highways to help reduce the impact of adverse weather for road users and operators.

*Road Weather Research and Development (ITS JPO).* Seeks to reduce road congestion and safety impacts caused by adverse weather through the development and application of technology. The program will integrate existing observational networks and data management systems for road weather applications; improve weather modeling capabilities and forecast tools; enhance

mechanisms for communicating road weather information to users; and integrate road weather technologies into an information infrastructure.

*Strategic Highway Research Program II (Corporate Activities)*. Conducts concentrated, results-oriented applied research focusing on solving the top problems in the area of highway safety, reliability, capacity, and renewal. Research in this area will focus on identifying and developing strategies to mitigate congestion caused by major sources of unreliable travel, such as traffic incidents, work zones, and adverse weather. This program will also support Reduced Congestion RD&T Strategies 2 and 4 and Safety RD&T Strategy 1.

*Surface Transportation Congestion Relief Solutions (Operations R&D)*. Develops information to assist State DOTs and MPOs with measuring and addressing congestion problems. Initiatives to address non-recurring congestion will focus on reducing the time required to restore traffic flow to "normal" conditions following minor traffic incidents and minimizing the impact of work zones on motorist mobility.

**Table 4-2. Milestones for Reducing Non-Recurring Congestion**

| Research Product or Information Gained  | FY 07-08 | FY 09-10 |
|---|----------|----------|
| <i>Advanced Technology Development and Prototyping—Wake Turbulence</i><br>Evaluate NASA prototype ground-based departure spacing system                   | X        |          |
| <i>Wake Turbulence</i><br>Implement wake avoidance procedures at the 35 Operational Evolution Plan airports   | X        | X        |
| Conduct wake turbulence assessments of potential air traffic routing and separation changes in en route airspace  | X        | X        |
| <i>Emergency Transportation Operations</i><br>Real-time evacuation tool evaluation and technology transfer  | X        |          |
| <i>Clarus</i><br>Multistate regional demonstrations   | X        |          |
| <i>Road Weather Research and Development</i><br>Develop weather responsive transportation management system prototype                                     | X        |          |
| Enhanced maintenance decision support system  | X        |          |
| <i>Strategic Highway Research Program II</i><br>Establish local and national monitoring programs for mobility and travel time reliability                 | X        |          |
| Develop analytic procedures for determining the impacts of reliability improvement strategies   |          | X        |
| <i>Surface Transportation Congestion Relief</i><br>Quick clearance procedures, policies, and technologies to speed system recovery from traffic incidents | X        |          |
| Policies, procedures, and technologies to reduce the impact of work zones on the traveling public   | X        |          |

## Extend the Life of the Existing Transportation System and Improve Infrastructure Durability

An important element of the Department's congestion reduction goal is to increase system capacity by transforming the way that infrastructure is designed, constructed, and maintained. Through RD&T, the Department seeks to develop and deploy innovative methods and technologies that will significantly improve infrastructure durability, extend its life, and significantly reduce its long-term costs, in all transportation modes. This RD&T strategy will be advanced through research in two key areas: preserving the existing infrastructure, and improving infrastructure durability and characterizing materials.

### *Preserving Existing Infrastructure*

This research area seeks to develop and deploy improved technologies and methods for infrastructure rehabilitation, maintenance, and repair. The primary RD&T programs that will support this area between 2006 through 2010 are described below.

#### **FAA**

*Airport Technology Research – Capacity.* Develops standards and guidance materials for airport design, construction, and maintenance to ensure the cost-effectiveness of aircraft runways, taxiways, and aprons. The program will develop pavement design standards to provide manufacturers with the assurance of the compatibility of their aircraft on airports throughout the world; provide airport operators with precise cost estimates for permitting new aircraft operations on their facilities; and ensure that the Federal funds invested in rebuilding or strengthening runways are used prudently. This program will also support the RD&T Strategy for Global Connectivity.

#### **FHWA**

*Alkali-Silica Reactivity (Pavement R&D and Structures R&D).* Conducts research and implements technologies to address the problem of cracking and eventual failure of concrete in bridges, pavements, and other structures due to silica and alkali reaction in portland cement. Research will contribute to the durability and preservation of concrete pavements and structures.

*Asphalt and Asphalt Reclamation (Pavement R&D).* Focuses on building and rehabilitating pavements to perform better and last longer without disrupting the local communities and regional economies that depend so heavily on the highway system.

*Steel Bridge Testing (Structures R&D).* Yields new information on the testing of steel bridges using nondestructive technology. Research results will contribute to steel bridge preservation and durability.

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### Congestion Reduction RD&T

- Reduce Surface, Freight, and Aviation Congestion
- **Extend System Life and Improve Durability**
- Advance Use of Next Generation Technologies and Combinations of Modes
- Improve Planning, Operations, and Management
- Improve Services for Underserved Areas and Populations
- Advance the Transportation Workforce and Research

**FRA**

*Track and Structures.* Conducts research on rail inspection techniques, material and component reliability, track and structure design and performance, and track stability data processing and feedback in cooperation with the railroad industry and suppliers. The program will address automated systems for rail defect detection, high-speed video joint bar inspection, and track geometry inspection; and conduct testing and evaluation on the safety performance of new products (such as composites and nanotechnologies) to support the development of appropriate engineering guides before their widespread use. This program will also support Safety RD&T Strategy 1.

**FTA**

*Identify Solutions to Improve Transit Infrastructure Maintenance (Improve Capital and Operating Efficiencies).* Conducts research on improved inspections and integrated maintenance systems for public transportation and the use of GIS to track infrastructure assets.

**Table 4-3. Milestones for Preserving Existing Infrastructure**

| Research Product or Information Gained  | FY 07-08 | FY 09-10 |
|---|----------|----------|
| <i>Airport Technology</i><br>Research nondestructive testing methods  | X        | X        |
| <i>Alkali-Silica Reactivity</i><br>Guidance for reducing the effects of ASR on new and existing structures and pavements                | X        |          |
| <i>Asphalt and Asphalt Reclamation</i><br>Develop technologies to advance asphalt pavement recycling and related pavement reclamation   | X        | X        |
| <i>Steel Bridge Testing</i><br>Improved technology for detecting small defects in steel bridges   | X        |          |
| <i>Track and Structures</i>   |          |          |
| <i>Identify Solutions to Improve Transit Infrastructure Maintenance</i><br>Improved track inspection and integrated maintenance systems |          | X        |

***Improving Infrastructure Durability and Characterizing Materials***

DOT research in this area explores potential advances in the materials and methods used in the construction of airport and highway pavements, highway bridges, and railroad track and structures. The primary RD&T programs that will support this area between 2006 through 2010 are described below.

**FAA**

*Airport Technology Research – Capacity.* Develops standards and guidance materials for airport design, construction, and maintenance. (See “Preserving

Existing Infrastructure” above.) This program will also support the RD&T Strategy for Global Connectivity.

## **FHWA**

*Asphalt Research Consortium (Pavement R&D).* Focuses on research in flexible pavements and on extending the life cycle of asphalt. This research consortium will be led by the Western Research Institute in Laramie, Wyoming.

*Exploratory Advanced Research (Corporate Activities).* Addresses longer-term, higher-risk research with potentially dramatic breakthroughs for understanding the characterization of materials used in highway infrastructure. This program will also support Reduced Congestion RD&T Strategies 3 and 4, Safety RD&T Strategy 1, and Environmental RD&T Strategy 1.

*Fundamental Properties of Asphalt (Pavement R&D).* Promotes innovative technologies that will improve pavement durability, extend service life, and help reduce costs.

*High-Performing Steel Bridge (Structures R&D).* Demonstrates the application of high-performance steel in the construction and rehabilitation of bridges. This research will contribute to improving the durability of steel bridges.

*Innovative Bridge Research and Deployment (Structures R&D).* Promotes, demonstrates, evaluates, and documents the application of innovative designs, materials, and construction methods in the construction, repair, and rehabilitation of bridges and other highway structures. Program activities will include research and deployment of high-performance concrete bridge technology.

*Innovative Pavement Research and Deployment (Pavement R&D).* Researches, develops, demonstrates, promotes, supports, and documents the application of innovative pavement technologies, specifications and test methods, and practices. Activities will include the development and deployment of new, cost-effective, and innovative designs, materials, and practices to extend pavement life and performance; promotion and use of improved engineering design criteria and specifications; and use of accelerated construction techniques to increase safety and reduce construction time.

*Long-Term Bridge Performance (Structures R&D).* Provides performance data on in-service bridges monitored for at least 20 years. Highway agencies will use this data to make informed decisions on all aspects of bridge design and performance and to construct bridges to meet future needs.

*Long-Term Pavement Performance.* Answers questions on “how” and “why” pavements perform as they do. The program will continue to gather and process data describing the structure, service conditions, and performance of more than 2,400 pavement test sections in North America for use by highway engineers in making decisions leading to more cost-effective and better performing pavements.

*Seismic Research (Structures R&D).* Studies the vulnerability of the Federal-aid system and other surface transportation systems to seismic activity. The program will develop and implement cost-effective methods to reduce vulnerabilities and conduct seismic research, including upgrades to earthquake simulation facilities as necessary to carry out the program.

*Strategic Highway Research Program II (Corporate Activities).* Conducts concentrated, results-oriented applied research focused on solving the top problems in the area of highway safety, reliability, capacity, and renewal. This program will also support Reduced Congestion RD&T Strategies 1 and 4 and Safety RD&T Strategy 1.

*Ultra-high-performance Concrete Demonstrations (Structures R&D).* Demonstrates the use of a steel-fiber-reinforced reactive powder concrete with over twice the compressive strength of high-performance concrete. This work will yield data leading to important new structural innovations in highway transportation.

*Wood Composite Materials (Structures R&D).* Explores innovative applications of wood composite materials in transportation structures. The program will exploit the demonstrated potential of wood composite products as an alternative method of providing low-cost, extremely durable, and environmentally sensitive material for building and repairing bridges and roadway appurtenances.

#### **FRA**

*Track and Structures.* Conducts research on rail inspection techniques, material and component reliability, track and structure design and performance, and track stability data processing and feedback in cooperation with the railroad industry and suppliers. The program will address automated systems for rail defect detection, high-speed video joint bar inspection, and track geometry inspection. This program will also support Safety RD&T Strategy 1.

#### **OST**

*Preparing Infrastructure for the Impacts of Climate Change.* Through the crossmodal DOT Center for Climate Change, conducts regional research on the impacts of climate change on transportation infrastructure. This effort will consider such conditions as a rise in sea levels, more extreme temperatures, and increases in severe weather events and, based on this assessment, develop recommendations for transportation planners and engineers. This activity will be funded through other operating administration RD&T programs and does not appear in the funding tables in Appendix C.



**Table 4-4. Milestones for Improving Infrastructure Durability and Characterizing Materials**

| Research Product or Information Gained  | FY 07-08 | FY 09-10 |
|---|----------|----------|
| <i>Airport Technology</i>   |          |          |
| Improve paving materials  | X        |          |
| Develop advanced airport pavement design procedures                                 | X        | X        |
| <i>Asphalt Research Consortium</i>  |          |          |
| Develop technologies to advance and extend the life of asphalt pavement             | X        |          |
| <i>Exploratory Advanced Research</i>  |          |          |
| Laser shearography system for detection of cracks in concrete                       | X        |          |
| Nuclear system for nondestructive measurement of chlorides in concrete              | X        |          |
| Fiber optic sensor for internal relative humidity of concrete                       | X        |          |
| Guidelines for preventing delayed ettringite formation in concrete                  | X        |          |
| Improved classification system for fly ash in concrete                              |          | X        |
| Guidelines for controlling strong chaotic motions in cable-stayed bridges           | X        |          |
| Recommendations for use of retarders to control set of concrete                     |          | X        |
| <i>Fundamental Properties of Asphalt</i>  |          |          |
| Develop improved asphalt binder technologies for improved pavement performance      |          | X        |
| <i>High-Performing Steel Bridge</i>   |          |          |
| One Coat Paint System   | X        |          |
| Guidelines and code changes for advanced welding processes                          | X        | X        |
| 100-year, permanent paint system  | X        | X        |
| Modern fracture control plan to guide fabrication and maintenance of bridges        | X        |          |
| Designers guide for efficient use of high-performance steel                         | X        |          |
| <i>Innovative Bridge Research and Deployment</i>                                    |          |          |
| Revisions to Bridge Design Code for lightweight, very high strength concrete        | X        | X        |
| Improved practices to enhance the quality of high performance concrete bridge decks | X        |          |
| Design manual on geosynthetic reinforced soil technology                            | X        |          |
| <i>Innovative Pavement Research and Deployment</i>                                  |          |          |
| Develop and implement quality assurance technologies                                | X        |          |
| Guidance for minimizing moisture damage in asphalt pavements                        |          | X        |
| Guidance for the use of modifiers and additives in asphalt paving                   |          | X        |
| Information and models for "next generation" performance prediction                 |          | X        |
| Guidance for optimizing pavement surface characteristics                            |          | X        |
| Develop and deploy improved material technologies                                   |          | X        |
| Identify and implement material recycling technologies                              | X        | X        |
| Improved material selection and design systems                                      | X        |          |
| <i>Long-Term Bridge Performance</i>   |          |          |

| <b>Research Product or Information Gained</b>  | <b>FY 07-08</b> | <b>FY 09-10</b> |
|--|-----------------|-----------------|
| <i>Long Term Pavement Performance</i>  |                 |                 |
| Develop database and supporting documentation  | X               |                 |
| Develop and implement quality assurance technologies   | X               |                 |
| <i>Seismic Research</i>  |                 |                 |
| Design details to accommodate seismic behavior and design of prefabricated segmental bridge piers for accelerated bridge construction in seismic regions | X               |                 |
| Design criteria for protection of bridges against earthquakes and other hazards  | X               |                 |
| Implement improved earthquake loss estimation technology   |                 | X               |
| <i>Strategic Highway Research Program II</i>   |                 |                 |
| <i>Ultra-high-performance Concrete Demonstrations</i>  |                 |                 |
| Develop precast UHPC bridge deck   | X               |                 |
| Design provisions and examples compatible with AASHTO specifications   | X               |                 |
| <i>Wood Composite Materials</i>  |                 |                 |
| <i>Track and Structures</i>  |                 |                 |

## Advance Use of Next Generation Technologies and Combinations of Modes

This RD&T strategy focuses on the development and introduction of advanced technologies and concepts that will significantly improve the capacity, efficiency, and performance of the transportation network. Over the next five years, the Department will implement this strategy through research in two areas: multimodal and intermodal transportation, and next generation technologies and systems.

### *Multimodal and Intermodal Transportation*

An important activity for the Department is to conduct research leading to an integrated and interconnected transportation system that meets the needs of a growing economy and is efficient, accessible, and cost-effective for both passengers and freight. The primary RD&T programs that will support this area between 2006 through 2010 are described below.

#### **Emerging Research Priority: System Resilience and Global Logistics**

Research is needed to identify freight bottlenecks and changing transportation patterns and to develop and implement technologies to enhance the efficiency of cargo flows. RD&T priorities include such areas as universal electronic manifests; advanced location and geospatial systems for end-to-end tracking and identification of containerized and bulk cargo and hazardous materials; the feasibility of key corridors for short-sea shipping and short-haul rail/inland ports/cargo consolidation centers; and decision support systems and tools to help State and local governments realign intermodal capacity, implement congestion pricing, and leverage private sector infrastructure investment.

#### Key Supporting RD&T Programs:

- Advanced Travel Forecasting Procedures Program
- Electronic Freight Management
- Integrated Corridor Management Systems
- Surface Transportation Environment and Planning
- Freight and Logistics
- Appalachian Inland Ports Feasibility
- National Cooperative Freight Transportation Research

## Congestion Reduction RD&T

- Reduce Surface, Freight, and Aviation Congestion
- Extend System Life and Improve Durability
- Advance Use of Next Generation Technologies and Combinations of Modes
- Improve Planning, Operations, and Management
- Improve Services for Underserved Areas and Populations
- Advance the Transportation Workforce and Research

## FHWA

*Advanced Travel Forecasting Procedures Program (Planning and Environment).* Continues deployment of the Transportation Analysis Simulation System (TRANSIMS) as a planning tool. The program will develop additional applications and uses of the TRANSIMS model. This program will also support Reduced Congestion RD&T Strategy 4.

*Electronic Freight Management (ITS JPO).* Focuses on improving the operational efficiency, productivity, and security of the freight transportation system. The program will implement a common electronic information transfer protocol and a message portal to provide access to shipment information for all supply chain

partners in real time. This program will also support Reduced Congestion RD&T Strategy 4.

*Integrated Corridor Management Systems (ITS JPO).* Assists agencies in implementing Integrated Corridor Operations through support for analytical tools, approaches, and technical standards. The program will demonstrate the value of Integrated Corridor Management for operating and optimizing an entire system as opposed to individual networks. This program will also support Reduced Congestion RD&T Strategy 1.

*Surface Transportation Environment and Planning Cooperative Research Program (Planning and Environment).* Focuses on improving understanding of the complex relationship between surface transportation and the environment. Research in this area will advance the state of the practice in multimodal and intermodal transportation planning. This program will also support Reduced Congestion RD&T Strategies 1, 4, 5, and 6; Safety RD&T Strategy 1; the RD&T Strategy for Global Connectivity; and Environmental RD&T Strategies 1 and 2.

## OST

*Freight and Logistics.* Supports the National Freight Action Policy and Departmental priorities related to port and freight capacity issues. In particular, this effort will engage the freight community, both public and private, in developing and implementing solutions for our freight capacity challenges and reducing the environmental impacts of freight, and will support the President's Ocean Action Plan.

## RITA

*Appalachian Inland Ports Feasibility.* Addresses the feasibility of creating a system of inland ports and distribution centers in Appalachia. This project will be carried out by the Appalachian Regional Commission under a grant managed by RITA and funded by FHWA.

*National Cooperative Freight Transportation Research Program.* Awards contracts and grants for research on critical freight transportation issues through an FHWA-funded program administered by the National Research Council. Among other topics, the program will address techniques for estimating the public benefits of freight transportation projects, approaches for calculating the contribution of truck and rail traffic to congestion, use of technology to increase the capacity of truck-only highway lanes, and freight transportation research needs in all modes.

**Table 4-5. Milestones for Multimodal and Intermodal Transportation**

| Research Product or Information Gained  | FY 07-08 | FY 09-10 |
|---|----------|----------|
| <i>Advanced Travel Forecasting Procedures (TRANSIMS)</i><br>Demonstrate mode-split procedures combining highway, transit, and non-motorized modes for tracking and simulating travelers on a second-by-second basis | X        | X        |
| Use multiprocessor and 64-bit computer technology to simulate movements of vehicles and persons for entire regions  | X        | X        |
| <i>Electronic Freight Management</i><br>Demonstrate and test the functionality and economic benefits of information transfer protocol   | X        |          |
| <i>Integrated Corridor Management</i><br>Analysis, modeling, and simulation of selected pioneer sites   |          | X        |
| <i>Surface Transportation Environment and Planning Cooperative Research</i><br>Advance the state of the practice in multimodal and intermodal transportation planning   | X        | X        |
| <i>Freight and Logistics</i>  |          |          |
| <i>Appalachian Inland Ports Feasibility</i>   |          |          |
| <i>National Cooperation Freight Transportation Research</i>   |          |          |

***Next Generation Technologies and Systems***

The goal of research in this area is to apply advances in information, communication, and other technologies to develop and introduce broad advances in aviation and surface transportation systems. The primary RD&T programs that will support this area between 2006 through 2010 are described below.

**Emerging Research Priority: Next Generation Air Transportation (NGATS)**

The goal of NGATS research is to provide the knowledge base to achieve aviation throughput and capacity gains; reduce user and service costs; increase service provider productivity; and ensure a safe, secure, and environmentally compatible aviation system.

Major research areas include best practices for next generation safety management; wake vortex information to support separation reduction; reducing the uncertainties of noise and environmental impacts; and developing a common weather forecast system and probabilistic weather forecast methods. Moreover, for the NGATS to succeed there is an urgent need to establish the requirements for the Next Generation Position, Navigation and Timing System, which will ultimately become an essential element in the operation of nearly all transportation systems.

Key Supporting RD&T Programs:

- Center for Advanced Aviation Systems Development
- National Plan for Transformation of Air Transportation
- Navigation and Spectrum Policy

**FAA**

*Center for Advanced Aviation Systems Development (CAASD)*. Develops knowledge to produce a safer, more efficient global air transportation system. Studies performed at the CAASD will comprise an essential component of FAA research, system engineering, and operations research, including efforts to identify and test technologies for worldwide application to air traffic management, navigation, communication, separation assurance, surveillance, system safety, and security. This program will also support Reduced Congestion RD&T Strategy 4.

*National Plan for Transformation of Air Transportation – Joint Program and Development Office (JPDO)*. Leads the development and implementation of the Next Generation Air Transportation System to increase the safety, capacity, efficiency, and security of U.S. air transportation. The program will integrate capabilities across Federal agencies to meet defense, commerce, and homeland security requirements. This program will also support Reduced Congestion RD&T Strategy 1.

**FHWA**

*Exploratory Advanced Research (Corporate Activities)*. Addresses longer-term, higher-risk research with potentially dramatic breakthroughs for improving data analysis techniques for system condition and performance monitoring and for system operational assessment. This program will also support Reduced Congestion RD&T Strategies 2 and 4, Safety RD&T Strategy 1, and Environmental RD&T Strategy 1.

**FRA**

*High-Speed Rail Corridor Planning*. Provides funding to states for studies and analyses related to the development of high-speed intercity passenger rail corridors. (This program will be completed in FY 2006).

*Nationwide Differential Global Positioning System*. Continues installation of the NDGPS, which will provide precise positioning and navigation information to ensure the safety and security of lives and property throughout the United States. (This program will be completed in FY 2006).

*Train Control*. Develops train control standards and equipment for locomotives. In cooperation with railroads and suppliers, the program will develop the interoperability standard and requirements specifications for next generation advanced train control systems using wireless communication, GPS, and advanced microprocessor technologies. This program will also support Safety RD&T Strategy 1.

**OST**

*Navigation and Spectrum Policy*. Supports the formulation of positioning, navigation, and spectrum policy and the civilian management and use of the GPS. This effort will fund DOT's share of support for operation of the National Space-Based Positioning, Navigation and Timing (PNT) Coordination Office, develop long-term implementation plans for integrated PNT technologies, and

examine potential transportation applications for space-based technologies. This program will also support Reduced Congestion RD&T Strategy 4, Safety RD&T Strategy 1, and the RD&T Strategy for Global Connectivity.

**RITA**

*Commercial Remote Sensing Products and Spatial Technologies.* Develops a policy for new applications of commercial remote sensing and spatial information technologies for national infrastructure development and construction. The program will carry out major national initiatives to implement the policy, including validating new methods, tools, and systems for cost-effectively monitoring the quality of infrastructure construction and assessing infrastructure condition; developing and verifying new applications of integrated remote sensing and spatial information technologies for mitigating freight congestion and increasing the capacity of freight flows through intermodal systems; and developing new service applications for corridor planning and decisionmaking to reduce the time and costs required for completing environmental and transportation impact assessments.

**Table 4-6. Milestones for Next Generation Technologies and Systems**

| Research Product or Information Gained   | FY 07-08 | FY 09-10 |
|--|----------|----------|
| <i>Center for Advanced Aviation Systems Development</i>  |          |          |
| Investigate and expand use of GPS and advanced navigation systems  | X        | X        |
| <i>National Plan for Transformation of Air Transportation</i>  |          |          |
| <i>Exploratory Advanced Research</i>   |          |          |
| Explore data analysis techniques for system condition and performance monitoring   |          | X        |
| Explore and develop enabling network and sensor technologies, modeling capabilities, and systems analysis techniques, e.g., TRANSIMS |          | X        |
| <i>Train Control</i>   |          |          |
| <i>Navigation and Spectrum Policy</i>  |          |          |
| <i>Commercial Remote Sensing</i>   |          |          |

## Improve the Planning, Operation, and Management of Transportation Services and Assets

One necessary factor in reducing transportation congestion is to plan, manage, operate, and finance surface transportation and aviation services in a more efficient and cost-effective manner. In particular, work in three research areas will advance this RD&T strategy over the next five years: improving efficiency of operations and investments; improving transportation planning and decisionmaking; and promoting innovations in transportation finance.

### *Improving Efficiency of Operations and Investments*

Research in this area seeks to improve the efficiency of aviation and surface operations, the quality of transit services, and the effectiveness of public investments in radionavigation systems. The primary RD&T programs that will support this area between 2006 through 2010 are described below.

#### **FAA**

*Advanced Technology Development and Prototyping.* Improves the efficiency of aviation operations through the following activities:

- *Airspace Management Laboratory*—Will provide decision support capabilities to national, regional, and local airspace system management specialists and develop and implement information management systems to improve the end-to-end integrity of post-operational data. This program will also support Reduced Congestion RD&T Strategy 1.
- *System Capacity Planning and Improvement*—Will provide measurement tools, procedural recommendations, technologies, and problem-solving methodologies to enhance capacity and alleviate aviation system congestion, delays, and operational inefficiencies. This program will also support Reduced Congestion RD&T Strategy 1.

*Center for Advanced Aviation Systems Development.* Develops knowledge to produce a safer, more efficient global air transportation system. Studies will comprise an essential component of FAA research, system engineering, and operations research, including efforts to identify and test technologies for worldwide application to air traffic management, navigation, communication, separation assurance, surveillance, system safety, and security. This program will also support Reduced Congestion RD&T Strategy 3.

*Weather Program.* Strives to reduce the number of accidents associated with weather and to minimize the impacts of adverse weather events on NAS operational capacity. Research will increase safety and capacity by developing new technologies for providing accurate, accessible, and efficient weather observations, warnings, and forecasts. This program will also support Safety RD&T Strategy 1.

#### **Congestion Reduction RD&T**

- Reduce Surface, Freight, and Aviation Congestion
- Extend System Life and Improve Durability
- Advance Use of Next Generation Technologies and Combinations of Modes
- **Improve Planning, Operations, and Management**
- Improve Services for Underserved Areas and Populations
- Advance the Transportation Workforce and Research Capability



## FHWA

*Advanced Travel Forecasting Procedures Program (Planning and Environment).* Continues deployment of TRANSIMS as a planning tool. This program will develop additional applications and uses of TRANSIMS and will demonstrate methods to analyze the effect of operational improvements on travel demand. This program will also support Reduced Congestion RD&T Strategy 3.

*Electronic Freight Management (ITS JPO).* Focuses on improving the operational efficiency, productivity, and security of the freight transportation system. The program will implement a common electronic information transfer protocol and a message portal to provide access to shipment information for all supply chain partners in real time. This program will also support Reduced Congestion RD&T Strategy 3.

*Exploratory Advanced Research (Corporate Activities).* Addresses longer-term, higher-risk research with potentially dramatic breakthroughs in innovative financing of fully automated intermodal transportation systems. This program will also support Reduced Congestion RD&T Strategies 2 and 3, Safety RD&T Strategy 1, and Environmental RD&T Strategy 1.

*Multistate Corridor Operations and Management (ITS JPO).* Promotes regional cooperation, planning, and shared implementation of programs and projects to improve transportation system management and operations. Program goals will be accomplished through multistate cooperative agreements, coalitions, and other arrangements.

*Surface Transportation Environment and Planning Cooperative Research Program (Planning and Environment).* Focuses on improving understanding of the complex relationship between surface transportation and the environment. This program will also support Reduced Congestion RD&T Strategies 1, 3, 5, and 6; Safety RD&T Strategy 1; the RD&T Strategy for Global Connectivity; and Environmental RD&T Strategies 1 and 2.

## FTA

*Identify Best Practices and Technologies to Increase Transit Ridership (Increase Transit Ridership).* Identifies best practices and technologies to increase transit ridership, barriers to adopting these practices and technologies, and solutions for overcoming them. The program will demonstrate and evaluate methods, techniques, and technologies to increase ridership and identify best practices for improving transit services across the country. This program will also support Reduced Congestion RD&T Strategy 1.

*Identify Methods and Technologies to Improve Transit Operational Efficiency (Improve Capital and Operating Efficiencies).* Researches and demonstrates methods to improve bus and heavy-rail efficiency. Examines operational delivery strategies, such as Bus Rapid Transit, which involve fleet operations and Intelligent Transportation Systems. This program will also support Reduced Congestion RD&T Strategy 1.

**OST**

*Aviation and International Policy.* Conducts policy research to support DOT's role in promoting the U.S. aviation industry. Among other activities, the program will update a study examining airport access issues, particularly access to gates and terminal buildings, and their effects on the operating and competitive structures of the airline industry. This program will also support Reduced Congestion RD&T Strategy 5 and the RD&T Strategy for Global Connectivity.

*Economic and Strategic Analysis.* Analyzes the economic implications of public and private ownership and operation of transportation systems. In this research area, the program will assess the aggregate costs and benefits of transportation infrastructure investments and develop productivity estimates for each transportation mode. This program will also support Reduced Congestion RD&T Strategy 1.

*Navigation and Spectrum Policy.* Supports the formulation of positioning, navigation, and spectrum policy and the civilian management and use of GPS. The program will support the planning and development of the Federal Radionavigation Plan and updates to the Federal Radionavigation System to account for new GPS signals, advances in augmentation systems, and enhancements to ground-based radionavigation aids. This program will also support Reduced Congestion RD&T Strategy 3, Safety RD&T Strategy 1, and the RD&T Strategy for Global Connectivity.

**Table 4-7. Milestones for Improving Efficiency of Operations and Investments**

| Research Product or Information Gained  | FY 07-08 | FY 09-10    |
|---|----------|-------------|
| <i>Airspace Management Laboratory</i>   |          |             |
| Analyze, deploy, and enhance traffic data and metrics products  | X        | X           |
| Analyze and enhance decision-support tools  | X        | X           |
| Create a fully integrated aeronautical information management system  | X        | X           |
| <i>System Capacity Planning and Improvement</i>   |          |             |
| Updated capacity benchmark study  | X        | X           |
| Modeling and simulation of new large aircraft ground movements  | X        | X           |
| Metrics for the 35 Operational Evolution Plan airports  | X        | X           |
| Future airport capacity study   | X        | X           |
| <i>Center for Advanced Aviation Systems Development</i>   |          |             |
| Evaluate airspace redesign enhancements in all operational domains  | X        | X           |
| Research and evaluate new air traffic management and control operating concepts   | X        | X           |
| <i>Weather Program</i>  |          |             |
| Develop and make available electronically high-glance-value weather products with longer forecast lead times and increased accuracy |          | X<br>(2015) |

## RD&T to Reduce System Congestion

| Research Product or Information Gained   | FY 07-08 | FY 09-10 |
|--|----------|----------|
| <i>Advanced Travel Forecasting Procedures (TRANSIMS)</i><br>Use simulation technologies to understand the impact of operational improvements on the demand for travel  | X        | X        |
| <i>Electronic Freight Management</i><br>Demonstrate and test the functionality and economic benefits of information transfer protocol  | X        |          |
| <i>Exploratory Advanced Research</i><br>Policy research, including Economic Impact Analysis of Highway Investment and Congestion on Business Logistics Costs<br>Explore innovative financing alternatives for surface transportation |          | X<br>X   |
| <i>Multistate Corridor Operations and Management</i>   |          |          |
| <i>Surface Transportation Environment and Planning Cooperative Research</i><br>Improved understanding of the relationship between transportation and the environment   | X        | X        |
| <i>Identify Best Practices and Technologies to Increase Transit Ridership</i><br>Identify best practices for ridership improvement   | X        |          |
| <i>Identify Methods and Technologies to Improve Transit Operational Efficiency</i><br>Collect and make available geospatial data<br>Develop parameters for shared-use-track demonstrations   | X<br>X   |          |
| <i>Aviation and International Policy</i>   |          |          |
| <i>Economic and Strategic Analysis</i>   |          |          |
| <i>Navigation and Spectrum Policy</i>  |          |          |

### ***Improving Planning and Decisionmaking***

RD&T activities in this area address the improvement of transportation models and other decisionmaking tools; their more effective use in the planning process; and broadening stakeholder participation in transportation planning and decisionmaking. The primary RD&T programs that will support this area between 2006 through 2010 are described below.

#### **FHWA**

*Advanced Travel Forecasting Procedures Program (Planning and Environment).* Continues deployment of TRANSIMS as a planning tool and develops additional applications and uses. This program will develop methods to include time of day in the modeling process, thereby improving the model's capability to respond to the effects of congestion on travel demand. This program will also support Reduced Congestion RD&T Strategy 3.

*Center for Environmental Excellence (Planning and Environment).* Assists states in planning and delivering environmentally sound surface transportation projects. The center will provide technical assistance, information on best practices, and training in the use of tools and decisionmaking processes. This program will also

support Reduced Congestion RD&T Strategy 6 and Environmental RD&T Strategies 1 and 2.

*Strategic Highway Research Program II (Corporate Activities)*. Conducts concentrated, results-oriented applied research focused on solving the top problems in the area of highway safety, reliability, capacity, and renewal. This program will also support Reduced Congestion RD&T Strategies 1 and 2 and Safety RD&T Strategy 1.

*Surface Transportation Environment and Planning Cooperative Research Program (Planning and Environment)*. Focuses on improving understanding of the complex relationship between surface transportation and the environment. This program will also support Reduced Congestion RD&T Strategies 1, 3, 5, and 6; Safety RD&T Strategy 1; the RD&T Strategy for Global Connectivity; and Environmental RD&T Strategies 1 and 2.

*Transportation, Economics, and Land Use System (TELUS) (Planning and Environment)*. Helps MPOs and State DOTs develop their transportation improvement programs and carry out other transportation planning responsibilities. A fully integrated information management and decision support system, TELUS will help states and MPOs assure public participation in the transportation planning process.

**FTA**

*Identify Practices and Technologies to Control Capital and Operating Costs (Improve Capital and Operating Efficiencies)*. Identifies practices, methods, and technologies to improve risk management, analyze capital cost variables, improve design and control methods, and identify appropriate standards. This program will also examine alternative delivery providers, costs of technology adoption, and improved planning models. This program will also support the RD&T Strategy for Global Connectivity.

**Table 4-8. Milestones for Improving Planning and Decisionmaking**

| Research Product or Information Gained   | FY 07-08 | FY 09-10 |
|--|----------|----------|
| <i>Advanced Travel Forecasting Procedures (TRANSIMS)</i><br>Use simulation technologies to understand the impact of travel, by time of day, on overall mobility  | X        | X        |
| <i>Center for Environmental Excellence</i><br>Promote the advancement of Context Sensitive Solutions<br>Identify and promote technology and geospatial innovations   | X<br>X   | X<br>X   |
| <i>Strategic Highway Research Program II</i>   |          |          |
| <i>Surface Transportation Environment and Planning Cooperative Research</i><br>Develop and/or support accurate models for evaluating transportation control measures<br>Develop indicators of economic, social, and environmental performance of transportation systems to facilitate alternative analysis | X<br>X   | X<br>X   |

| Research Product or Information Gained   | FY 07-08         | FY 09-10       |
|--|------------------|----------------|
| <i>Transportation, Economics, and Land Use System</i><br>Use TELUS to assist states and MPOs in the development of transportation improvement programs and other transportation planning initiatives   | X                | X              |
| <i>Identify Practices and Technologies to Control Capital and Operating Costs</i><br>Provide enhanced tools and methods for technical planning<br>Develop improved models of the performance of bus operations<br>Demonstrate application of enhanced information systems to engineering<br>Develop voluntary industry standards | X<br>X<br>X<br>X | X<br><br><br>X |

**Promoting Innovations in Transportation Finance**

This research addresses innovative mechanisms for financing transportation services and improvements, including public-private partnerships and user fees. The primary RD&T programs that will support this area are described below.

**FTA**

*Identify Practices and Technologies to Control Capital and Operating Costs (Improve Capital and Operating Efficiencies).* Identifies practices, methods, and technologies to improve risk management, analyze capital cost variables, improve design and control methods, and identify appropriate standards. This program will also support the RD&T Strategy for Global Connectivity.

**OST**

*Center for Excellence in Project Finance.* Supports State DOTs in the development of transportation project finance plans and oversight tools. The center will develop and offer training in state-of-the-art financing methods through an FHWA-funded grant managed by OST.

*Economic and Strategic Analysis.* Analyzes the economic implications of public and private transportation policy issues. This program will advance the Department's understanding of the barriers to public-private partnerships and other innovative financing techniques. This program will also support Reduced Congestion RD&T Strategy 1.

**Table 4-9. Milestones for Promoting Innovations in Transportation Finance**

| Research Product or Information Gained   | FY 07-08 | FY 09-10 |
|--|----------|----------|
| <i>Identify Practices and Technologies to Control Capital and Operating Costs</i><br>Establish Center for Transit-Oriented Development | X        | X        |
| <i>Center for Excellence in Project Finance</i>  |          |          |
| <i>Economic and Strategic Analysis</i>   |          |          |

## Improve Transportation Services for Underserved Areas and Populations

Improving mobility for traditionally underserved areas and populations is a core Departmental priority. This RD&T strategy will involve research in two major areas: improving access for the elderly, people with disabilities, and other transportation-disadvantaged populations; and improving transportation in rural areas and small communities.

### *Improving Access for Transportation-Disadvantaged Populations*

RD&T programs in this research area seek to improve mobility and accessibility through technology applications and service coordination. The primary RD&T programs that will support this area between 2006 through 2010 are described below.

#### **FHWA**

*Mobility Services for All Americans (ITS JPO).* Builds upon several past and current DOT-led activities to increase mobility and accessibility for the transportation disadvantaged and the general public. The program will achieve more efficient use of Federal transportation funding resources through technology integration and service coordination.

#### **FTA**

*Identify Solutions to Provide Public Transportation for Targeted Populations (Increase Transit Ridership).* Undertakes research to determine how to expand transit services to elderly and mobility-impaired populations, with an emphasis on using existing systems. The program will also research methods to improve coordination of human services and examine technologies to improve accessibility.

#### **OST**

*Aviation and International Policy.* Conducts policy research to support DOT's role in promoting the aviation industry. In this research area, the program will research space requirements, maneuvering needs, reach ranges, and other key factors for occupied power wheelchairs and scooters used in airports, terminals, and other facilities. This program will also support Reduced Congestion RD&T Strategy 4 and the RD&T Strategy for Global Connectivity.

*Safety, Energy, and Environment.* Conducts policy research to support the formulation and recommendation of Departmental policies, plans, and guidelines related to public health and safety. The program will update a plan providing strategies for improved senior safety and mobility and fund the fulfillment of DOT's responsibilities under Executive Order No. 13330 on Human Service Transportation ("United We Ride"), including policy development and demonstration and testing of new technologies. This program will also support Reduced Congestion RD&T Strategy 1, Safety RD&T Strategy 1, and Environmental RD&T Strategy 1.

## Congestion Reduction RD&T

- Reduce Surface, Freight, and Aviation Congestion
- Extend System Life and Improve Durability
- Advance Use of Next Generation Technologies and Combinations of Modes
- Improve Planning, Operations, and Management
- Improve Services for Underserved Areas and Populations
- Advance the Transportation Workforce and Research

**Table 4-10. Milestones for Improving Access for Transportation-Disadvantaged Populations**

| Research Product or Information Gained   | FY 07-08 | FY 09-10 |
|--|----------|----------|
| <i>Mobility Services for All Americans</i>   |          |          |
| Model system planning and design   | X        |          |
| Model deployment and evaluation  |          | X        |
| <i>Identify Solutions to Provide Public Transportation for Targeted Populations</i>  |          |          |
| Facilitate access to public transportation for persons with disabilities             | X        | X        |
| Assess reverse commuting programs  | X        | X        |
| Demonstrate transit vehicle guidance technology to improve accessibility             | X        |          |
| Enhance coordination of human services transportation providers                      | X        |          |
| Establish and support National Technical Assistance Center for Senior Transportation | X        | X        |
| <i>Aviation and International Policy</i>   |          |          |
| <i>Safety, Energy, and Environment</i>   |          |          |

### ***Improving Transportation in Rural Areas and Small Communities***

This research addresses the many transportation issues facing rural areas and small communities, including the need for improvements in rural transportation planning, infrastructure, and transit services. The primary RD&T programs that will support this area between 2006 through 2010 are described below.

#### **FHWA**

*Center for Transportation Advancement and Regional Development (Planning and Environment)*. Assists in the development of small metropolitan and rural regional transportation systems that are responsive to the needs of businesses and local communities. The program will accomplish its goals through comprehensive training, education, and research activities. This program will also support Reduced Congestion RD&T Strategy 6.

*Rural Interstate Corridor Communications (ITS JPO)*. Aims to improve communications services in rural communities. The program will assess the feasibility of installing fiber optic cabling and wireless communication infrastructure along rural multistate Interstate System route corridors.

*Surface Transportation Environment and Planning Cooperative Research Program (Planning and Environment)*. Focuses on improving understanding of the complex relationship between surface transportation and the environment. In this area the program will support research initiatives to improve transportation in rural and small communities. This program will also support Reduced Congestion RD&T Strategies 1, 3, 4, and 6; Safety RD&T Strategy 1; the RD&T Strategy for Global Connectivity; and Environmental RD&T Strategies 1 and 2.

**FTA**

*Identify Cost-Effective Solutions to Provide Rural Transportation Services (Increase Transit Ridership).* Researches appropriate classifications of transit services in rural areas and logical approaches to provide these services. The program will identify parameters for appropriate transit vehicles for rural use.

**OST**

*Aviation and International Policy.* Conducts policy research to support DOT's role in promoting the aviation industry. Studies the economic impact of air service in small communities. This program will also support Reduced Congestion RD&T Strategy 4 and the RD&T Strategy for Global Connectivity.

**RITA**

*Cold Region and Rural Transportation Research.* Supports the development of a research facility for basic and applied research on surface transportation issues facing rural and cold regions. RITA will manage an FHWA-funded grant to the Western Transportation Institute at Montana State University to establish the facility in Lewiston, Montana.

*Rural Transportation Research.* Supports research in rural transportation at the New England Transportation Institute in White River Junction, Vermont. Funded by an FHWA grant and managed by RITA, the program will enhance economic development within the general activity of rural transportation planning

*Rural Transportation Research Initiative.* Supports research on rural transportation issues at North Dakota State University's Upper Great Plains Transportation Institute. Research will be carried out through a cost-shared FHWA grant managed by RITA.

**Table 4-11. Milestones for Improving Transportation in Rural Areas and Small Communities**

| Research Product or Information Gained  | FY 07-08 | FY 09-10 |
|---|----------|----------|
| <i>Center for Transportation Advancement and Regional Development</i><br>Improved knowledge of transportation and economic development  | X        | X        |
| <i>Rural Interstate Corridor Communications</i><br>Report to Congress   | X        |          |
| <i>Surface Transportation Environment and Planning Cooperative Research</i><br>Enhanced knowledge of strategies to improve transportation in rural areas and small communities        | X        | X        |
| <i>Identify Cost-Effective Solutions to Provide Rural Transportation Services</i><br>Demonstrate rural service solutions<br>Identify improved transit vehicles for rural applications | X        | X<br>X   |
| <i>Cold Region and Rural Transportation Research</i>  |          |          |
| <i>Rural Transportation Research—Vermont</i>  |          |          |



| Research Product or Information Gained                | FY 07-08 | FY 09-10 |
|---|----------|----------|
| Rural Transportation Research Initiative—North Dakota |          |          |

## Advance the Nation's Transportation Workforce and Research Capability

This broad Departmental strategy, which also cuts across all DOT goals, seeks to strengthen the foundation for the 21<sup>st</sup> century transportation system through a world-class transportation workforce and a national research capability. The strategy will emphasize research activities in four key areas: university research and education; cooperative and stakeholder research; technical assistance and training; and DOT research facilities and expertise.

### *University Research and Education*

RD&T in this area supports university-based transportation research and education activities, including the Department's expanded University Transportation Centers Program. The supporting RD&T programs will include the following:

#### **FAA**

*Aeromedical Research.* Offers FAA National Research Council postdoctoral and senior research awards. Research interns at the Civil Aerospace Medical Institute will continue to work closely with scientists, engineers, and physicians on research projects relevant to aerospace safety. This program will also support Safety RD&T Strategies 1, 2, and 3.

*Joint University Program.* Provides grants from FAA and NASA to the Massachusetts Institute of Technology, Ohio State University, and Princeton University. Research will provide increased knowledge and solutions in disciplines such as air traffic control theory, human factors, satellite navigation and communications, capacity issues in air traffic control, synthetic vision, and meteorological hazards. See Section 9 for more information about this research program. This program will be funded through other FAA research activities and does not appear in the funding tables in Appendix C.

*Transportation Centers of Excellence Program.* Improves aviation through unique consortia of Federal, university, and industry researchers. Funded through contracts, grants, and cost sharing, these consortia will work to improve aviation through shared resources, leveraged funding, and pooled talent. Section 9 provides further details about the program. This program will be funded through other FAA research activities and does not appear in the funding tables in Appendix C.

## Congestion Reduction RD&T

- Reduce Surface, Freight, and Aviation Congestion
- Extend System Life and Improve Durability
- Advance Use of Next Generation Technologies and Combinations of Modes
- Improve Planning, Operations, and Management
- Improve Services for Underserved Areas and Populations
- Advance the Transportation Workforce and Research Capability

**FHWA**

*Eisenhower Fellowship Program.* Seeks to attract the best and brightest minds to transportation research and the transportation workforce. Encompassing all transportation modes, the program will award fellowships based on applicants' academic achievements, recommendations, and likelihood of pursuing a career in transportation.

*Garrett A. Morgan Technology and Transportation Education Program.* Focuses on improving the preparation of elementary and secondary school students, particularly women and minorities, in science, technology, engineering, and mathematics. The program will award grants to State and local educational agencies for internships, curriculum development, and other activities related to transportation.

*Transportation Education Development Pilot Program.* Seeks to train individuals at all educational levels for careers in transportation. This pilot program will focus on curriculum development for in-service professional development programs.

**FRA**

*University Research Program.* Competitively awards university research grants for work on challenging priority areas identified in the FRA Strategic Plan. The program will continue to fund university research using discretionary funds or in accordance with Congressional mandates. See Section 9 for more information about the program. This program will be funded through other FRA research activities and does not appear in the funding tables in Appendix C.

**RITA**

*University Transportation Centers (UTC) Program.* Invests in university-based centers of excellence to advance transportation innovation, research, education, and technology transfer. RITA will continue to manage this FHWA- and FTA-funded program, for which SAFETEA-LU authorized an expansion from 33 to 60 UTCs, 20 of which will be competitively selected. Section 9 provides details about the Department's UTC program.

**Table 4-12. Milestones for University Research and Education**

| Research Product or Information Gained                    | FY 07-08 | FY 09-10 |
|---|----------|----------|
| <i>Aeromedical Research</i>                               |          |          |
| Academic collaboration in Aeromedical research            | X        | X        |
| <i>Eisenhower Fellowship Program</i>                      |          |          |
| <i>Garret Morgan Program</i>                              |          |          |
| <i>Transportation Education Development Pilot Program</i> |          |          |
| <i>FRA University Research Program</i>                    |          |          |
| <i>University Transportation Centers Program</i>          |          |          |

***Cooperative and Stakeholder Research***

The Department provides support for a number of cooperative research activities, particularly those with State and local transportation agencies, airport operating authorities, and the transit industry. During the next five years, specific RD&T programs will include:

**FAA**

*Airport Cooperative Research Program.* Carries out applied research on problems that are shared by airport operating agencies and that are not being adequately addressed by existing research programs. Mandated by the Vision 100-Century of Aviation Reauthorization Act, the program will be administered by the Transportation Research Board (TRB), with research projects selected by an independent governing board of airport managers and others appointed by the Secretary. See Section 9 for program details. This program will also support Environmental RD&T Strategy 2.

**FHWA**

*State Planning and Research.* Encourages states to develop, establish, and implement RD&T programs that anticipate and address transportation concerns before they become critical problems. The program will give high priority to applied research on state or regional problems, transfer of technology from researchers to users, and research for setting standards and specifications.

**FTA**

*Transit Cooperative Research Program.* Funds research on issues significant to the transit industry. Administered by the TRB, the program will continue to emphasize local problem solving in transit planning, service concepts, vehicles and equipment, facilities, operations, human resources, maintenance, and administrative practices. See Section 9.

**Table 4-13. Milestones for Cooperative and Stakeholder Research**

| Research Product or Information Gained   | FY 07-08 | FY 09-10 |
|--|----------|----------|
| <i>Airport Cooperative Research Program</i><br>Carry out applied research on airport safety, security, environmental stewardship, administration, policy and planning, design, maintenance, and operations | X        |          |
| <i>State Planning and Research</i>   |          |          |
| <i>Transit Cooperative Research Program</i>  |          |          |

***Technical Assistance and Training***

RD&T activities in this area address the professional capacity building of the transportation workforce through technical assistance, training, technology transfer, and peer exchange. The primary RD&T programs that will support this area between 2006 through 2010 are described below.

**FHWA**

*Center for Environmental Excellence (Planning and Environment).* Assists states in planning and delivering environmentally sound surface transportation projects. The center will provide technical assistance, information on best practices, and training in the use of tools and decisionmaking processes. This program will also support Reduced Congestion RD&T Strategy 4 and Environmental Stewardship RD&T Strategies 1 and 2.

*Center for Transportation Advancement and Regional Development (Planning and Environment).* Focuses on training, education, and research geared toward developing small metropolitan and rural regional transportation systems. The center will promote the use of innovative strategies to expand the capabilities, capacity, and effectiveness of regional transportation networks, including activities related to freight projects, transit system upgrades, roadways, bridges, and intermodal facilities. This program will also support Reduced Congestion RD&T Strategy 5.

*Freight Planning Capacity Building.* Supports research, training, and education in freight planning at the State and local levels. Among other activities, the program will identify and disseminate best practices in freight planning; provide opportunities for freight transportation staff to engage in peer exchange; refine data and analysis tools used to assess freight transportation needs; and facilitate relationships between governmental and private entities.

*Local Technical Assistance Program (LTAP).* Improves skills and knowledge of local transportation providers through training, technical assistance, and technology transfer. The program will continue to support 57 LTAP centers serving each state, Puerto Rico, and American Indian tribal government.

*National Highway Institute (NHI).* Provides leadership and resources for the development and delivery of training and education programs to improve the quality of our highway system and its intermodal connections. Established in 1970, the NHI will continue to provide training, resource materials, and educational opportunities to the surface transportation community to develop both core competencies and new skills.

*Professional Capacity Building (ITS JPO).* Ensures that sufficient numbers of trained public transit, highway agency, and motor vehicle regulatory professionals are available to build, operate, and maintain an integrated, interoperable, and intermodal ITS infrastructure. The program will cultivate the next generation of transportation professionals and increase awareness of ITS benefits and deployment options among public-sector decisionmakers and industry.

*Surface Transportation Congestion Relief Solutions Assistance and Training.* Offers technical assistance and training to State and local transportation agencies. The program will work with agencies to improve their approaches to surface transportation congestion measurement, analysis, and project programming.

*Surface Transportation Environment and Planning Cooperative Research Program (Planning and Environment).* Focuses on improving understanding of the complex relationship between surface transportation and the environment. The program will strengthen and advance State, local, and tribal capabilities regarding the complex relationship between surface transportation and the environment. This program will also support Reduced Congestion RD&T Strategies 1, 3, 4, and 5; Safety RD&T Strategy 1; the RD&T Strategy for Global Connectivity; and Environmental RD&T Strategies 1 and 2.

**FTA**

*Improve the Capacity of the Transit Industry and Workforce (Improve Capital and Operating Efficiencies).* Promotes best practices in transit workforce development. Among other efforts, the program will continue to inform domestic transit agencies about technological opportunities available internationally. This program will also support the RD&T Strategy for Global Connectivity.

*National Transit Institute.* Develops and teaches new methods and techniques to improve transit workforce performance. The Institute will continue to conduct courses at sites nationwide on a variety of subjects, ranging from advanced technology and multimodal planning to management development and training effectiveness.

**RITA**

*Technology Transfer Grant.* Supports the creation of an Advanced Transportation Technology Center at Argonne National Laboratory. The center will conduct research and demonstration projects leading to the exchange of research results with the private sector and universities.

**Table 4-14. Milestones for Technical Assistance and Training**

| <b>Research Product or Information Gained</b>   | <b>FY 07-08</b> | <b>FY 09-10</b> |
|---|-----------------|-----------------|
| <i>Center for Environmental Excellence</i>  |                 |                 |
| Problem-solving sessions on Federal environmental legislation, policies, and procedures | X               | X               |
| Workshops on implementing SAFETEA-LU Environmental Review Process provisions            | X               | X               |
| Transfer knowledge to environmental and transportation professionals                    | X               | X               |
| <i>Center for Transportation Advancement and Regional Development</i>                   |                 |                 |
| Transfer knowledge to economic development and transportation professionals             | X               | X               |
| <i>Freight Planning Capacity Building</i>   |                 |                 |
| Courses and workshops that improve freight professional capacity                        | X               |                 |
| <i>Local Technical Assistance Program</i>   |                 |                 |
| <i>National Highway Institute</i>   |                 |                 |
| <i>Professional Capacity Building</i>   |                 |                 |
| Create ITS Learning Center  | X               |                 |

| Research Product or Information Gained  | FY 07-08 | FY 09-10 |
|---|----------|----------|
| <i>Surface Transportation Congestion Relief Assistance and Training</i>   |          |          |
| <i>Surface Transportation Environment and Planning Cooperative Research</i><br>Strengthen and advance State, local, and tribal capabilities regarding the complex relationship between surface transportation and the environment | X        | X        |
| <i>Improve the Capacity of the Transit Industry and Workforce</i><br>Identify international transit best practices  | X        | X        |
| <i>National Transit Institute</i>   |          |          |
| <i>Technology Transfer Grant</i>  |          |          |

### ***DOT Research Facilities and Expertise***

Within this RD&T strategy, this area includes RD&T activities supporting the maintenance, operation, and upgrading of the Department's research, demonstration, and testing facilities. The primary RD&T programs that will support this area between 2006 through 2010 are described below.

#### **FAA**

*Aeromedical Research – Civil Aerospace Medical Institute.* Provides aerospace medical expertise across the full spectrum of aviation-related scientific, medical, and bioengineering disciplines. The Institute will both modernize existing capabilities and expand into the revolutionary areas developed by basic medical research.

*William J. Hughes Technical Center.* Supports FAA research facilities at the William J. Hughes Technical Center in support of program goals. These centralized facilities will consist of aircraft, NAS systems, simulators, a communication systems laboratory, and a human factors laboratory. The Center will also be funded under the "Plant – R&D Facilities" line item of FAA's budget request.

#### **FRA**

*Railroad Facilities and Test Equipment.* Provides for the procurement, maintenance, and improvement of facilities and equipment used to test new railroad systems. The program will improve research capabilities at FRA's Transportation and Technology Center, at the Volpe Transportation Systems Center, and at railroad research contractors, and will also fund operation and maintenance of FRA's T-16 and T-18 track research instrumentation platforms, and their enhancements, to incorporate and demonstrate new inspection technologies as an ongoing process to expedite deployment and beneficial return on research investments.

#### **NHTSA**

*Vehicle Research and Test Center.* Supports NHTSA's safety research programs through vehicle and equipment test procedure development, testing, safety

performance criteria, and breakthrough research in crash prevention, crash protection, and integrated safety. Testing and research done at the center, which houses NHTSA's anthropomorphic dummy laboratory, will address such priorities as vehicle compatibility, rollover protection, driver distraction, and human injury research.

## 5 RD&T to Enhance Global Connectivity

Our transportation system is our lifeline to economic growth, freer trade, and greater cultural exchange. America's continued economic prosperity depends on a strong and interconnected global transportation system. Toward this end, the Department will continue to liberalize aviation markets worldwide, expand the capacity and efficiency of our freight transportation system, improve intermodal linkages, and ensure efficient trade movements across borders. The following RD&T strategy represents the primary research topic in support of Global Connectivity:

1. Conduct and sponsor research leading to harmonized international standards, improved cross-border collaboration, and global leadership for U.S. transportation providers.

The following sections summarize safety research areas, emerging research priorities, and primary RD&T activities for advancing these RD&T strategies. Appendix C shows anticipated funding levels for supporting RD&T programs for FY 2006 through 2010.

### Harmonize Transportation Standards and Support Leadership for U.S. Transportation Providers

Critical outcomes for the Department's global connectivity goal are reduced barriers to trade in transportation goods and services, enhanced competitiveness of U.S. transportation providers and manufacturers, and harmonized and standardized international regulatory and facilitation requirements. Research in two primary areas will contribute to these outcomes and support the global connectivity RD&T strategy: international standards and coordination, and transportation industry development.

#### *International Standards and Coordination*

To achieve the global connectivity goal and outcomes, the Department incorporates support for harmonized international standards and decisionmaking, particularly with regard to transportation safety and environmental issues, within a number of RD&T activities. The primary RD&T programs that will support this area between 2006 through 2010 are described below.

#### **FAA**

*Airport Technology Research.* Supports the development of pavement design standards that airports throughout the world need to accommodate new large aircraft. The International Civil Aviation Organization (ICAO) will use data from FAA's National Pavement Test Facility to develop pavement standards for

"Our highway, seaports, rail yards, airports, and border crossings all have a profound significance for bottom-line costs for businesses that depend on an efficient supply chain and product distribution system. And they have strategic significance for the United States' continued leadership as the world's largest global trading partner."

Secretary Norman Y. Mineta

#### **Global Connectivity RD&T**

- Harmonize Standards and Support Leadership for U.S. Transportation Providers



aircraft weighing in excess of a million pounds. This program will also support Safety RD&T Strategies 1 and 2 and Reduced Congestion RD&T Strategy 2.

*Environment and Energy.* Develops, applies, and disseminates knowledge and tools in support of harmonized emissions- and noise-related certification standards, operational procedures, and abatement technology. Through this program, FAA will continue to represent the United States on the ICAO Committee on Aviation Environmental Protection, which establishes and assesses the adequacy of international standards for aircraft noise and engine exhaust emissions. This program will also support Environmental RD&T Strategies 1 and 2.

*Fire Research and Safety.* Develops technologies, procedures, test methods, and criteria to prevent accidents caused by hidden in-flight fires and fuel tank explosions. The program will support international standards and cooperation in several areas, including fuel tank protection, fire and smoke detectors, halon replacement, lithium battery fire hazards, and improved material fire tests. This program will also support Safety RD&T Strategies 1, 2, and 3.

#### **FHWA**

*Surface Transportation Environment and Planning Cooperative Research Program (Planning and Environment).* Focuses on improving understanding of the complex relationship between surface transportation and the environment. In this research area, the program will focus on improving surface transportation decisionmaking and coordination across borders. This program will also support Safety RD&T Strategy 1; Reduced Congestion RD&T Strategies 1, 3, 4, 5, and 6; and Environmental RD&T Strategies 1 and 2.

#### **FTA**

*Identify Practices and Technologies to Control Capital and Operating Costs (Improve Capital and Operating Efficiencies).* Supports efforts to develop voluntary standards for public transportation. This program will also support Reduced Congestion RD&T Strategy 4.

#### **NHTSA**

*International Coordination of Research.* Supports agency efforts toward future harmonized test devices and procedures development. This activity will be funded through other NHTSA RD&T programs and does not appear in the funding tables in Appendix C.

#### **OST**

*Navigation and Spectrum Policy.* Supports the formulation of positioning, navigation, and spectrum policy and the civilian management and use of the GPS. This effort will examine potential applications of international space-based PNT systems and augmentations. This program will also support Safety RD&T Strategy 1 and Reduced Congestion RD&T Strategies 3 and 4.

## PHMSA

*Hazardous Materials Safety R&D.* Provides the foundation for PHMSA's hazardous material regulatory, enforcement, and emergency response actions. The program will conduct studies to support regulatory changes and provide the basis for adaptation of international standards. This program will also support Safety RD&T Strategy 1, Environmental RD&T Strategy 1, and Security RD&T Strategy 2.

**Table 5-1. Milestones for International Standards and Coordination**

| Research Product or Information Gained   | FY 07-08 | FY 09-10 |
|--|----------|----------|
| <i>Airport Technology</i><br>Develop international pavement design standards to accommodate new large aircraft   | X        | X        |
| <i>Environment and Energy</i><br>Develop international noise standard for subsonic jets and large airplanes  | X        |          |
| <i>Fire Research and Safety</i><br>Research and tests in support of reduced flammability limits for fuel tanks<br>Fire-test criteria for structural composites | X<br>X   |          |
| <i>Surface Transportation Environment and Planning Cooperative Research</i><br>Improve transportation decisionmaking and coordination across borders           | X        | X        |
| <i>Identify Practices and Technologies to Control Capital and Operating Costs</i><br>Develop voluntary international standards for transit                     | X        | X        |
| <i>Navigation and Spectrum Policy</i>  |          |          |
| <i>Hazardous Materials Safety</i><br>Support development of international standards  | X        | X        |

## *Transportation Industry Development*

Programs in this research area promote the export of U.S. transportation goods and services and international technology transfer. The primary RD&T programs that will support this area between 2006 through 2010 are described below.

### FHWA

*International Highway Transportation Outreach Program.* Informs the U.S. highway community of technological innovations in foreign countries and promotes U.S. highway transportation expertise, goods, and services. The program will help to increase transfers of U.S.-developed highway technologies to foreign countries.

### FTA

*Improve the Capacity of the Transit Industry and Workforce (Improve Capital and Operating Efficiencies).* Conducts research to advance the U.S. transit industry. The program will conduct technology transfer activities with foreign countries; support trade missions, market research, and other trade-related activities; and

continue training and information diffusion programs in Latin America and Africa to develop U.S. transit exports. This program will also support Reduced Congestion RD&T Strategy 6.

**OST**

*Aviation and International Policy.* Conducts policy research to support DOT's role in promoting the U.S. aviation industry. Among other efforts, the program will develop a methodology for quantifying the economic impacts of air transportation; examine the operating and competitive structures of the air cargo industry; analyze changes in airline labor contracts and their impact on industry cost structures; define the requirements for and develop the aviation data modernization system; and continue the Office of the Secretary's Project on the Future of the Airline Industry. This program will also support Reduced Congestion RD&T Strategies 4 and 5.

**Table 5-2. Milestones for Transportation Industry Development**

| Research Product or Information Gained                            | FY 07-08 | FY 09-10 |
|---|----------|----------|
| <i>International Highway Transportation Program</i>               |          |          |
| <i>Improve the Capacity of the Transit Industry and Workforce</i> |          |          |
| Research foreign transit markets                                  | X        | X        |
| Promote U.S. transit exports                                      | X        | X        |
| <i>Aviation and International Policy</i>                          |          |          |

## 6 RD&T to Support Environmental Stewardship

Transportation exerts pressure on environmental resources worldwide. The Department must balance environmental challenges with the need for a safe and efficient transportation network. The following RD&T strategies represent the primary research topics in support of environmental stewardship:

1. Conduct and support research to understand the various impacts of transportation activities on the natural and built environment and communities and to advance technologies and concepts to mitigate those impacts.
2. Conduct and support research on ways to improve the environmental review process to achieve the timely delivery of transportation projects.

The following sections summarize environmental stewardship research areas, emerging research priorities, and primary RD&T activities for advancing these RD&T strategies. Appendix C shows anticipated funding levels for supporting RD&T programs for FY 2006 through 2010.

### Understand and Mitigate Transportation Impacts

Current trends in transportation are exerting pressure on environmental resources worldwide. In the United States, commercial and personal travel has grown substantially in recent years and will continue to increase in the future. Increased travel boosts transportation's share of energy consumption and continues to challenge efforts to reduce air pollutant emissions. This Departmental RD&T strategy has two critical concerns: more fully understanding transportation's impact on the environment, and advancing technologies, plans, and methods to manage these impacts.

#### *Understanding Transportation Impacts*

Research in this critical area develops improved understanding of the broad environmental impacts of aviation, highway, and hazardous materials transportation activities. The primary RD&T programs that will support this area between 2006 through 2010 are described below.

#### **FAA**

*Environment and Energy.* Develops and validates methodologies, models, metrics, and tools to assess and mitigate the effect of aircraft noise and emissions in a manner that balances the interrelationships between emissions and noise and includes economic consequences. Among other efforts, research will develop a better science-based understanding of the impacts of aircraft noise

"Preserving the environment and advancing vital transportation infrastructure are not mutually exclusive."

Secretary Norman  
Y. Mineta

#### **Environmental Stewardship RD&T**

- Understand and Mitigate Transportation Impacts
- Improve the Environmental Review Process

and emissions on air quality and climate change. This program will also support Environmental RD&T Strategy 2 and the RD&T Strategy for Global Connectivity.

#### **FHWA**

*Center for Environmental Excellence (Planning and Environment).* Assists states in planning and delivering environmentally sound surface transportation projects. The center will contribute to understanding and mitigating transportation impacts through the documentation and sharing of best practices. This program will also support Environmental RD&T Strategy 2 and Reduced Congestion RD&T Strategies 4 and 6.

*Exploratory Advanced Research (Corporate Activities).* Addresses longer-term, higher-risk research with potentially dramatic breakthroughs for assessing the effects of transportation decisions on human health and the environment. This program will also support Safety RD&T Strategy 1 and Reduced Congestion RD&T Strategies 2, 3, and 4.

*Surface Transportation Environment and Planning Cooperative Research Program (Planning and Environment).* Focuses on improving understanding of the complex relationship between surface transportation and the environment. Environmental research will improve the state of the practice regarding research that addresses the impact of transportation on the environment. This program will also support Environmental RD&T Strategy 2; Safety RD&T Strategy 1; Reduced Congestion RD&T Strategies 1, 3, 4, 5, and 6; and the RD&T Strategy for Global Connectivity.

#### **OST**

*Safety, Energy, and Environment.* Conducts policy research to support the formulation and recommendation of Departmental policies, plans, and guidelines related to environmental enhancement and communities, public health, and safety. In this area, research will address the issues and environmental implications related to new energy and emissions reduction technologies, particularly alternative fuels. This program will also support Safety RD&T Strategy 1 and Reduced Congestion RD&T Strategies 1 and 5.

#### **PHMSA**

*Hazardous Materials Safety R&D.* Provides the foundation for PHMSA's hazardous material regulatory, enforcement, and emergency response actions. Although PHMSA has focused on safety, we are cognizant that efforts to improve safety have a secondary positive impact on the environment. Better ways to consider and evaluate these environmental effects are sought in this research area. This program will also support Safety RD&T Strategy 1, the RD&T Strategy for Global Connectivity, and Security RD&T Strategy 2.

**Table 6-1. Milestones for Understanding Transportation Impacts**

| Research Product or Information Gained  | FY 07-08 | FY 09-10 |
|---|----------|----------|
| <i>Environment and Energy</i>   |          |          |
| New methodologies to quantify and assess the impact of aircraft noise and emissions and their interrelationships              |          | X        |
| Aviation Environmental Portfolio Management Tool  |          | X        |
| Methodologies to quantify and assess the impact of particulate matter and hazardous air pollutants                            | X        |          |
| Direct measurements of hazardous air pollutants and particulate matter from engines to replace factors used in modeling tools |          | X        |
| Assess impacts of aviation on regional air quality  |          | X        |
| Assess impact of aviation on climate change   |          | X        |
| <i>Center for Environmental Excellence</i>  |          |          |
| Collaborate on research agenda development  | X        | X        |
| Document good practices through solicitation of case studies and best practices   | X        | X        |
| <i>Exploratory Advanced Research</i>  |          |          |
| Identify research to better understand the impacts of transportation on the environment                                       | X        |          |
| <i>Surface Transportation Environment and Planning Cooperative Research</i>   |          |          |
| Improve the state of the practice regarding the impact of transportation on the environment                                   | X        | X        |
| <i>Safety, Energy, and Environment</i>  |          |          |
| <i>Hazardous Materials Safety</i>   |          |          |
| See milestones for "Hazardous Materials Safety" under Safety RD&T Strategy 1.   |          |          |

### ***Advancing Technologies, Plans, and Methods to Manage Impacts***

Applying the knowledge gained through the research described above, RD&T in this area seeks to mitigate transportation's negative impacts through improved environmental standards, planning tools, and technologies. The primary RD&T programs that will support this area between 2006 through 2010 are described below.

#### **FAA**

*Environment and Energy.* Develops and validates methodologies, models, metrics, and tools to assess and mitigate the effect of aircraft noise and emissions in a manner that balances the interrelationships between emissions and noise and includes economic consequences. Research will address improved certification standards, operational procedures, and other actions to reduce aircraft noise and seek to minimize the impact of aviation emissions. This program will also support Environmental RD&T Strategy 2 and the RD&T Strategy for Global Connectivity.

**Emerging Research Priority: Alternative Fuels and Energy Efficiency**

RD&T in this area will increase the awareness and understanding of decision makers, both inside and beyond the Government, as to the impact of fuel prices and fuel efficiency on the capability of the transportation system to move people and goods, the availability of opportunities to improve fuel efficiency, the transportation requirements associated with alternative fuel infrastructures, and the impact of alternative-fuel-equipped vehicles on safety. Potential initiatives include analysis of the influence of both fuel price and fuel efficiency on the demand for travel and shipments; detailed inventorying and characterization of newly manufactured vehicles; expansion and refinement of vehicle simulation tools; development and analysis of fuel production, distribution, and delivery scenarios; and the safety impacts of downsizing and weight reductions and alternative fuel use.

**Key Supporting RD&T Programs:**

- Renewable Transportation Systems
- National Fuel Cell Bus Technology Development
- Protect the Environment and Promote Energy Independence
- Hydrogen Initiative
- Safety, Energy, and Environment
- Advanced Vehicle Technology
- Bio-based Transportation
- Hydrogen Fuels Safety R&D
- Hydrogen Powered Research

**FHWA**

*Center for Environmental Excellence (Planning and Environment).* Assists states in planning and delivering environmentally sound surface transportation projects. In this research area the center will promote and document best practices, technology, and geospatial innovations. This program will also support Environmental RD&T Strategy 2 and Reduced Congestion RD&T Strategies 4 and 6.

*Renewable Transportation Systems (Planning and Environment).* Focuses on research, development, and field testing of hydrogen fuel cell and biofuel transportation technologies. The program will be carried out through an FHWA grant to the University of Vermont.

*Surface Transportation Environment and Planning Cooperative Research Program (Planning and Environment).* Focuses on improving understanding of the complex relationship between surface transportation and the environment. The program will advance technologies, plans, and methods to manage the impact of transportation on the environment. This program will also support Environmental RD&T Strategy 2; Safety RD&T Strategy 1; Reduced Congestion RD&T Strategies 1, 3, 4, 5, and 6; and the RD&T Strategy for Global Connectivity.

**FRA**

*Hazardous Materials Transportation.* Conducts research in hazardous materials transportation safety, damage assessment and inspection, and tank car safety. The program's safety-related activities in tank car thermal protection, gasket

materials, and operating environments will also yield benefits for environmental stewardship. This program will also support Safety RD&T Strategy 1.

#### **FTA**

*National Fuel Cell Bus Technology Development Program.* Facilitates the development of commercially viable fuel cell bus technology and related infrastructure. Research will further fuel cell technology as it relates to transit bus operations, including hydrogen production, energy storage, fuel cell technologies, vehicle–system integration, and power electronics technologies.

*Protect the Environment and Promote Energy Independence.* Seeks to identify and overcome barriers to the adoption of technologies that will improve energy efficiency and reduce emissions from transit vehicles. A key activity will be an FTA program to encourage the deployment of new low-emission technology, including hybrid transit buses. This program will also support Environmental RD&T Strategy 2.

#### **NHTSA**

*Hydrogen Initiative.* Seeks to ensure that hydrogen internal combustion engine and fuel-cell-powered vehicles attain a level of safety comparable to other vehicles. In support of the President's Hydrogen Initiative, NHTSA will conduct risk assessments of hydrogen-fueled vehicles to quantify potential failures that could indicate unsafe conditions. This program will also support Safety RD&T Strategy 3.

#### **OST**

*Safety, Energy, and Environment.* Conducts policy research to support the formulation and recommendation of Departmental policies, plans, and guidelines related to environmental stewardship, public health, and safety. The program will identify technologies and policies that encourage sustainability; examine potential market-based mechanisms for increasing fuel economy; analyze incentives for partnerships to support transportation needs, especially freight, while reducing community impacts; conduct research to reduce transportation emissions, including greenhouse gases, and increase transportation energy security; and research non-chemical methods of preventing the entry of potential disease-carrying insects onto aircraft. This program will also support Safety RD&T Strategy 1 and Reduced Congestion RD&T Strategies 1 and 5.

#### **PHMSA**

*Pipeline Safety R&D.* Improves pipeline inspection and analysis tools and strengthens the industry's ability to effectively manage pipeline integrity. Research will address improvements in corrosion detection technology and direct assessment techniques; tools for preventing and detecting damage and leaks; and materials that can better withstand third-party damage, corrosion, and cracking. This program will also support Safety RD&T Strategy 1.

#### **RITA**

*Advanced Vehicle Technology.* Supports research and development of advanced vehicle technology concepts at the University of Kansas Transportation Research



Institute. Research will focus on technologies related to vehicle emissions, fuel cells and catalytic processes, and intelligent transportation systems.

*Bio-based Transportation.* Supports bio-based transportation research of national importance at the National Biodiesel Board and at various research centers identified in the Farm Security and Rural Investment Act of 2002. This RITA-managed grant will be funded by FHWA.

*Hydrogen Fuels Safety R&D (Multimodal RD&T)*—Executes, coordinates, and identifies research, development, demonstration, and testing of technologies that have multimodal transportation applications. The program will support the President’s Hydrogen Initiative through work with other agencies to evaluate hydrogen delivery infrastructure concepts, transportation and vehicle fuel system containers and components, and in-service inspection technologies, and will also support the development of appropriate consensus codes and standards. This program will also support Safety RD&T Strategy 3.

*Hydrogen Powered Research.* Supports a hydrogen-powered transportation research initiative at the University of Montana. This RITA-managed grant will be funded through FHWA’s RD&T program. This program will also support Safety RD&T Strategy 3.

**Table 6-2. Milestones for Advancing Technologies, Plans, and Methods to Manage Impacts**

| Research Product or Information Gained   | FY 07-08 | FY 09-10 |
|--|----------|----------|
| <i>Environment and Energy</i>  |          |          |
| Implement new continuous-descent approach noise and emission abatement procedure at low traffic airports during night-time operations              | X        |          |
| Determine feasibility of using continuous-descent approach procedures at airports with greater traffic levels and with mixed fleets and operations |          | X        |
| Deploy elements of an internet-based capability to inform the public about aircraft noise  |          | X        |
| <i>Center for Environmental Excellence</i>   |          |          |
| Document good practices through solicitation of case studies and best practices  | X        | X        |
| Promote the advancement of Context Sensitive Solutions   | X        | X        |
| Identify and promote technology and geospatial innovations   | X        | X        |
| Promote good practices through awards  | X        | X        |
| <i>Renewable Transportation Systems</i>  |          |          |
| <i>Surface Transportation Environment and Planning Cooperative Research</i>  |          |          |
| Advance technologies, plans, and methods to manage the impact of transportation on the environment   | X        | X        |
| <i>Hazardous Materials Transportation—Rail</i>   |          |          |
| <i>National Fuel Cell Bus Technology Development Program</i>   |          |          |

| Research Product or Information Gained   | FY 07-08 | FY 09-10 |
|--|----------|----------|
| <i>Protect the Environment and Promote Energy Independence</i>   |          |          |
| Increase deployment of hybrid electric vehicles  | X        | X        |
| Prepare transit vehicles for use of hydrogen   | X        | X        |
| Advance fuel cell applications for transit vehicles  | X        | X        |
| Improve energy efficiency of rail systems  | X        | X        |
| <i>Hydrogen Initiative</i>   |          |          |
| See milestones for "Safety Consequences of Advanced Technologies" under Safety RD&T Strategy 3.                            |          |          |
| <i>Safety, Energy, and Environment</i>   |          |          |
| <i>Pipeline Safety</i>   |          |          |
| Improvements in pipeline damage prevention and leak detection  | X        | X        |
| Improvements in pipeline operations, controls, and monitoring  | X        | X        |
| <i>Advanced Vehicle Technology</i>   |          |          |
| Identify potential new research areas and prepare a strategic implementation plan  | X        |          |
| <i>Bio-Based Transportation</i>  |          |          |
| Complete tests of biofuels for compatibility with new and emerging exhaust after-treatment technologies                    | X        |          |
| Publish a national fuel specification standard for biodiesel blends  | X        |          |
| Continue research to improve the energy efficiency of producing biofuels with a focus on cellulosic ethanol                | X        |          |
| <i>Hydrogen Fuels Safety R&amp;D</i>   |          |          |
| <i>Hydrogen Powered Research</i>   |          |          |
| Distribute and update safety materials and provide safety training through the Hydrogen Safety Training Center             | X        |          |
| Identify methods to integrate hydrogen distribution and storage for a hydrogen-powered magnetic levitation monorail system | X        |          |
| Continue palladium membrane development for hydrogen production  | X        |          |

## Improve the Environmental Review Process

A key element of the Department's environmental stewardship goal is to balance the importance of preserving environmental quality with the need for a safe and efficient transportation network. Through this RD&T strategy, the Department is emphasizing its commitment to implementing Executive Order 13274, "Environmental Stewardship and Transportation Infrastructure Project Reviews," signed by President Bush to speed up decisionmaking on vital airport, highway, transit, and intermodal transportation projects while safeguarding the environment. The focus of this RD&T strategy will be research in the area of environmental streamlining.

### Environmental Stewardship RD&T

- Understand and Mitigate Transportation Impacts
- Improve the Environmental Review Process

### ***Environmental Streamlining***

The objective of environmental streamlining is to balance the need for timely delivery of transportation projects with protection of the environment. The primary RD&T programs that will support this area between 2006 through 2010 are described below.

#### **FAA**

*Airport Cooperative Research Program.* Carries out applied research on problems that are shared by airport operating agencies and that are not being adequately addressed by existing research programs. Mandated by the Vision 100-Century of Aviation Reauthorization Act, the program will be administered by the Transportation Research Board (TRB), with research projects selected by an independent governing board of airport managers and others appointed by the Secretary. See Section 9 for program details. This program will also support Reduced Congestion RD&T Strategy 6.

#### **FHWA**

*Center for Environmental Excellence (Planning and Environment).* Assists states in planning and delivering environmentally sound surface transportation projects. In this area, the center will conduct problem-solving sessions and workshops to support environmental stewardship and streamlining. This program will also support Environmental RD&T Strategy 1 and Reduced Congestion RD&T Strategies 4 and 6.

*Surface Transportation Environment and Planning Cooperative Research Program (Planning and Environment).* Focuses on improving understanding of the complex relationship between surface transportation and the environment. The program will support research to promote environmental streamlining and stewardship. This program will also support Environmental RD&T Strategy 1; Safety RD&T Strategy 1; Reduced Congestion RD&T Strategies 1, 3, 4, 5, and 6; and the RD&T Strategy for Global Connectivity.

#### **FTA**

*Protect the Environment and Promote Energy Independence.* Seeks to identify and overcome barriers to the adoption of technologies that will improve energy efficiency and reduce emissions from transit vehicles. The program will respond to changes in environmental review requirements in SAFETEA-LU. This program will also support Environmental RD&T Strategy 1.

**Table 6-3. Milestones for Environmental Streamlining**

| <b>Research Product or Information Gained</b>  | <b>FY 07-08</b> | <b>FY 09-10</b> |
|--|-----------------|-----------------|
| <i>Airport Cooperative Research Program</i><br>Conduct research to develop guidance to protect airports from incompatible land uses that constrain development | X               |                 |
| <i>Center for Environmental Excellence</i><br>Problem-solving sessions on Federal environmental legislation, policies, and procedures                          | X               | X               |
| Workshops on implementing SAFETEA-LU Environmental Review Process revisions  | X               | X               |
| <i>Surface Transportation Environment and Planning Cooperative Research</i><br>Support research to promote environmental streamlining and stewardship          | X               | X               |
| <i>Protect the Environment and Promote Energy Independence</i>   |                 |                 |



## 7 RD&T to Ensure Security, Preparedness and Response

There is a critical need to ensure the transportation system's rapid response and recovery from disruptions due to attacks, natural disasters, and other major events. DOT will also work with the Department of Homeland Security (DHS), Department of Defense (DOD), and State, local, and private sector partners to protect our transportation system against terrorism and to ensure that it remains a vital link for defense mobilization. Two RD&T strategies represent the primary research topics in support of the Department's security goal:

1. Conduct and support research to reduce the vulnerability of transportation systems and to improve their ability to prepare for and recover from attacks, natural disasters, and emergencies.
2. Conduct and support research to develop technologies and procedures to secure hazardous materials shipments and to assess the risks of hazmat events.

The following sections summarize security, preparedness, and response research areas, emerging research priorities, and primary RD&T activities for advancing these RD&T strategies. Appendix C shows anticipated funding levels for supporting RD&T programs for FY 2006 through 2010.

### Reduce Vulnerability and Improve System Preparedness and Recovery

One of the Department's most pressing concerns is to work with DHS to identify, support, and conduct RD&T on technologies, policies, and methods that will assure the continued security and preparedness of the Nation's transportation network. In support of this RD&T strategy the Department will conduct research in two critical areas: emergency preparedness and response, and transportation security risks and vulnerabilities. The primary RD&T programs that will support this area between 2006 through 2010 are described below.

#### *Preparedness and Response*

The focus of this RD&T is to improve the transportation system's ability to mitigate and respond to attacks, natural disasters, emergencies, and other significant events that place a substantial demand on the transportation system. These efforts will include the following RD&T programs:

"Together we succeeded in decreasing the dangers of terrorism through new and better technology."

Secretary Norman  
Y. Mineta

#### Security, Preparedness and Response RD&T

- Reduce Vulnerability and Improve Preparedness and Recovery
- Secure Hazardous Materials Shipments and Assess Risks

**FHWA**

*Emergency Transportation Operations (ITS JPO).* Improves operational technology and practices to enable the safe and effective movement of people and goods during emergency evacuation situations (both with and without notice). The program will address the application of ITS technologies to improve notice and no-notice evacuation planning and execution, with an orientation that includes both decisionmakers and evacuees. This program will also support Safety RD&T Strategy 2 and Reduced Congestion RD&T Strategy 1.

*Next-Generation 911 (ITS JPO).* Aims to establish the foundation for public emergency communications services in a wireless mobile society. This ITS initiative will enable an enhanced 9-1-1 system that permits the transmission of voice, data, or video from any communication device to Public Safety Answering Points and onto emergency responder networks. This program will also support Safety RD&T Strategy 2.

**FTA**

*Identify Solutions to Improve Transit Emergency Preparedness (Improve Safety and Emergency Preparedness).* Assists States, transit authorities, and the industry through safety technical assistance and improved technology and training. Research will address methods, techniques, technologies, and training to improve emergency preparedness, including a web-based approach to managing emergency incidents. This program will also support Safety RD&T Strategy 2.

**Table 7-1. Milestones for Preparedness and Response**

| Research Product or Information Gained  | FY 07-08 | FY 09-10 |
|---|----------|----------|
| <i>Emergency Transportation Operations</i><br>Real-time evacuation tool evaluation and technology transfer      | X        |          |
| <i>Next-Generation 911</i><br>Evaluation of next-generation 9-1-1 framework and transition plan                 | X        |          |
| <i>Identify Solutions to Improve Transit Emergency Preparedness</i><br>Develop web-based emergency preparedness | X        | X        |
| Support metropolitan-area preparations for emergency situations   | X        | X        |

***Security Risks and Vulnerabilities***

Research in this area seeks to develop, deploy, and promote technologies, designs, and procedures to reduce the vulnerability of the transportation system and to accurately assess security risks and vulnerabilities. The primary RD&T programs that will support this area between 2006 through 2010 are described below.

**FHWA**

*Anti-Ram Barriers.* Develops models of vehicles and roadside hardware to assess and improve roadside objects used as anti-ram barriers. This project will be funded by the Department of State and does not appear in Appendix C.

**FRA**

*Railroad System Issues.* Provides for research in railroad systems safety and infrastructure security. Work in this area will address the security of railroad communication systems. The program will develop encryption technology and key management for wireless communications used in train control and operations management to protect train movements and routings from hackers and vandalism that may lead to train collisions, run-away equipment, overspeed derailments, possible danger to roadway workers, or disruption to the national railroad network. This program will also support Security RD&T Strategy 2 and Safety RD&T Strategies 1 and 2.

**OST**

*Security Policy.* Conducts research to support the development of Departmental security policy. In this area the program will assess the mobility and economic impacts of container security measures and of a terrorist attack on a major transit system. This program will also support Security RD&T Strategy 2.

**Table 7-2. Milestones for Security Risks and Vulnerabilities**

| Research Product or Information Gained | FY 07-08 | FY 09-10 |
|--|----------|----------|
| <i>Railroad System Issues</i>          |          |          |
| <i>Security Policy</i>                 |          |          |

**Secure Hazardous Materials Shipments and Assess the Risks of Hazmat Events**

Working with DHS, the Department has a lead role in developing technologies, tools, and procedures to ensure the secure shipment of hazardous materials and to prepare for potential hazmat emergencies. DOT will advance this RD&T strategy over the next five years through security research in the area of hazardous materials risks and vulnerabilities.

***Hazardous Materials Risks and Vulnerabilities***

DOT research in this area addresses such critical issues as hazardous materials routing, tank car security, and emergency response. The primary RD&T programs that will support this area between 2006 through 2010 are described below.

**Security, Preparedness and Response RD&T**

- Reduce Vulnerability and Improve Preparedness and Recovery
- Secure Hazardous Materials Shipments and Assess Risks



**FMCSA**

*Improve Security through Safety Initiatives.* Develops and implements safety initiatives that also have security benefits for truck and motor coach operations. In particular, the program will examine hazardous materials routing procedures and security risks and develop an enhanced routing tool for use by FMCSA and industry.

**FRA**

*Railroad System Issues.* Provides for research in railroad systems safety and infrastructure security. In this area, the program will conduct research on tank car security. This program will also support Security RD&T Strategy 1 and Safety RD&T Strategies 1 and 2.

**OST**

*Security Policy.* Conducts research to support the development of Departmental security policy. One project will work with industry to explore measures that can be taken to limit exposure to toxic inhalation materials in urban areas while maintaining expeditious delivery of these shipments. This program will also support Security RD&T Strategy 1.

**PHMSA**

*Hazardous Materials Safety R&D.* Provides the foundation for PHMSA's hazardous material regulatory, enforcement, and emergency response actions. In this research area, the program will identify and quantify security risks inherent in hazardous materials transportation, point to ways to control and minimize these risks, and assess emergency response capabilities for both intentional and unintentional hazardous material transportation incidents. This program will also support Safety RD&T Strategy, the RD&T Strategy for Global Connectivity, and Environmental Stewardship RD&T Strategy 1.

**Table 7-3. Milestones for Security of Hazardous Shipments**

| <b>Research Product or Information Gained</b>   | <b>FY 07-08</b> | <b>FY 09-10</b> |
|---|-----------------|-----------------|
| <i>Improve Security through Safety Initiatives</i><br>Research security measures to reduce risks in routing hazardous materials | X               |                 |
| <i>Railroad System Issues</i>   |                 |                 |
| <i>Security Policy</i>  |                 |                 |
| <i>Hazardous Materials Safety</i><br>Assess security risks, vulnerabilities, and consequences                                   | X               | X               |

## 8 Organizational Excellence in RD&T

In support of the President's Management Agenda, the Department has adopted the following RD&T strategy to advance organizational excellence:

1. Consistently apply the President's R&D Investment Criteria—relevance, quality, and performance—to all DOT-sponsored and in-house research.

The following sections summarize organizational excellence research areas, emerging research priorities, and primary RD&T activities for advancing these RD&T strategies. Appendix C shows anticipated funding levels for RD&T programs for FY 2006 through 2010.

"Only by managing the Federal government in a more transparent, results-oriented way can we govern with accountability."

Secretary Norman  
Y. Mineta

### Consistently Apply the R&D Investment Criteria

Through the RD&T Planning Council and RD&T Planning Team, RITA conducts annual reviews of operating administrations' RD&T programs to ensure effective implementation of the R&D investment criteria of relevance, quality, and performance and that research programs are evaluated according to established best practices. These reviews also enable the operating administrations to identify areas of mutual interest and to prevent unnecessary duplication.

#### Organizational Excellence RD&T

- Consistently apply the R&D Investment Criteria

As described in Section 9, the Department's operating administrations also have processes in place to ensure that research is relevant to stakeholder and national needs, is peer-reviewed, and is meeting performance objectives. The primary RD&T programs that will support this area between 2006 through 2010 are described below. Table 8-1 lists program milestones.

#### FAA

*System Planning and Resource Management.* Meets the Administration's criteria for addressing customer needs, increasing program efficiency, and reducing management and operating costs. The program will continue to produce the annual *National Aviation Research Plan*, administer the Congressionally mandated Research, Development and Engineering Advisory Committee, conduct external program coordination, and undertake strategic planning for FAA research programs.

#### FHWA

*RD&T Review and Evaluation.* Ensures that stakeholders are engaged throughout the RD&T planning process and supports external review of research programs. Among other activities, this work will support the TRB Research and Technology Coordinating Committee and an independent assessment process for FHWA's 24 laboratories by panels of external experts. This activity will be funded through other FHWA RD&T programs and does not appear in the funding tables in Appendix C.

### **FMCSA**

*Enable and Motivate Internal Excellence.* Improves the performance and excellence of FMCSA's research and technology program. This effort will develop and update strategic and tactical plans for research and technology; engage stakeholders in program planning and execution; produce technical reports, briefs, and web-based information; and develop and monitor fiscal and performance accountability.

### **FRA**

*Review of FRA RD&T Programs.* Through a committee established by the TRB, reviews the management structure and approach of FRA research programs; the direction and allocation of research funds; and whether there is an appropriate balance of Federal, State, and private sector input and cost sharing. This committee will be refocused to assist with developing an updated five-year plan for railroad research. This activity will be funded through other FRA RD&T programs and does not appear in the funding tables in Appendix C.

### **FTA**

*Provide Transit Research Leadership.* Ensures FTA's ability to lead transit research in partnership with the transit industry. Activities will include continued support for the Transit Research Analysis Committee, which provides stakeholder review of FTA research programs; the transit-related activities of the TRB; and technical support for research activities, including program evaluations and reporting.

### **NHTSA**

*NHTSA RD&T Planning and Outreach.* Develops the five-year report on safety rulemaking and supporting research priorities and conducts public meetings to share research results. In addition to these activities, NHTSA will develop a five-year strategic research plan. This activity will be funded through other NHTSA RD&T programs and does not appear in the funding tables in Appendix C.

### **PHMSA**

*Stakeholder and Peer Review.* Supports ongoing stakeholder input into the development of PHMSA's pipeline safety and hazardous materials safety RD&T programs. Efforts will support pipeline safety R&D Forums, the work of the pipeline safety research Blue Ribbon Panel, and implementation of peer-review requirements for highly influential and influential research. This activity will be funded through other PHMSA RD&T programs and does not appear in the funding tables in Appendix C.

### **RITA**

*R&D Planning and Management (RD&T Coordination).* Implements an integrated planning process for RD&T aligned with Departmental goals. The program will continue to work through the DOT RD&T Planning Council and RD&T Planning Team to coordinate and provide strategic direction for DOT's research programs, to promote efficient use of RD&T resources; and to prevent unnecessary research duplication.

*Transportation Futures and Applied Technology Program.* Enhances RITA's role as the administration with responsibility for RD&T coordination and management across the Department. Among other activities, the program will develop a roadmap for RD&T based on the *DOT RD&T Strategic Plan*, adopt DOT-wide performance measures for research, conduct technology scans to identify emerging opportunities, lead multimodal RD&T activities, and support participation in external science and technology working groups and committees.

**Table 8-1. Milestones for Applying the R&D Investment Criteria**

| <b>Research Product or Information Gained</b>                                | <b>FY 07-08</b> | <b>FY 09-10</b> |
|--|-----------------|-----------------|
| <i>System Planning and Resource Management</i>                               |                 |                 |
| Publish annual aviation research plan  | X               | X               |
| Work with research advisory committee to plan and implement RD&T investments | X               | X               |
| <i>FMCSA Enable and Motivate Internal Excellence</i>                         |                 |                 |
| Build strategic roadmaps   | X               | X               |
| Update 5-Year Strategic Plan   | X               | X               |
| Implement/capture research management performance metrics                    | X               | X               |
| Support President's Management Agenda  | X               | X               |
| <i>Provide Transit Research Leadership</i>                                   |                 |                 |
| Update Strategic Transit Research Plan                                       | X               | X               |
| Work with Transit Research Analysis Committee to improve research management | X               | X               |
| Support Transportation Research Board core activities                        | X               | X               |
| Produce Transit Conditions and Performance Report                            | X               | X               |
| <i>RD&amp;T Planning and Management</i>                                      |                 |                 |
| RD&T Planning Council review of RD&T budgets, programs, and priorities       | X               | X               |
| <i>Transportation Futures and Applied Technology Program</i>                 |                 |                 |



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## 9 RD&T Coordination

The Department's RD&T program emphasizes cooperation, information sharing, and collaboration—both within DOT and across the Federal Government. The Department also promotes partnerships with universities, State and local governments, industry, and other organizations, thereby eliminating unnecessary research duplication and broadening the range of expertise brought to bear on transportation problems.

### Internal RD&T Coordination

Led by RITA, the Department's internal RD&T coordination process tracks multiyear priorities with annual budgets and goals. RITA works with the other operating administrations to define DOT-wide RD&T priorities, ensure program effectiveness, and prevent research duplication. To assist RITA with RD&T planning, the Department recently established two internal bodies: the RD&T Planning Council and the RD&T Planning Team (see Section 1). The Department's RD&T coordination process has three elements: multiyear strategic planning, annual program planning, and budget and performance planning:

*Multiyear RD&T Planning.* The RD&T Planning Council and RD&T Planning Team define long-term, multiyear RD&T strategies and emerging research priorities. These strategies and priorities guide RD&T investments and provide the framework for the Department's *Strategic RD&T Plan*.

*Annual Program Planning.* Considering both Departmental and operating administration priorities, the Planning Council and Planning Team develop annual RD&T priorities for each upcoming fiscal year. Priorities are included in the Secretary's budget guidance to the operating administrations and in the annual *RD&T Funding Report* submitted to Congress.

*Budget and Performance Planning.* Assisted by RITA, the Planning Council and Planning Team support RD&T budgeting and program assessment through annual reviews of modal RD&T budgets, research programs, and R&D investment criteria implementation.

As part of this coordination process, the RD&T Planning Council and RD&T Planning Team collaborate with other DOT-wide bodies, including the ITS Management Council, the Human Factors Coordinating Committee, the Center for Climate Change and Environmental Forecasting, and the Hydrogen Working Group.

**DOT Center for Climate Change and Environmental Forecasting**

Led by the Office of the Assistant Secretary for Transportation Policy, this "virtual" center brings together all operating administrations to promote a better understanding of the links between transportation and greenhouse-gas emissions. Recently, the center completed a study of the greenhouse-gas-reduction potential of selected fuels, and initiated work on the impacts of climate change on the transportation system. The DOT operating administrations contribute staff and other resources and RITA provides administrative support to the center.

## **Coordination with Other Federal Agencies**

As the agency with the most direct responsibility for transportation, DOT leads transportation RD&T in the Federal Government. To further this role, the Department works closely with other agencies to avoid duplication and to leverage research investments.

The Department coordinates Federal RD&T through the White House Office of Science and Technology Policy and the National Science and Technology Council (NSTC). Chaired by the President, the NSTC is a cabinet-level council that coordinates science and technology policies across the Government. In addition, the Department's operating administrations coordinate with particular agencies in specific research areas of mutual interest. Among the agencies with which the Department actively collaborates are the following:

### ***Department of Commerce***

With a mission of promoting economic growth by developing and applying technology, measurements, and standards, the National Institute of Standards and Technology (NIST) conducts much of the transportation-related RD&T in the Department of Commerce (DOC).

NIST research on materials is particularly important. For example, NIST is conducting research with FHWA on high-performance concrete; working with FRA on the fire safety of passenger rail car materials; and collaborating with PHMSA to advance pipeline materials for Arctic operations. Another DOC agency, the National Oceanic and Atmospheric Administration, is coordinating with PHMSA so that emergency planning for major storm events will lessen impacts on the pipeline infrastructure, and working with FHWA on technologies for road weather observations. Finally, DOC is a participant in the Joint Planning and Development Office (JPDO), through which FAA, DOC, NASA, DOD, and DHS are defining the future air transportation system.

### ***Department of Defense***

The Department of Defense (DOD) accounts for a large proportion of all Federal RD&T. In the area of transportation, DOD seeks advances in aviation and space technologies; surface vehicles; ship design and propulsion; satellite positioning and communications; chemical, biological, and explosive agent detection; and high-performance materials. The Defense Advanced Research Projects Agency,

in particular, provides substantial funding for research on maritime and other transportation technologies.

DOD also conducts research in such areas as human performance, materials science, microelectronics, and nanotechnology. Examples of collaborative work with DOT include FHWA–U.S. Army Corps of Engineers studies on concrete curing and pavement performance; FHWA work with the Navy on high-performance steel for bridges; an FHWA project with the Army's Cold Region Research and Engineering Laboratory to develop a winter weather Maintenance Decision Support System; the joint FAA–NASA–DOD Aviation Safety Program; FRA work on a Rail Car Inspection Guide for the military through DOD's Technical Support Working Group; and the JPDO.

### ***Department of Energy***

Primarily concerned with energy conservation and reducing petroleum dependence, the Department of Energy (DOE) conducts research in alternative fuels, propulsion systems, and related technologies. DOE and DOT work closely on implementing the President's Hydrogen Initiative. DOE's role in hydrogen production, storage, and use complements DOT's role in hydrogen infrastructure, heavy vehicles, and safety.

DOE has more than 20 major laboratories and research facilities—many with strong capabilities in advanced materials, energy conversion and storage, and other transportation-relevant areas. For example, Argonne National Laboratory researches fuel cells, hybrid vehicles, Intelligent Transportation Systems, and rail technologies. Part of FAA's Airworthiness Assurance "Center of Excellence," Sandia National Laboratories partner with DOT on research addressing aircraft maintenance; crashworthiness; inspection and repair techniques; propulsion, fuel system, and landing gear safety; and new materials. DOE's National Energy Technology Laboratory coordinates with PHMSA to carry out a program of research, development, demonstration, and standardization to ensure the integrity of pipeline facilities. Finally, DOE laboratories work closely with DOT on tests and demonstrations of technologies for detecting chemical, biological, and explosive agents.

### ***Department of Homeland Security***

Established by the Homeland Security Act of 2002, the Department of Homeland Security (DHS) prevents, protects against, and responds to acts of terrorism on U.S. soil. Two DHS agencies are former DOT operating administrations: the Transportation Security Administration (TSA) and the U.S. Coast Guard.

TSA protects the Nation's transportation systems to ensure freedom of movement for people and commerce. The missions of the Coast Guard are homeland security, maritime law enforcement, marine safety, and marine environmental protection. Collaborative RD&T with DHS includes Operation Safe Commerce, a public–private partnership providing a test-bed for technologies that increase container security; FRA–DHS research on real-time tracking of hazardous-materials tank cars and development of a rail addendum to



the overall DOT–DHS Memorandum of Understanding; FMCSA–TSA efforts on Untethered Trailer Tracking and Commercial Vehicle Information Systems and Networks; FHWA support for development of an advanced Driver Training Range at the Federal Law Enforcement Training Center and joint research on anti-ram barriers; and FAA–DHS collaboration through the JPDO.

### ***Department of the Interior***

The Department of the Interior protects and manages the Nation's natural resources and cultural heritage and provides scientific and other information about those resources.

Within DOI, the Minerals Management Service (MMS) oversees the Nation's natural gas, oil, and other mineral resources on the outer continental shelf. MMS has two major programs: Offshore Minerals Management and Minerals Revenue Management. The offshore activity is supported by a broad Technology Assessment and Research Program, which conducts research associated with operational safety, pollution prevention, and oil spill response and cleanup capabilities. Current collaborative work with DOT includes joint MMS-PHMSA research to address pipeline safety and environmental protection of offshore areas.

### ***Environmental Protection Agency***

Transportation research in the Environmental Protection Agency (EPA) primarily involves emissions abatement, control, and compliance, and programs on air and water quality. For example, EPA's Clean Automotive Technology Program includes research and partnerships with industry to develop clean, advanced automotive technology. Conducted at the EPA National Vehicle and Fuel Emissions Laboratory, this research complements DOT and other Federal efforts in advanced vehicles. In another area, DOE coordinates with PHMSA to carry out a program of research, development, demonstration, and standardization to ensure the integrity of pipeline facilities.

### ***National Aeronautics and Space Administration***

The National Aeronautics and Space Administration (NASA) has a distinguished background in aeronautical and space transportation research. Although topics such as propulsion, aerodynamics, and control systems have predominated, NASA is now also addressing aviation safety and air traffic management. NASA and FAA are full research partners. The agencies share budget information, discuss metrics and goals, and coordinate research at the senior management level through the NASA–FAA Executive Committee and at the working level through the Interagency Air Traffic Management Integrated Product Team and the FAA–NASA Aviation Safety Program. NASA and FAA also hold joint meetings of their research advisory committees. Examples of specific joint research include work on aircraft noise and emissions reduction and on development of technologies for the future air transportation system through the JPDO.

### **Joint Planning and Development Office**

In 2003, FAA, NASA, and other agencies joined to form the JPDO, charged with developing a *National Plan for the Transformation of Air Transportation*. The plan's purpose is threefold: establish a vision for future air transportation; set national aerospace goals; and ensure that the United States remains at the forefront of aviation. The JPDO will coordinate the development and use of new technologies to ensure that, when available, they may be used to their fullest potential in aircraft and the air traffic control system. It also will facilitate the transfer of technology to the private sector and to Federal agencies with operational responsibilities.

The JPDO plan will lay the groundwork for a system that meets the needs of all users and that is efficient in the application of aerospace resources. This Next Generation Air Transportation System will provide the capacity and flexibility to support future demands—while ensuring the safety of the flying public. It will be part of an integrated national and global transportation system, one that simultaneously satisfies the nation's economic, defense, and homeland security needs.

### ***National Science Foundation***

An independent Federal agency, the National Science Foundation (NSF) strengthens U.S. science and engineering through education and research. NSF accomplishes this mission through an annual investment in approximately 20,000 research and education projects—efforts that ultimately will lead to broad improvements in transportation. Of particular relevance to DOT are NSF's Materials Research Science and Engineering Centers, which conduct a range of research on material properties, synthesis, structure, and performance. NSF also engages in cooperative research, such as a DOT-NSF Partnership for Research in Information and Communications Systems for Surface Transportation; and a project with FHWA and State DOTs on the long-term durability of materials and structures.

### **Coordination with Stakeholders**

Regular consultation and engagement with stakeholders is a critical element of all of the Department's RD&T programs. Such activities avoid duplication, uphold the technical quality of DOT research, and ensure that RD&T programs are wise public investments that address stakeholder needs. Within the operating administrations, stakeholder input and review are essential for establishing RD&T priorities, programmatic activities, and performance metrics. The following paragraphs summarize the administrations' stakeholder activities. Appendix D lists website links to additional information about modal advisory committees and RD&T plans.

#### ***FAA***

A primary method for which FAA ensures RD&T effectiveness is its Research, Engineering, and Development Advisory Committee (REDAC). Established by Congress in 1989, this committee reports to the FAA Administrator on RD&T

issues and provides a link between agency research and similar efforts in industry, academia, and government. The committee considers aviation research needs in six key areas: air traffic services, airport technology, aircraft safety, aviation information security, human factors, and the environment. It meets twice a year with FAA senior managers and annually reviews FAA's RD&T budget. REDAC members represent corporations, universities, associations, consumers, and other agencies.

Another body, the Commercial Space Transportation Advisory Committee, advises on RD&T in commercial space transportation safety. This committee comprises senior executives from the U.S. commercial space transportation industry, including entrepreneurial firms as well as large aerospace companies; space-related State government officials; academia; and representatives from space advocacy organizations.

### ***FHWA***

Within FHWA, the TRB Research and Technology Coordinating Committee reviews RD&T, advises on research activities, and provides policy-level recommendations on program direction. The committee consists of 18 members from the States, academia, and private sector. The committee examined national highway research and technology needs and roles in *TRB Special Report 261*, which urged FHWA to focus on long-term, fundamental research; address gaps and emerging issues; conduct policy research; and engage in technology transfer.

In addition to the RTCC, FHWA has broad interaction with stakeholder groups, such as the Association of American State Highway and Transportation Officials, and engages customers throughout the RD&T planning process. For stakeholder input to the ITS program, FHWA had previously relied on ITS America as a Utilized Federal Advisory Committee. The Department has determined that this program has matured to the point where a formal DOT Advisory Committee is needed, and is in the process of establishing such a body.

### ***FMCSA***

FMCSA obtains input on its Research and Technology (R&T) Program from various stakeholders, including the National Transportation Safety Board, safety advocacy groups, the national enforcement community, the motor carrier industry, commercial driver groups, truck manufacturers, the driver training community, sleep researchers, insurance representatives, truck manufacturers, and the motor coach industry. The agency holds annual stakeholder forums to solicit recommendations for R&T projects and improved program planning. This input is reflected in a recently completed 5-year strategic plan and in annual budget submissions.

## **FRA**

FRA research is guided by inputs from both internal and external stakeholders, including FRA's Office of Safety, the Association of American Railroads Railway Technology Working Committee and Tank Car Committee, the American Public Transportation Association Research Needs Conference, and the Highway–Railroad Grade Crossing Research Needs Conference.

Of particular importance is the TRB Committee for Review of the FRA Research, Development, and Demonstration Programs. Initially established by Congress, this committee conducts an annual assessment of FRA's Railroad R&D program. Reviews address FRA's research management structure and approach; current direction and allocation of funds devoted to various program areas; and whether there is an appropriate balance of Federal, State, and private sector input and cost sharing. The committee includes representatives from States, railroads, labor unions, universities, financial institutions, and research organizations. To evaluate FRA research in another program area, the TRB has established a Strategic Hazardous Materials Transportation Research Program.

## **FTA**

Formed in October 2003 under the TRB, FTA's Transit Research Analysis Committee (TRAC) assesses research needs and advises the agency on the Federal role in transit research; high-priority research opportunities; and processes for ensuring that FTA receives input and cooperation from stakeholders. Members represent transit authorities, community service agencies, State DOTs, research institutes, consulting firms, and equipment manufacturers. FTA has incorporated input and advice from the TRAC in its recently completed five-year *Strategic Research Plan*.

## **MARAD**

Although MARAD receives no direct RD&T funding, the agency works closely with stakeholders to stimulate innovation through collaborative efforts such as the Marine Transportation System initiative, the Short Sea Shipping Cooperative Program, the Ship Operations Cooperative Program, the Marine Energy and Emissions Technologies Program, and several other cooperative research programs. This approach brings together the maritime industry, academia, and agencies to identify, coordinate, facilitate, and accomplish maritime RD&T. Recommendations for future research also come from the Marine Transportation System National Advisory Council, a Federal Advisory Council to MARAD.

## **NHTSA**

NHTSA assures the quality and effectiveness of its research through several means, including collaborative research with manufacturers and suppliers and regular public meetings with stakeholders. Public meetings provide a forum in which researchers can present their work, respond to comments, and obtain broad input on the agency's RD&T program.

### ***PHMSA***

PHMSA's pipeline safety program relies on stakeholder involvement, including R&D Forums and meetings of a Blue Ribbon Panel, to make sure that RD&T is aligned with the pipeline safety mission, makes use of the best available knowledge and expertise, and considers stakeholder perspectives. Stakeholders represented include Federal and State agencies, industry, pipeline trade associations, and standards organizations. PHMSA Office of Hazardous Materials Safety conducts its RD&T activities in consultation with other agencies, state and local governments, international organizations, the regulated industry, and the interested public.

### ***RITA***

RITA works with stakeholders to ensure the effectiveness of its RD&T planning efforts and to identify RD&T priorities. In addition, RITA will rely on the Advisory Council for Transportation Statistics for advice on the quality and objectivity of BTS data and analyses and review by the National Research Council to ensure the effectiveness of its RD&T strategic planning and coordination activities.

## **Research Partnerships**

In addition to coordinating RD&T with other Federal research agencies and with transportation stakeholders, the Department actively pursues research and technology partnerships with universities, State and local governments, industry, and other organizations. The following paragraphs present the major joint programs and initiatives:

### ***University Research***

#### **Center for the Commercial Deployment of Transportation Technologies**

MARAD and the U.S. Transportation Command provide coordinated support to the Center for the Commercial Deployment of Transportation Technologies (CCDOTT), a chartered university center at California State University in Long Beach. The center is Congressionally sponsored, with funding provided from DOD.

The CCDOTT functions as a partnership of academic institutions, government agencies, and private companies. It has three purposes: leverage advanced transportation technologies—including emerging high-speed ship systems, decision support tools, tagging and tracking, and agile port and terminal systems—to solve defense and commercial infrastructure problems; sponsor applied research in support of defense and commercial infrastructure initiatives; and provide a bilateral technology transfer/dual-use bridge between DOD and industry. The center has completed a series of studies to date, and is now implementing these efforts as well as pursuing further research.

### **FRA University Research Program**

This FRA program awards competitive research grants to universities for work on challenging priority areas identified in the FRA Strategic Plan. Efforts are supported using discretionary funds or in accordance with Congressional mandates. When the work progresses to the prototype stage, cooperating railroads or FRA technical support contractors provide field testing support as necessary.

### **Global Maritime and Transportation School**

Located at the U.S. Merchant Marine Academy in Kings Point, New York, the Global Maritime and Transportation School (GMATS) is designated as a National Maritime Enhancement Institute, recognizing its expertise, capabilities, and industry affiliations contributing to the advancement of safe, secure, economically viable, and environmentally sensible marine and intermodal transportation systems.

The GMATS Division of Research and Special Projects conducts applied research in a number of areas, including maritime security; modal and intermodal freight systems; marine and intermodal terminal operations; maritime training and education; industry leadership and business ethics; port and waterway design and traffic management; maritime business and economics; communication and information systems; shipboard operations; and marine engineering, shipbuilding, and naval architecture.

### **Joint University Program**

Jointly sponsored by FAA and NASA, the Joint University Program seeks to materially improve the efficiency, performance, and safety of air transportation in the United States by identifying promising targets for development, by conducting associated long-term research, and by educating technological leaders.

Through the program, leading academic researchers and their students are involved in solving critical aeronautical problems, particularly those related to aircraft guidance, navigation, and control; meteorological hazards; and human factors. The program currently provides research grants to the Massachusetts Institute of Technology, Ohio University, and Princeton University.

### **Renewable Energy Transportation Laboratory**

Located at the U.S. Merchant Marine Academy, the Renewable Energy Transportation Laboratory acts as a test bed for a full range of alternative energy technologies. It facilitates advancements in renewable technologies, gives students a hands-on aspect to their studies, and promotes interest in the application of alternative energy systems.

Currently receiving financial and technical support from the Long Island Power Authority and from Plug Power (in Latham, New York), the laboratory features integrated and fully operational wind, solar photovoltaic, and hydrogen-fuel-cell generators (which develop nonpolluting power for hydrogen production and the operation of two electric work carts); an "Electrathon" endurance race car; and a hydrogen-fuel-cell-powered boat.

### **Transportation Centers of Excellence**

Centers of Excellence (COEs) are unique consortia of Federal, university, and industry researchers working to improve aviation through shared resources, leveraged funding, and pooled talent. Following an extensive selection process, university core members enter into cooperative agreements with FAA. Subsequently, research scientists are funded through matching grants and cost-share contracts. COE members are required to provide matching funds from non-Federal sources, solidifying their partnership with FAA, and enabling the Center to strive to be an independent national resource. Through these partnerships between government, academia, and industry, all parties maximize and strengthen their technological capabilities.

The current Centers are Airliner Cabin Environment; Joint Center for Advanced Materials Research; Aircraft Noise and Aviation Emissions Mitigation; General Aviation; Airworthiness Assurance; Operations Research; and Airport Technology.

### **University Transportation Centers Program**

The Department's largest university research program, the University Transportation Centers (UTCs) program invests in university-based centers of excellence to advance innovation, research, education, and technology transfer. The program is managed by RITA and funded by FHWA and FTA. The focus of the UTC program is multimodal and supportive of the Department's strategic goals. SAFETEA-LU authorized the most significant expansion of the UTC program to date, increasing the annual funding for the program and the number of UTCs from the 33 established in Transportation Equity Act for the 21<sup>st</sup> Century (TEA-21) to 60. With the expansion of the UTC program comes new opportunities for the UTC program to make an even greater contribution to transportation research, education, and technology transfer.

In 2006, twenty centers will be competitively selected. An additional forty centers, named in SAFETEA-LU, will be funded. Each UTC will have a specific transportation theme that advances one of DOT's strategic goals. In the future, RITA will work collaboratively across the operating administrations and Secretarial offices to strengthen the UTC program and its relevance to Departmental goals, to identify Federal technical monitors of individual centers, and to ensure that university research and innovation addresses the most critical transportation challenges of the Nation.

### ***Cooperative Research and Partnerships***

#### **Airport Cooperative Research Program**

Mandated by Congress in the Vision 100-Century of Aviation Reauthorization Act, the Airport Cooperative Research Program carries out applied research on problems that are shared by airport operating agencies and that are not being adequately addressed by existing Federal research programs. An independent governing board of airport managers and others appointed by the Secretary of Transportation select the research projects. The TRB administers the program.

### **Cargo Handling Cooperative Program**

The Cargo Handling Cooperative Program (CHCP) is a public-private partnership established in 1983 to increase the productivity of marine freight transportation by fostering cargo-handling RD&T among intermodal freight entities. The program's focus is on industry-driven technology priorities and a system-level approach to freight transportation. CHCP participants pursue innovations that will increase the productivity and cost-effectiveness of cargo operations.

The program emphasizes integrated systems for freight movement through advances in infrastructure design; seamless international transportation networks; and communication and information flows. Initiatives are based on a system-level approach—from origin to destination—so that intermodal transfer points, port connections, and other subsystems all meet system requirements. Although the CHCP has not independently funded research for the past several years, its members have been able to use the program's framework to obtain funding for selected projects, such as Chassis Tag Research and Security Container Seal Processes.

### **Commercial Remote Sensing and Spatial Technologies Program**

Managed by RITA, the Commercial Remote Sensing and Spatial Technologies Program will promote partnerships with consortia teams by bringing together resources and expertise from university research centers, industry, technology service providers for transportation systems, and State transportation agencies.

The products from the program will address a variety of commercial applications to solve multimodal transportation challenges. These applications will involve the development of products and services that integrate advances in satellite and aerial high-resolution imageries; GPS, including navigation tools and services; and Geographic Information Systems (GIS), including mapping and visualization tools.

### **Hazardous Materials Cooperative Research Program**

This PHMSA program was established by SAFETEA-LU. Administered by the TRB, the program, once implemented, will provide grants for research on a number of safety and security issues, with possible topics including hazardous materials data and analysis, planning and preparing for hazardous materials emergencies, support for first responders, and hazardous materials commodity flow studies.

### **Marine Transportation System**

The Marine Transportation System (MTS) is a Secretarial initiative to advance maritime interests in the United States. Seventeen different Federal agencies and all industry components are actively engaged in its development. Industry groups include entities involved with intermodal connections, cargo, and passenger movements, and other public and private stakeholders. The Interagency Committee of the MTS, the Federal team, and the MTS National Advisory Council, the industry team, each have formed Research and Technology and other subcommittees to assist with coordination and priority



setting. The MTS initiative has energized the intermodal industry, as well as Federal, State, and local transportation agencies, to coordinate and accelerate the application of advanced communication, information, and ITS technologies.

### **National Cooperative Freight Transportation Research**

Established by SAFETEA-LU and managed by RITA, the National Cooperative Freight Transportation Research Program supports research on critical freight transportation issues. Among these issues are techniques for estimating and quantifying the public benefits of freight transportation projects; alternative approaches to calculating the contribution of truck and rail traffic to congestion; the feasibility of consolidating origins and destinations for freight movement; incorporating estimates of international trade into landside transportation planning; using technology to increase the capacity of truck-only highway lanes; and emerging and future freight transportation research needs in all modes.

The NRC will administer the program, award contracts and grants through competition and merit review, and establish an advisory committee representing a cross-section of freight stakeholders. This advisory committee will recommend a national research agenda for freight transportation that includes a multiyear strategic plan.

### **National Cooperative Highway Research Program**

Established in 1962, the National Cooperative Highway Research Program (NCHRP) addresses issues of interest to State DOTs. In most cases, projects are focused on problems of immediate national concern that can be solved through applied research. Results are intended to have an impact on practice through products such as specifications, user manuals, and guidelines. States voluntarily contribute 5.5 percent of State Planning and Research funds to support the program, which is administered by the TRB.

Projects in the NCHRP are solely the prerogative of the American Association of State Highway and Transportation Officials (AASHTO) and its member departments. AASHTO's Standing Committee on Research selects projects annually from a list of problem statements submitted by the departments, AASHTO committees, and FHWA. Each NCHRP project is assigned to a panel, appointed by the TRB, which is looked to for technical guidance and counsel. Heavy emphasis is placed on appointing members who represent potential users of the research results. Project findings are published and disseminated in the NCHRP report series.

### **Ship Operations Cooperative Program**

MARAD's Ship Operations Cooperative Program (SOCP) is a long-producing, effective public-private partnership that promotes national security and economic growth through the identification, development, and application of new methods, procedures, and technologies for maritime vessel activities. The program's objective is to improve the competitiveness, productivity, efficiency, safety, and environmental responsiveness of U.S. vessel operations. The SOCP currently has more than 40 member organizations that contribute funding, resources, and active project management.

### **Ship Structure Committee**

An international cooperative program with 10 participating agencies, the Ship Structure Committee advances ship safety and structural integrity. This program, in which MARAD participates, enhances the safety of life at sea, promotes technology and educational advancements, and protects the marine environment through research on ship structural design, life-cycle risk management, and production technologies.

Among the two dozen or so projects that are typically underway are efforts addressing the structural safety of high-speed ferries, structural problems on modern cruise ships, the use of aluminum in ship structures, structural fire protection, design guidelines for structural repairs, and the relationship of structural integrity to chemical treatment of ballast water.

### **Short Sea Shipping Cooperative Program**

This program is MARAD's most recent industry-inspired partnership. Formed in October 2003, the program's purpose is to share resources and in-kind services in the development of Short Sea Shipping in North America. Short Sea Shipping is the water transportation of freight and passengers that does not cross an ocean.

Both MARAD and the 35 private sector partners that formed the program believe that increased awareness and application of Short Sea Shipping can decrease traffic congestion, improve safety, and benefit the environment. One of the program's first goals is to conduct outreach to future users of a North American Short Sea Shipping System.

### **Transit Cooperative Research Program**

Through the Transit Cooperative Research Program (TCRP), FTA funds research on issues significant to the transit industry. Research is directed to near-term, local problem solving in transit planning, service concepts, vehicles and equipment, facilities, operations, human resources, maintenance, and administrative practices. More than 260 products of TCRP research have been delivered to the public transportation community. The TRB, which administers the TCRP, maintains a publications list and a description of all TCRP studies on its web site at <http://www4.trb.org/trb/crp.nsf/TCRP+projects>.

### **Transportation Pooled-Fund Program**

When there is significant or widespread interest in solving a transportation-related problem, several Federal, State, regional, or local transportation agencies, academic institutions, foundations, or private firms may jointly fund research, planning, or technology transfer activities as a pooled-fund study.

To qualify as a pooled-fund study, more than one agency, academic institution, or private company must find the subject important enough to commit funds or other resources. If a subject has been studied previously, the new effort should provide additional information that will complement or advance previous investigations.

A State DOT or FHWA must sponsor each pooled-fund study. Participation by foreign governments, local agencies, private companies, foundations, and academic institutions is at the discretion of the lead state. FHWA provides financial management of the program. In 2005, the program included 113 state-led studies and 63 FHWA-led projects—with a total value of approximately \$128 million. For details on individual pooled-fund studies go to <http://www.pooledfund.org/>

## Appendix A: National Research Council Letter Report

*[To be added]*



## Appendix B: Stakeholder Input

*[To be added]*

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## Appendix C: RD&T Funding

### Anticipated Funding for RD&T Strategies FY 2006-2010

Table C-1. Funding in Support of DOT RD&T Strategies (\$000)

#### Safety RD&T Strategy 1—Understand and Address Causal Factors and Risks

| RD&T Program  | Support for RD&T Strategy |        |        |        |        |
|---|---------------------------|--------|--------|--------|--------|
|   | FY 06                     | FY 07  | FY 08* | FY 09* | FY 10* |
| <b>FAA</b>  |                           |        |        |        |        |
| Advanced Materials/Structural Safety                              | 5,881                     | 2,843  | 2,826  | 2,853  | 2,854  |
| Aeromedical Research  | 8,800                     | 6,962  | 7,061  | 7,212  | 7,337  |
| Aging Aircraft  | 19,807                    | 18,621 | 18,116 | 18,073 | 17,720 |
| Air Traffic Control/Technical Operations<br>Human Factors         | 9,557                     | 9,654  | 9,637  | 9,757  | 9,791  |
| Aircraft Catastrophic Failure Prevention<br>Research              | 3,307                     | 1,512  | 1,487  | 1,492  | 1,478  |
| Airport Technology Research—Safety                                | 8,885                     | 9,367  | 9,367  | 9,367  | 9,367  |
| ATD&P—General Aviation and Vertical Flight<br>Technology          | 1,490                     | 2,000  | 2,000  | 2,000  | 2,000  |
| ATD&P—Runway Incursion Reduction                                  | 6,440                     | 8,000  | 5,000  | 5,000  | 5,000  |
| ATD&P—Safer Skies   | 3,370                     | 3,600  | 3,000  | 3,000  | 3,000  |
| ATD&P—Safe Flight 21  | 14,360                    | 16,800 | 20,000 | 20,000 | 20,000 |
| ATD&P—Wind Profiling and Weather<br>Research                      | 3,130                     | 1,100  | 0      | 0      | 0      |
| Atmospheric Hazards/Digital System Safety                         | 3,407                     | 3,848  | 3,803  | 3,828  | 3,807  |
| Aviation Safety Risk Analysis                                     | 4,883                     | 5,292  | 5,209  | 5,233  | 5,187  |
| Fire Research and Safety  | 6,182                     | 6,638  | 6,628  | 6,712  | 6,737  |
| Flightdeck/Maintenance/System Integration<br>Human Factors        | 8,099                     | 7,999  | 7,869  | 7,901  | 7,827  |
| Propulsion and Fuel Systems                                       | 5,741                     | 4,048  | 3,976  | 3,988  | 3,945  |
| Unmanned Aircraft Systems Research**                              | —                         | —      | —      | —      | —      |
| Weather Program   | 20,376                    | 19,545 | 18,750 | 18,549 | 17,942 |
| <b>FHWA</b>   |                           |        |        |        |        |
| Corporate Activities—Exploratory Advanced<br>Research             |                           |        |        |        |        |
| Corporate Activities—SHRP II                                      |                           |        |        |        |        |
| Planning and Environment—STEP                                     |                           |        |        |        |        |
| Safety R&D—Center for Excellence in Rural<br>Safety               | 732                       | 732    | 732    | 732    | 732    |
| Safety R&D—Center for Surface<br>Transportation Safety            | 627                       | 627    | 627    | 627    | 627    |
| Safety R&D—Motorcycle Crash Causation<br>Study                    | 1,178                     | 1,178  | 0      | 0      | 0      |
| Safety R&D—Safety Research and<br>Innovation Deployment Program   |                           |        |        |        |        |
| Safety R&D—Transportation Injury Research                         | 1,046                     | 1,046  | 1,046  | 1,046  | 1,046  |
| Safety R&D—Transportation Safety<br>Information Management System | 836                       | 836    | 0      | 0      | 0      |



Appendix C: RT&D Funding

| RD&T Program   | Support for RD&T Strategy |        |        |        |        |
|--|---------------------------|--------|--------|--------|--------|
|  | FY 06                     | FY 07  | FY 08* | FY 09* | FY 10* |
| ITS—Cooperative Intersection Collision Avoidance                       |                           |        |        |        |        |
| ITS—Integrated Vehicle-Based Safety Systems                            |                           |        |        |        |        |
| ITS—Vehicle-Infrastructure Integration                                 |                           |        |        |        |        |
| <b>FMCSA</b>   |                           |        |        |        |        |
| Advance Safety Through Information-Based Initiatives                   | 1,483                     | 1,349  | 1,349  | 1,349  | 1,349  |
| Improve Safety of Commercial Motor Vehicles                            | 2,772                     | 3,147  | 3,147  | 3,147  | 3,147  |
| Produce Safer Carriers   | 871                       | 629    | 629    | 629    | 629    |
| Produce Safer Drivers  |                           |        |        |        |        |
| Thermal Imaging Inspection System (FHWA)                               | 1,414                     | 0      | 0      | 0      | 0      |
| <b>FRA</b>   |                           |        |        |        |        |
| Grade Crossings  | 1,881                     | 2,178  | 2,178  | 2,178  | 2,178  |
| Hazardous Materials Transportation                                     |                           |        |        |        |        |
| Human Factors  | 3,366                     | 3,366  | 3,366  | 3,366  | 3,366  |
| Integrated Track Stability Assessment and Monitoring System            | 1,485                     | 0      | 0      | 0      | 0      |
| Railroad System Issues   |                           |        |        |        |        |
| Rolling Stock and Components   | 4,688                     | 2,871  | 2,871  | 2,871  | 2,871  |
| Track and Structures   |                           |        |        |        |        |
| Track and Train Interaction  | 3,168                     | 3,168  | 3,168  | 3,168  | 3,168  |
| Train Control  |                           |        |        |        |        |
| <b>FTA</b>   |                           |        |        |        |        |
| Improve Safety and Emergency Preparedness                              |                           | 7,811  | 7,811  | 7,811  | 7,811  |
| <b>NHTSA</b>   |                           |        |        |        |        |
| Crash Avoidance and Human/Vehicle Performance                          | 6,980                     | 6,750  | 6,750  | 6,750  | 6,750  |
| Crash Avoidance Initiative   | 495                       | 0      | 0      | 0      | 0      |
| Data Analysis Program  | 1,980                     | 2,000  | 2,000  | 2,000  | 2,000  |
| Early Fatality Notification System                                     | 990                       | 1,000  | 1,000  | 1,000  | 1,000  |
| Fatality Analysis Reporting System                                     | 6,992                     | 7,063  | 7,063  | 7,063  | 7,063  |
| Heavy Vehicles   | 4,470                     | 2,115  | 2,115  | 2,115  | 2,115  |
| Highway Safety Research  | 4,621                     | 6,833  | 6,833  | 6,833  | 6,833  |
| National Automotive Sampling System                                    | 12,108                    | 12,230 | 12,230 | 12,230 | 12,230 |
| National Motor Vehicle Crash Causation Survey                          | 7,920                     | 7,000  | 7,000  | 7,000  | 7,000  |
| Pneumatic Tire Research  | 615                       | 300    | 300    | 300    | 300    |
| Special Crash Investigations   | 1,683                     | 1,700  | 1,700  | 1,700  | 1,700  |
| State Data Program   | 2,515                     | 2,890  | 2,890  | 2,890  | 2,890  |
| <b>OST</b>   |                           |        |        |        |        |
| Navigation and Spectrum Policy   |                           | 994    | 994    | 994    | 994    |
| Safety, Energy, and Environment  |                           | 970    | 970    | 970    | 970    |
| <b>PHMSA</b>   |                           |        |        |        |        |
| Hazardous Materials Safety R&D   | 1,829                     | 2,093  | 2,093  | 2,093  | 2,093  |
| Hazardous Materials Transportation Cooperative Research Program (FHWA) | 1,250                     | 1,250  | 1,250  | 1,250  | 1,250  |
| Pipeline Safety R&D  | 7,126                     | 7,274  | 7,274  | 7,274  | 7,274  |
| <b>Total Funding for RD&amp;T Strategy</b>                             |                           |        |        |        |        |

\*Outyear numbers are for planning purposes only.

\*\*Program provides secondary support and does not allocate specific funding for this RD&T Strategy.

**Table C-2. Funding in Support of DOT RD&T Strategies (\$000)****Safety RD&T Strategy 2— Mitigate the Consequences of Accidents and Incidents**

| RD&T Program   | Support for RD&T Strategy |        |        |        |        |
|--|---------------------------|--------|--------|--------|--------|
|  | FY 06                     | FY 07  | FY 08* | FY 09* | FY 10* |
| <b>FAA</b>   |                           |        |        |        |        |
| Advanced Materials/Structural Safety**                       | —                         | —      | —      | —      | —      |
| Aeromedical Research**                                       | —                         | —      | —      | —      | —      |
| Fire Research and Safety**                                   | —                         | —      | —      | —      | —      |
| <b>FHWA</b>  |                           |        |        |        |        |
| Safety R&D—Safety Research and Innovation Deployment Program |                           |        |        |        |        |
| ITS—Emergency Transportation Operations                      |                           |        |        |        |        |
| ITS—Next-Generation 911                                      |                           |        |        |        |        |
| <b>FMCSA</b>   |                           |        |        |        |        |
| Produce Safer Drivers  |                           |        |        |        |        |
| <b>FRA</b>   |                           |        |        |        |        |
| Railroad System Issues                                       |                           |        |        |        |        |
| Train Occupant Protection                                    | 6,039                     | 4,950  | 4,950  | 4,950  | 4,950  |
| <b>FTA</b>   |                           |        |        |        |        |
| Improve Safety and Emergency Preparedness**                  | —                         | —      | —      | —      | —      |
| <b>NHTSA</b>   |                           |        |        |        |        |
| Automobile Accident Injury Research (FHWA)                   | 353                       | 353    | 353    | 353    | 353    |
| Human Injury Research  | 13,860                    | 11,500 | 11,500 | 11,500 | 11,500 |
| Safety Systems   | 9,134                     | 7,726  | 7,726  | 7,726  | 7,726  |
| <b>Total Funding for RD&amp;T Strategy</b>                   |                           |        |        |        |        |

\*Outyear numbers are for planning purposes only.

\*\*Program provides secondary support and does not allocate specific funding for this RD&amp;T Strategy.

**Table C-3. Funding in Support of DOT RD&T Strategies (\$000)****Safety RD&T Strategy 3—Assess Impacts of New Technologies, Vehicles, Concepts, Designs, and Procedures**

| RD&T Program                                | Support for RD&T Strategy |       |        |        |        |
|---|---------------------------|-------|--------|--------|--------|
|   | FY 06                     | FY 07 | FY 08* | FY 09* | FY 10* |
| <b>FAA</b>                                  |                           |       |        |        |        |
| Advanced Materials/Structural Safety**      | —                         | —     | —      | —      | —      |
| Aeromedical Research**                      | —                         | —     | —      | —      | —      |
| Airport Technology Research—Safety**        | —                         | —     | —      | —      | —      |
| Atmospheric Hazards/Digital System Safety** | —                         | —     | —      | —      | —      |
| Commercial Space Transportation             | 75                        | 125   | 125    | 125    | 125    |
| Fire Research and Safety**                  | —                         | —     | —      | —      | —      |
| Unmanned Aircraft Systems Research          | 0                         | 1,200 | 1,146  | 1,131  | 1,089  |
| <b>NHTSA</b>                                |                           |       |        |        |        |
| Hydrogen Initiative                         | 916                       | 925   | 925    | 925    | 925    |
| Plastic and Composite Vehicles              | 243                       | 0     | 0      | 0      | 0      |
| <b>RITA</b>                                 |                           |       |        |        |        |
| Hydrogen Fuels Safety R&D                   | 495                       | 495   | 495    | 495    | 495    |
| Hydrogen Powered Research (FHWA)            | 530                       | 530   | 530    | 530    | 530    |
| <b>Total Funding for RD&amp;T Strategy</b>  |                           |       |        |        |        |

\*Outyear numbers are for planning purposes only.

\*\*Program provides secondary support and does not allocate specific funding for this RD&amp;T Strategy.

**Table C-4. Funding in Support of DOT RD&T Strategies (\$000)****Reduced Congestion RD&T Strategy 1—Reduce Traffic, Freight, and Aviation Congestion**

| RD&T Program  | Support for RD&T Strategy |       |        |        |        |
|---|---------------------------|-------|--------|--------|--------|
|   | FY 06                     | FY 07 | FY 08* | FY 09* | FY 10* |
| <b>FAA</b>  |                           |       |        |        |        |
| ATD&P—Airspace Management Laboratory                              | 6,930                     | 4,000 | 4,000  | 4,000  | 4,000  |
| ATD&P—Airspace Redesign   | 0                         | 2,800 | 3,000  | 3,000  | 3,000  |
| ATD&P—NAS Requirements  | 790                       | 800   | 2,000  | 2,000  | 3,200  |
| ATD&P—Operations Concept Validation                               | 0                         | 3,000 | 3,000  | 3,000  | 3,000  |
| ATD&P—System Capacity Planning and Improvement                    | 6,435                     | 5,500 | 6,500  | 6,500  | 6,500  |
| ATD&P—Wake Turbulence (F&E)                                       | 3,960                     | 1,000 | 0      | 0      | 0      |
| National Plan for Transformation of Air Transportation**          | —                         | —     | —      | —      | —      |
| Wake Turbulence (RE&D)  | 2,273                     | 3,066 | 2,946  | 2,917  | 2,825  |
| <b>FHWA</b>   |                           |       |        |        |        |
| Corporate Activities—SHRP II                                      |                           |       |        |        |        |
| Operations R&D—Surface Transportation Congestion Relief Solutions | 7,528                     | 7,528 | 7,528  | 7,528  | 7,528  |
| Planning and Environment—STEP                                     |                           |       |        |        |        |
| ITS—Emergency Transportation Operations                           |                           |       |        |        |        |
| ITS—Integrated Corridor Management Systems                        |                           |       |        |        |        |
| ITS—Clarus  |                           |       |        |        |        |
| ITS—Vehicle-Infrastructure Integration                            |                           |       |        |        |        |
| ITS Research—Road Weather Research and Development                | 5,000                     | 5,000 | 5,000  | 5,000  | 5,000  |
| <b>FTA</b>  |                           |       |        |        |        |
| Improve Capital and Operating Efficiencies**                      | —                         | —     | —      | —      | —      |
| Increase Transit Ridership  |                           | 2,000 | 2,000  | 2,000  | 2,000  |
| <b>OST</b>  |                           |       |        |        |        |
| Economic and Strategic Analysis                                   |                           | 493   | 493    | 493    | 493    |
| Safety, Energy, and Environment**                                 | —                         | —     | —      | —      | —      |
| <b>Total Funding for RD&amp;T Strategy</b>                        |                           |       |        |        |        |

\*Outyear numbers are for planning purposes only.

\*\*Program provides secondary support and does not allocate specific funding for this RD&T Strategy.

Table C-5. Funding in Support of DOT RD&amp;T Strategies (\$000)

**Reduced Congestion RD&T Strategy 2—Extend the Life of the Existing Transportation System and Improve Infrastructure Durability**

| RD&T Program  | Support for RD&T Strategy |        |        |        |        |
|---|---------------------------|--------|--------|--------|--------|
|   | FY 06                     | FY 07  | FY 08* | FY 09* | FY 10* |
| <b>FAA</b>  |                           |        |        |        |        |
| Airport Technology Research—Capacity                          | 8,440                     | 8,503  | 8,503  | 8,503  | 8,503  |
| <b>FHWA</b>   |                           |        |        |        |        |
| Corporate Activities—Exploratory Advanced Research            |                           |        |        |        |        |
| Corporate Activities—SHRP II                                  |                           |        |        |        |        |
| Long-Term Pavement Performance                                | 8,465                     | 8,465  | 8,465  | 8,465  | 8,465  |
| Pavement R&D—Alkali-Silica Reactivity                         | 1,025                     | 1,025  | 1,025  | 1,025  | 1,025  |
| Pavement R&D—Asphalt and Asphalt Reclamation                  | 1,255                     | 0      | 0      | 0      | 0      |
| Pavement R&D—Asphalt Research Consortium                      | 6,273                     | 6,273  | 6,273  | 6,273  | 6,273  |
| Pavement R&D—Fundamental Properties of Asphalt                | 3,513                     | 3,513  | 3,513  | 3,513  | 3,513  |
| Pavement R&D—Innovative Pavement Research and Deployment      | 18,925                    | 18,925 | 18,925 | 18,925 | 18,925 |
| Structures R&D—High-Performing Steel Bridge                   | 3,429                     | 3,429  | 3,429  | 3,429  | 3,429  |
| Structures R&D—Innovative Bridge Research and Deployment      | 10,957                    | 10,957 | 10,957 | 10,957 | 10,957 |
| Structures R&D—Long-Term Bridge Performance                   | 6,482                     | 6,482  | 6,482  | 6,482  | 6,482  |
| Structures R&D—Seismic Research                               | 2,091                     | 2,091  | 2,091  | 2,091  | 2,091  |
| Structures R&D—Steel Bridge Testing                           | 1,046                     | 1,046  | 1,046  | 1,046  | 1,046  |
| Structures R&D—Ultra-high-performance Concrete Demonstrations | 523                       | 523    | 523    | 523    | 523    |
| Structures R&D—Wood Composite Materials                       | 836                       | 836    | 0      | 0      | 0      |
| <b>FRA</b>  |                           |        |        |        |        |
| Track and Structures  |                           |        |        |        |        |
| <b>FTA</b>  |                           |        |        |        |        |
| Improve Capital and Operating Efficiencies**                  | —                         | —      | —      | —      | —      |
| <b>Total Funding for RD&amp;T Strategy</b>                    |                           |        |        |        |        |

\*Outyear numbers are for planning purposes only.

\*\*Program provides secondary support and does not allocate specific funding for this RD&T Strategy.

Table C-6. Funding in Support of DOT RD&amp;T Strategies (\$000)

**Reduced Congestion RD&T Strategy 3—Advance Use of Next-Generation Technologies and Combinations of Modes**

| RD&T Program  | Support for RD&T Strategy |        |        |        |        |
|---|---------------------------|--------|--------|--------|--------|
|   | FY 06                     | FY 07  | FY 08* | FY 09* | FY 10* |
| <b>FAA</b>  |                           |        |        |        |        |
| Center for Advanced Aviation Systems Development                        | 37,895                    | 30,100 | 34,400 | 36,550 | 38,700 |
| National Plan for Transformation of Air Transportation                  | 17,919                    | 18,100 | 17,436 | 17,292 | 16,794 |
| <b>FHWA</b>   |                           |        |        |        |        |
| Corporate Activities—Exploratory Advanced Research                      |                           |        |        |        |        |
| ITS—Electronic Freight Management**                                     | —                         | —      | —      | —      | —      |
| ITS—Integrated Corridor Management Systems                              |                           |        |        |        |        |
| Planning and Environment—Advanced Travel Forecasting Procedures Program |                           |        |        |        |        |
| Planning and Environment—STEP   |                           |        |        |        |        |
| <b>FRA</b>  |                           |        |        |        |        |
| High-Speed Rail Corridor Planning                                       | 7,118                     | 0      | 0      | 0      | 0      |
| NDGPS   | 9,900                     | 0      | 0      | 0      | 0      |
| Train Control   |                           |        |        |        |        |
| <b>OST</b>  |                           |        |        |        |        |
| Freight and Logistics   |                           | 614    | 614    | 614    | 614    |
| Navigation and Spectrum Policy  |                           | 383    | 383    | 383    | 383    |
| <b>RITA</b>   |                           |        |        |        |        |
| Appalachian Inland Ports Feasibility (FHWA)                             | 418                       | 0      | 0      | 0      | 0      |
| Commercial Remote Sensing Products and Spatial Technologies (FHWA)      | 6,482                     | 6,482  | 6,482  | 6,482  | 6,482  |
| National Cooperative Freight Transportation Research Program (FHWA)     | 3,137                     | 3,137  | 3,137  | 3,137  | 3,137  |
| <b>Total Funding for RD&amp;T Strategy</b>                              |                           |        |        |        |        |

\*Outyear numbers are for planning purposes only.

\*\*Program provides secondary support and does not allocate specific funding for this RD&T Strategy.

**Table C-7. Funding in Support of DOT RD&T Strategies (\$000)****Reduced Congestion RD&T Strategy 4—Improve the Planning, Operation, and Management of Transportation Services and Assets**

| RD&T Program  | Support for RD&T Strategy |       |        |        |        |
|---|---------------------------|-------|--------|--------|--------|
|   | FY 06                     | FY 07 | FY 08* | FY 09* | FY 10* |
| <b>FAA</b>  |                           |       |        |        |        |
| ATD&P—Airspace Management Laboratory**                                  | —                         | —     | —      | —      | —      |
| ATD&P—System Capacity Planning and Improvement**                        | —                         | —     | —      | —      | —      |
| Center for Advanced Aviation Systems Development**                      | —                         | —     | —      | —      | —      |
| Weather Program**   | —                         | —     | —      | —      | —      |
| <b>FHWA</b>   |                           |       |        |        |        |
| Corporate Activities—Exploratory Advanced Research                      |                           |       |        |        |        |
| Corporate Activities—SHRP II  |                           |       |        |        |        |
| ITS—Electronic Freight Management                                       |                           |       |        |        |        |
| ITS Research—Multistate Corridor Operations and Management              | 7,000                     | 7,000 | 7,000  | 7,000  | 7,000  |
| Planning and Environment—Advanced Travel Forecasting Procedures Program |                           |       |        |        |        |
| Planning and Environment—Center for Environmental Excellence            |                           |       |        |        |        |
| Planning and Environment—STEP   |                           |       |        |        |        |
| Planning and Environment—Transportation Economics and Land Use System   | 836                       | 836   | 836    | 836    | 836    |
| <b>FMCSA</b>  |                           |       |        |        |        |
| Motor Carrier Efficiency Study (FHWA)                                   | 1,046                     | 1,046 | 1,046  | 1,046  | 1,046  |
| <b>FTA</b>  |                           |       |        |        |        |
| Improve Capital and Operating Efficiencies                              |                           | 9,445 | 9,445  | 9,445  | 9,445  |
| Increase Transit Ridership  |                           | 500   | 500    | 500    | 500    |
| <b>OST</b>  |                           |       |        |        |        |
| Aviation and International Policy**                                     | —                         | —     | —      | —      | —      |
| Center for Excellence in Project Finance (FHWA)                         | 732                       | 732   | 732    | 732    | 732    |
| Economic and Strategic Analysis   |                           | 493   | 493    | 493    | 493    |
| Navigation and Spectrum Policy  |                           | 383   | 383    | 383    | 383    |
| <b>Total Funding for RD&amp;T Strategy</b>                              |                           |       |        |        |        |

\*Outyear numbers are for planning purposes only.

\*\*Program provides secondary support and does not allocate specific funding for this RD&T Strategy.

**Table C-8. Funding in Support of DOT RD&T Strategies (\$000)****Reduced Congestion RD&T Strategy 5—Improve Transportation Services for Underserved Areas and Populations**

| RD&T Program   | Support for RD&T Strategy |        |        |        |        |
|--|---------------------------|--------|--------|--------|--------|
|  | FY 06                     | FY 07  | FY 08* | FY 09* | FY 10* |
| <b>FHWA</b>  |                           |        |        |        |        |
| Center for Transportation Advancement and Regional Development |                           |        |        |        |        |
| ITS—Mobility Services for All Americans                        |                           |        |        |        |        |
| ITS Research—Rural Interstate Corridor Communications          | 1,000                     | 1,000  | 0      | 0      | 0      |
| Planning and Environment—STEP                                  |                           |        |        |        |        |
| <b>FTA</b>   |                           |        |        |        |        |
| Increase Transit Ridership                                     |                           | 10,300 | 10,300 | 10,300 | 10,300 |
| <b>OST</b>   |                           |        |        |        |        |
| Aviation and International Policy                              |                           | 713    | 713    | 713    | 713    |
| Safety, Energy, and Environment**                              | —                         | —      | —      | —      | —      |
| <b>RITA</b>  |                           |        |        |        |        |
| Cold Region and Rural Transportation Research (FHWA)           | 836                       | 836    | 836    | 836    | 836    |
| Rural Transportation Research (FHWA)                           | 836                       | 0      | 0      | 0      | 0      |
| Rural Transportation Research Initiative (FHWA)                | 418                       | 418    | 418    | 418    | 418    |
| <b>Total Funding for RD&amp;T Strategy</b>                     |                           |        |        |        |        |

\*Outyear numbers are for planning purposes only.

\*\*Program provides secondary support and does not allocate specific funding for this RD&T Strategy.

**Table C-9. Funding in Support of DOT RD&T Strategies (\$000)****Reduced Congestion RD&T Strategy 6—Advance the Nation's Transportation Workforce and Research Capability**

| RD&T Program  | Support for RD&T Strategy |         |         |         |         |
|---|---------------------------|---------|---------|---------|---------|
|   | FY 06                     | FY 07   | FY 08*  | FY 09*  | FY 10*  |
| <b>FAA</b>  |                           |         |         |         |         |
| Aeromedical Research**  | —                         | —       | —       | —       | —       |
| Airport Cooperative Research Program  | 9,900                     | 10,000  | 10,000  | 10,000  | 10,000  |
| William J. Hughes Technical Center/Plant—R&D Facilities                                 | 20,288                    | 20,630  | 20,630  | 20,630  | 20,630  |
| <b>FHWA</b>   |                           |         |         |         |         |
| Eisenhower Transportation Fellowship Program  | 2,124                     | 2,124   | 2,124   | 2,124   | 2,124   |
| Freight Planning Capacity Building  | 845                       | 845     | 845     | 845     | 845     |
| Garrett A. Morgan Program   | 1,207                     | 1,207   | 1,207   | 1,207   | 1,207   |
| ITS—Professional Capacity Building  |                           |         |         |         |         |
| Local Technical Assistance Program  | 10,719                    | 10,719  | 10,719  | 10,719  | 10,719  |
| National Highway Institute  | 9,270                     | 9,270   | 9,270   | 9,270   | 9,270   |
| Planning and Environment—Center for Environmental Excellence                            |                           |         |         |         |         |
| Planning and Environment—Center for Transportation Advancement and Regional Development |                           |         |         |         |         |
| Planning and Environment—STEP   |                           |         |         |         |         |
| State Planning and Research   | 148,681                   | 165,723 | 165,723 | 165,723 | 165,723 |
| Surface Transportation Congestion Relief Assistance and Training                        | 724                       | 724     | 724     | 724     | 724     |
| Transportation Education Development Pilot Program                                      | 1,811                     | 1,811   | 1,811   | 1,811   | 1,811   |
| <b>FRA</b>  |                           |         |         |         |         |
| Railroad Facilities and Test Equipment  | 1,337                     | 1,881   | 1,881   | 1,881   | 1,881   |
| <b>FTA</b>  |                           |         |         |         |         |
| Improve Capital and Operating Efficiencies  |                           | 1,710   | 1,710   | 1,710   | 1,710   |
| National Transit Institute  | 4,257                     | 4,300   | 4,300   | 4,300   | 4,300   |
| Transit Cooperative Research Program  | 8,910                     | 9,300   | 9,300   | 9,300   | 9,300   |
| <b>NHTSA</b>  |                           |         |         |         |         |
| Vehicle Research and Test Center  | 1,002                     | 1,012   | 1,012   | 1,012   | 1,012   |
| <b>RITA</b>   |                           |         |         |         |         |
| Technology Transfer Grant (FHWA)  | 3,346                     | 3,346   | 3,346   | 3,346   | 3,346   |
| University Transportation Centers Program (FHWA/FTA)                                    | 76,630                    | 76,700  | 76,700  | 76,700  | 76,700  |
| <b>Total Funding for RD&amp;T Strategy</b>  |                           |         |         |         |         |

\*Outyear numbers are for planning purposes only.

\*\*Program provides secondary support and does not allocate specific funding for this RD&T Strategy.



**Table C-10. Funding in Support of DOT RD&T Strategies (\$000)**

**Global Connectivity RD&T Strategy—Harmonize Standards and Support Leadership for U.S. Transportation Providers**

| RD&T Program  | Support for RD&T Strategy |       |        |        |        |
|---|---------------------------|-------|--------|--------|--------|
|   | FY 06                     | FY 07 | FY 08* | FY 09* | FY 10* |
| <b>FAA</b>  |                           |       |        |        |        |
| Airport Technology Research—Capacity**                | —                         | —     | —      | —      | —      |
| Airport Technology Research—Safety**                  | —                         | —     | —      | —      | —      |
| Environment and Energy**                              | —                         | —     | —      | —      | —      |
| Fire Research and Safety**                            | —                         | —     | —      | —      | —      |
| <b>FHWA</b>   |                           |       |        |        |        |
| International Highway Transportation Outreach Program | 251                       | 251   | 251    | 251    | 251    |
| Planning and Environment—STEP                         |                           |       |        |        |        |
| <b>FTA</b>  |                           |       |        |        |        |
| Improve Capital and Operating Efficiencies            |                           | 600   | 600    | 600    | 600    |
| <b>OST</b>  |                           |       |        |        |        |
| Aviation and International Policy                     |                           | 2,438 | 2,438  | 2,438  | 2,438  |
| Navigation and Spectrum Policy                        |                           | 178   | 178    | 178    | 178    |
| <b>PHMSA</b>  |                           |       |        |        |        |
| Hazardous Materials Safety R&D**                      | —                         | —     | —      | —      | —      |
| <b>Total Funding for RD&amp;T Strategy</b>            |                           |       |        |        |        |

\*Outyear numbers are for planning purposes only.

\*\*Program provides secondary support and does not allocate specific funding for this RD&T Strategy.

**Table C-11. Funding in Support of DOT RD&T Strategies (\$000)****Environmental Stewardship RD&T Strategy 1—Understand and Mitigate Transportation Impacts**

| RD&T Program  | Support for RD&T Strategy |        |        |        |        |
|---|---------------------------|--------|--------|--------|--------|
|   | FY 06                     | FY 07  | FY 08* | FY 09* | FY 10* |
| <b>FAA</b>  |                           |        |        |        |        |
| Environment and Energy                                  | 15,840                    | 16,008 | 15,452 | 15,343 | 14,931 |
| <b>FHWA</b>   |                           |        |        |        |        |
| Center for Environmental Excellence                     |                           |        |        |        |        |
| Corporate Activities—Exploratory Advanced Research      |                           |        |        |        |        |
| Planning and Environment—STEP                           |                           |        |        |        |        |
| Renewable Transportation Systems                        | 836                       | 0      | 0      | 0      |        |
| <b>FRA</b>  |                           |        |        |        |        |
| Hazardous Materials Transportation                      |                           |        |        |        |        |
| <b>FTA</b>  |                           |        |        |        |        |
| National Fuel Cell Bus Technology Development Program   |                           | 11,500 | 11,500 | 11,500 | 11,500 |
| Protect the Environment and Promote Energy Independence |                           | 1,200  | 1,200  | 1,200  | 1,200  |
| <b>NHTSA</b>  |                           |        |        |        |        |
| Hydrogen Initiative**                                   | —                         | —      | —      | —      | —      |
| <b>OST</b>  |                           |        |        |        |        |
| Safety, Energy, and Environment                         |                           | 567    | 567    | 567    | 567    |
| <b>PHMSA</b>  |                           |        |        |        |        |
| Hazardous Materials Safety R&D**                        | —                         | —      | —      | —      | —      |
| Pipeline Safety R&D                                     | 1,781                     | 1,819  | 1,819  | 1,819  | 1,819  |
| <b>RITA</b>   |                           |        |        |        |        |
| Advanced Vehicle Technology (FHWA)                      | 2,091                     | 2,091  | 2,091  | 2,091  | 2,091  |
| Bio-based Transportation Research (FHWA)                | 10,456                    | 10,456 | 10,456 | 10,456 | 10,456 |
| Hydrogen Fuels Safety R&D**                             | —                         | —      | —      | —      | —      |
| Hydrogen Powered Research (FHWA)**                      | —                         | —      | —      | —      | —      |
| <b>Total Funding for RD&amp;T Strategy</b>              |                           |        |        |        |        |

\*Outyear numbers are for planning purposes only.

\*\*Program provides secondary support and does not allocate specific funding for this RD&T Strategy.

**Table C-12. Funding in Support of DOT RD&T Strategies (\$000)****Environmental Stewardship RD&T Strategy 2—Improve the Environmental Review Process**

| RD&T Program  | Support for RD&T Strategy |       |        |        |        |
|---|---------------------------|-------|--------|--------|--------|
|   | FY 06                     | FY 07 | FY 08* | FY 09* | FY 10* |
| <b>FAA</b>  |                           |       |        |        |        |
| Airport Cooperative Research Program**                  | —                         | —     | —      | —      | —      |
| <b>FHWA</b>   |                           |       |        |        |        |
| Center for Environmental Excellence                     |                           |       |        |        |        |
| Planning and Environment—STEP                           |                           |       |        |        |        |
| <b>FTA</b>  |                           |       |        |        |        |
| Protect the Environment and Promote Energy Independence |                           | 750   | 750    | 750    | 750    |
| <b>Total Funding for RD&amp;T Strategy</b>              |                           |       |        |        |        |

\*Outyear numbers are for planning purposes only.

\*\*Program provides secondary support and does not allocate specific funding for this RD&T Strategy.

**Table C-13. Funding in Support of DOT RD&T Strategies (\$000)****Security and Emergency Response RD&T Strategy 1—Reduce Vulnerability and Improve Preparedness and Response**

| RD&T Program                               | Support for RD&T Strategy |       |        |        |        |
|--|---------------------------|-------|--------|--------|--------|
|  | FY 06                     | FY 07 | FY 08* | FY 09* | FY 10* |
| <b>FHWA</b>                                |                           |       |        |        |        |
| ITS—Emergency Transportation Operations    |                           |       |        |        |        |
| ITS—Next-Generation 911                    |                           |       |        |        |        |
| <b>FRA</b>                                 |                           |       |        |        |        |
| Railroad System Issues                     |                           |       |        |        |        |
| <b>FTA</b>                                 |                           |       |        |        |        |
| Improve Safety and Emergency Preparedness  |                           | 2,390 | 2,390  | 2,390  | 2,390  |
| <b>OST</b>                                 |                           |       |        |        |        |
| Security Policy                            |                           | 256   | 256    | 256    | 256    |
| <b>Total Funding for RD&amp;T Strategy</b> |                           |       |        |        |        |

\*Outyear numbers are for planning purposes only.

Table C-14. Funding in Support of DOT RD&amp;T Strategies (\$000)

**Security and Emergency Response RD&T Strategy 2—Secure Hazardous Shipments and Assess the Risk of Hazmat Events**

| RD&T Program   | Support for RD&T Strategy |       |        |        |        |
|--|---------------------------|-------|--------|--------|--------|
|  | FY 06                     | FY 07 | FY 08* | FY 09* | FY 10* |
| <b>FMCSA</b>   |                           |       |        |        |        |
| Improve Security Through Safety Initiatives                              | 297                       | 450   | 450    | 450    | 450    |
| <b>FRA</b>   |                           |       |        |        |        |
| Railroad System Issues   |                           |       |        |        |        |
| <b>OST</b>   |                           |       |        |        |        |
| Security Policy  |                           | 256   | 256    | 256    | 256    |
| <b>PHMSA</b>   |                           |       |        |        |        |
| Hazardous Materials Safety R&D**   | —                         | —     | —      | —      | —      |
| Hazardous Materials Transportation Cooperative Research Program (FHWA)** | —                         | —     | —      | —      | —      |
| <b>Total Funding for RD&amp;T Strategy</b>                               |                           |       |        |        |        |

\*Outyear numbers are for planning purposes only.

\*\*Program provides secondary support and does not allocate specific funding for this RD&T Strategy.

Table C-15. Funding in Support of DOT RD&amp;T Strategies (\$000)

**Organizational Excellence RD&T Strategy—Consistently Apply the R&D Investment Criteria**

| RD&T Program  | Support for RD&T Strategy |       |        |        |        |
|---|---------------------------|-------|--------|--------|--------|
|   | FY 06                     | FY 07 | FY 08* | FY 09* | FY 10* |
| <b>FAA</b>  |                           |       |        |        |        |
| System Planning and Resource Management               | 1,189                     | 1,234 | 1,182  | 1,170  | 1,129  |
| <b>FMCSA</b>  |                           |       |        |        |        |
| Enable and Motivate Internal Excellence               | 937                       | 450   | 450    | 450    | 450    |
| <b>FTA</b>  |                           |       |        |        |        |
| Provide Transit Research Leadership                   | 1,600                     | 3,794 | 3,794  | 3,794  | 3,794  |
| <b>RITA</b>   |                           |       |        |        |        |
| R&D Planning and Management                           | 536                       | 247   | 247    | 247    | 247    |
| Transportation Futures and Applied Technology Program | 0                         | 2,228 | 2,228  | 2,228  | 2,228  |
| <b>Total Funding for RD&amp;T Strategy</b>            |                           |       |        |        |        |

\*Outyear numbers are for planning purposes only.

## Total RD&T Program Funding FY 2005-2007

Table C-16. FAA RD&T Funding (\$000)

| FAA RD&T Program   | FY 2005<br>Actual | FY 2006<br>Enacted | FY 2007<br>Request |
|--|-------------------|--------------------|--------------------|
| <b>Research, Engineering and Development</b>               | <b>129,880</b>    | <b>136,620</b>     | <b>130,000</b>     |
| <i>Improve Aviation Safety</i>                             | 104,886           | 96,040             | 88,162             |
| Fire Research and Safety                                   | 6,525             | 6,182              | 6,638              |
| Propulsion and Fuel Systems                                | 7,115             | 5,741              | 4,048              |
| Advanced Materials/Structural Safety                       | 6,643             | 5,881              | 2,843              |
| Atmospheric Hazards/Digital System Safety                  | 4,086             | 3,407              | 3,848              |
| Aging Aircraft   | 18,998            | 19,807             | 18,621             |
| Aircraft Catastrophic Failure Prevention<br>Research       | 1,107             | 3,307              | 1,512              |
| Flightdeck/Maintenance/System Integration<br>Human Factors | 11,700            | 8,099              | 7,999              |
| Aviation Safety Risk Analysis                              | 8,571             | 4,883              | 5,292              |
| Air Traffic Control/Airway Facilities HF                   | 9,391             | 9,557              | 9,654              |
| Aeromedical Research                                       | 10,079            | 8,800              | 6,962              |
| Weather Program Safety                                     | 20,671            | 20,376             | 19,545             |
| Unmanned Aircraft Systems                                  | 0                 | 0                  | 1,200              |
| <i>Improve Efficiency</i>                                  | 9,321             | 20,192             | 21,166             |
| National Plan for Transformation of Air<br>Transportation  | 5,059             | 17,919             | 18,100             |
| Wake Turbulence  | 4,262             | 2,273              | 3,066              |
| <i>Reduce Environmental Impact</i>                         | 11,795            | 15,840             | 16,008             |
| Environment and Energy                                     | 11,795            | 15,840             | 16,008             |
| <i>Mission Support</i>                                     | 3,878             | 4,548              | 4,664              |
| System Planning and Resource Management                    | 516               | 1,189              | 1,234              |
| William J. Hughes Technical Center Laboratory<br>Facility  | 3,362             | 3,359              | 3,430              |
| <b>Facilities and Equipment</b>                            | <b>119,863</b>    | <b>159,526</b>     | <b>96,800</b>      |
| <i>Advanced Technology Development and<br/>Prototyping</i> | 102,701           | 104,702            | 49,500             |
| <i>Plant (F)</i>   | 17,162            | 16,929             | 17,200             |
| <i>Center for Advanced Aviation System Development</i>     | 0                 | 37,895             | 30,100             |
| <b>Airport Improvement Program</b>                         | <b>0</b>          | <b>9,900</b>       | <b>27,870</b>      |
| <i>Airport Technology (T)</i>                              | 0                 | 9,900              | 27,870             |
| <b>Operations</b>  | <b>13,380</b>     | <b>13,581</b>      | <b>8,353</b>       |
| <b>Commercial Space Transportation</b>                     | <b>110</b>        | <b>75</b>          | <b>125</b>         |
| Subtotal, R&D  | 246,071           | 292,873            | 218,078            |
| Subtotal, Technology Investment (T)                        | 0                 | 9,900              | 27,870             |
| Subtotal, Facilities (F)                                   | 17,162            | 16,929             | 17,200             |
| <b>Total FAA</b>   | <b>263,233</b>    | <b>319,702</b>     | <b>263,148</b>     |

Table C-17. FHWA RD&amp;T Funding (\$000)

| <b>FHWA RD&amp;T Program</b>                        | <b>FY 2005<br/>Actual</b> | <b>FY 2006<br/>Enacted</b> | <b>FY 2007<br/>Request</b> |
|---|---------------------------|----------------------------|----------------------------|
| <b>Surface Transportation Research</b>              | <b>85,491</b>             | <b>196,400</b>             | <b>196,400</b>             |
| Safety  | 8,113                     | 8,296                      | 8,296                      |
| Safety (T)  | 1,432                     | 6,788                      | 6,788                      |
| Pavements   | 13,280                    | 20,144                     | 20,144                     |
| Pavements (T)                                       | 0                         | 10,847                     | 10,847                     |
| Structures  | 10,226                    | 14,514                     | 14,514                     |
| Structures (T)                                      | 1,394                     | 11,875                     | 11,875                     |
| Policy  | 7,470                     | 0                          | 0                          |
| Environmental, Planning, and Right-of-Way           | 9,510                     | 7,821                      | 7,821                      |
| Environmental, Planning, and Right-of-Way (T)       | 4,475                     | 11,731                     | 11,731                     |
| Highway Operations                                  | 6,474                     | 3,011                      | 3,011                      |
| Highway Operations (T)                              | 4,316                     | 4,517                      | 4,517                      |
| R&T Technical Support                               | 6,640                     | 0                          | 0                          |
| Long-Term Pavement Performance                      | 8,300                     | 8,465                      | 8,465                      |
| Advanced Research                                   | 623                       | 0                          | 0                          |
| R&T Strategic Plan/Performance Measures             | 623                       | 0                          | 0                          |
| International Outreach                              | 332                       | 251                        | 251                        |
| Asset Management                                    | 2,283                     | 0                          | 0                          |
| Corporate Activities                                | 0                         | 54,578                     | 54,578                     |
| OST, RITA, FMCSA, NHTSA & PHMSA                     | 0                         | 17,774                     | 17,774                     |
| OST, RITA, FMCSA, NHTSA & PHMSA (T)                 | 0                         | 15,788                     | 15,788                     |
| <b>Technology Deployment Program (T)</b>            | <b>41,501</b>             | <b>0</b>                   | <b>0</b>                   |
| <b>Training and Education</b>                       | <b>24,706</b>             | <b>26,700</b>              | <b>26,700</b>              |
| National Highway Institute (T)                      | 10,487                    | 9,270                      | 9,270                      |
| Local Technical Assistance Program (T)              | 11,148                    | 10,719                     | 10,719                     |
| Eisenhower Transportation Fellowship Program (T)    | 3,071                     | 2,124                      | 2,124                      |
| Garret Morgan Program                               | 0                         | 1,207                      | 1,207                      |
| Transportation Education Development Pilot          | 0                         | 1,811                      | 1,811                      |
| Freight Planning Capacity Building                  | 0                         | 845                        | 845                        |
| Surface Transportation Congestion Relief Assistance | 0                         | 724                        | 724                        |
| <b>Intelligent Transportation Systems</b>           | <b>198,359</b>            | <b>110,000</b>             | <b>110,000</b>             |
| Research  | 44,175                    | 51,667                     | 51,667                     |
| Operational Test                                    | 9,979                     | 11,671                     | 11,671                     |
| Architecture and Standards (T)                      | 15,104                    | 17,666                     | 17,666                     |
| ITS Program Support                                 | 9,546                     | 11,165                     | 11,165                     |
| Integration (T)                                     | 9,546                     | 11,165                     | 11,165                     |
| ITS Deployment (T)                                  | 104,310                   | 0                          | 0                          |
| Evaluation (T)                                      | 5,699                     | 6,666                      | 6,666                      |
| <b>University Transportation Research (T)</b>       | <b>59,594</b>             | <b>69,700</b>              | <b>69,700</b>              |

| <b>FHWA RD&amp;T Program</b>               | <b>FY 2005<br/>Actual</b> | <b>FY 2006<br/>Enacted</b> | <b>FY 2007<br/>Request</b> |
|--|---------------------------|----------------------------|----------------------------|
| <b>Other</b>                               | <b>149,983</b>            | <b>148,681</b>             | <b>165,723</b>             |
| State Planning and Research                | 149,983                   | 148,681                    | 165,723                    |
| <b>Administrative Expenses</b>             | <b>16,548</b>             | <b>17,044</b>              | <b>17,556</b>              |
| <b>Subtotal, R&amp;D</b>                   | <b>304,105</b>            | <b>379,669</b>             | <b>397,223</b>             |
| <b>Subtotal, Technology Investment (T)</b> | <b>272,077</b>            | <b>188,856</b>             | <b>188,856</b>             |
| <b>Subtotal, Facilities (F)</b>            | <b>0</b>                  | <b>0</b>                   | <b>0</b>                   |
| <b>Total FHWA</b>                          | <b>576,182</b>            | <b>568,525</b>             | <b>586,079</b>             |

Table C-18. FMCSA RD&amp;T Funding (\$000)

| <b>FMCSA RD&amp;T Program</b>                               | <b>FY 2005<br/>Actual</b> | <b>FY 2006<br/>Enacted</b> | <b>FY 2007<br/>Request</b> |
|---|---------------------------|----------------------------|----------------------------|
| <b>Motor Carrier Safety</b>                                 | <b>10,516</b>             | <b>12,098</b>              | <b>12,458</b>              |
| <i>Produce Safer Drivers</i>                                | 2,750                     | 3,623                      | 4,271                      |
| Produce Safer Drivers                                       | 2,750                     | 3,366                      | 4,271                      |
| Produce Safer Drivers (T)                                   | 0                         | 257                        | 0                          |
| <i>Improve Safety of Commercial Motor Vehicles</i>          | 2,777                     | 2,772                      | 3,147                      |
| Improve Safety of Commercial Motor Vehicles                 | 1,777                     | 297                        | 3,147                      |
| Improve Safety of Commercial Motor Vehicles (T)             | 1,000                     | 2,475                      | 0                          |
| <i>Produce Safer Carriers</i>                               | 120                       | 871                        | 629                        |
| Produce Safer Carriers                                      | 120                       | 871                        | 629                        |
| Produce Safer Carriers (T)                                  | 0                         | 0                          | 0                          |
| <i>Advance Safety Through Information-Based Initiatives</i> | 1,035                     | 1,483                      | 1,349                      |
| Advance Safety Through Information-Based Initiatives        | 460                       | 815                        | 1,349                      |
| Advance Safety Through Information-Based Initiatives (T)    | 575                       | 668                        | 0                          |
| <i>Improve Security Through Safety Initiatives</i>          | 500                       | 297                        | 450                        |
| Improve Security Through Safety Initiatives                 | 0                         | 297                        | 450                        |
| Improve Security Through Safety Initiatives (T)             | 500                       | 0                          | 0                          |
| <i>Enable and Motivate Internal Excellence</i>              | 1,250                     | 937                        | 450                        |
| Enable and Motivate Internal Excellence                     | 1,150                     | 937                        | 450                        |
| Enable and Motivate Internal Excellence (T)                 | 100                       | 0                          | 0                          |
| <b>Administrative Expenses</b>                              | <b>2,084</b>              | <b>2,115</b>               | <b>2,162</b>               |
| <b>Subtotal, R&amp;D</b>                                    | <b>8,341</b>              | <b>8,698</b>               | <b>12,458</b>              |
| <b>Subtotal, Technology Investment (T)</b>                  | <b>2,175</b>              | <b>3,400</b>               | <b>0</b>                   |
| <b>Subtotal, Facilities (F)</b>                             | <b>0</b>                  | <b>0</b>                   | <b>0</b>                   |
| <b>Total FMCSA</b>  | <b>10,516</b>             | <b>12,098</b>              | <b>12,458</b>              |

Table C-19. FRA RD&amp;T Funding (\$000)

| <b>FRA RD&amp;T Program</b>                           | <b>FY 2005<br/>Actual</b> | <b>FY 2006<br/>Enacted</b> | <b>FY 2007<br/>Request</b> |
|---|---------------------------|----------------------------|----------------------------|
| <b>Railroad Research and Development</b>              | <b>35,737</b>             | <b>54,525</b>              | <b>34,650</b>              |
| Railroad System Issues                                | 3,001                     | 3,168                      | 3,168                      |
| Human Factors   | 3,422                     | 3,366                      | 3,366                      |
| Rolling Stock and Components                          | 2,510                     | 4,688                      | 2,871                      |
| Track and Structures                                  | 3,670                     | 3,861                      | 3,861                      |
| Marshall University/University of Nebraska            | 1,984                     | 1,485                      | 0                          |
| Track and Train Interaction                           | 3,175                     | 3,168                      | 3,168                      |
| Train Control   | 893                       | 7,326                      | 7,920                      |
| Grade Crossings                                       | 1,885                     | 1,881                      | 2,178                      |
| Hazardous Materials Transportation                    | 967                       | 1,188                      | 1,287                      |
| Train Occupant Protection                             | 6,150                     | 6,039                      | 4,950                      |
| Corridor Planning                                     | 0                         | 7,118                      | 0                          |
| R&D Facilities and Test Equipment (F)                 | 1,334                     | 1,337                      | 1,881                      |
| Nationwide Differential Global Positioning System (T) | 6,746                     | 9,900                      | 0                          |
| <b>Next Generation High-Speed Rail</b>                | <b>19,493</b>             | <b>0</b>                   | <b>0</b>                   |
| HS Train Control Systems (T)                          | 7,440                     | 0                          | 0                          |
| Non-Electric Locomotives (T)                          | 1,687                     | 0                          | 0                          |
| Grade Crossing & Innovative Technologies (T)          | 4,315                     | 0                          | 0                          |
| Track/Structures Technology (T)                       | 992                       | 0                          | 0                          |
| Corridor Planning (T)                                 | 3,075                     | 0                          | 0                          |
| MAGLEV (T)  | 1,984                     | 0                          | 0                          |
| <b>Safety and Operations</b>                          | <b>4,227</b>              | <b>3,820</b>               | <b>3,996</b>               |
| Salaries and Expenses                                 | 3,096                     | 3,244                      | 3,394                      |
| Salaries and Expenses (T)                             | 1,131                     | 576                        | 602                        |
| <b>Subtotal, R&amp;D</b>                              | <b>30,753</b>             | <b>46,532</b>              | <b>36,163</b>              |
| <b>Subtotal, Technology Investment (T)</b>            | <b>27,370</b>             | <b>10,476</b>              | <b>602</b>                 |
| <b>Subtotal, Facilities (F)</b>                       | <b>1,334</b>              | <b>1,337</b>               | <b>1,881</b>               |
| <b>Total FRA</b>                                      | <b>59,457</b>             | <b>58,345</b>              | <b>38,646</b>              |



Table C-20. FTA RD&amp;T Funding (\$000)

| <b>FTA RD&amp;T Program</b>                                  | <b>FY 2005<br/>Actual</b> | <b>FY 2006<br/>Enacted</b> | <b>FY 2007<br/>Request</b> |
|--|---------------------------|----------------------------|----------------------------|
| <b>National Program</b>                                      | <b>37,200</b>             | <b>54,451</b>              | <b>40,500</b>              |
| <i>Increase Transit Ridership</i>                            | 15,019                    | 13,717                     | 12,800                     |
| Increase Transit Ridership                                   | 0                         | 0                          | 1,500                      |
| Increase Transit Ridership (T)                               | 15,019                    | 13,717                     | 11,300                     |
| <i>Improve Capital and Operating Efficiencies</i>            | 5,347                     | 18,755                     | 11,755                     |
| Improve Capital and Operating Efficiencies                   | 1,932                     | 1,980                      | 4,200                      |
| Improve Capital and Operating Efficiencies (T)               | 3,415                     | 16,775                     | 7,555                      |
| <i>Improve Safety and Emergency Preparedness</i>             | 9,002                     | 8,786                      | 10,201                     |
| Improve Safety and Emergency Preparedness                    | 0                         | 0                          | 500                        |
| Improve Safety and Emergency Preparedness (T)                | 9,002                     | 8,786                      | 9,701                      |
| <i>Protect Environment &amp; Promote Energy Independence</i> | 6,408                     | 11,593                     | 1,950                      |
| Protect Environment & Promote Energy Independence            | 1,788                     | 3,119                      | 1,200                      |
| Protect Environment & Promote Energy Independence (T)        | 4,620                     | 8,474                      | 750                        |
| <i>Provide Transit Research Leadership</i>                   | 1,424                     | 1,600                      | 3,794                      |
| Provide Transit Research Leadership                          | 300                       | 300                        | 300                        |
| Provide Transit Research Leadership (T)                      | 1,124                     | 1,300                      | 3,494                      |
| <b>Transit Cooperative Research Program (T)</b>              | <b>8,184</b>              | <b>8,910</b>               | <b>9,300</b>               |
| <b>National Transit Institute (T)</b>                        | <b>3,968</b>              | <b>4,257</b>               | <b>4,300</b>               |
| <b>Rural Transit Assistance Program (T)</b>                  | <b>5,208</b>              | <b>0</b>                   | <b>0</b>                   |
| <b>University Transportation Centers (T)</b>                 | <b>5,952</b>              | <b>6,930</b>               | <b>7,000</b>               |
| <b>Subtotal, Research and University Programs</b>            | <b>60,512</b>             | <b>74,548</b>              | <b>61,100</b>              |
| <b>Administrative Expenses</b>                               | <b>224</b>                | <b>280</b>                 | <b>585</b>                 |
| <b>Subtotal, R&amp;D</b>                                     | <b>4,244</b>              | <b>5,679</b>               | <b>8,285</b>               |
| <b>Subtotal, Technology Investment (T)</b>                   | <b>56,492</b>             | <b>69,149</b>              | <b>53,400</b>              |
| <b>Subtotal, Facilities (F)</b>                              | <b>0</b>                  | <b>0</b>                   | <b>0</b>                   |
| <b>Total FTA</b>   | <b>60,736</b>             | <b>74,828</b>              | <b>61,685</b>              |

Table C-21. NHTSA RD&amp;T Funding (\$000)

| <b>NHTSA RD&amp;T Program</b>                     | <b>FY 2005<br/>Actual</b> | <b>FY 2006<br/>Enacted</b> | <b>FY 2007<br/>Request</b> |
|---|---------------------------|----------------------------|----------------------------|
| <b>Research and Analysis</b>                      | <b>69,401</b>             | <b>71,908</b>              | <b>64,211</b>              |
| <i>Crashworthiness</i>                            | 25,263                    | 22,994                     | 19,226                     |
| Safety Systems                                    | 9,151                     | 9,134                      | 7,726                      |
| Biomechanics (Human Injury Research)              | 16,112                    | 13,860                     | 11,500                     |
| <i>Crash Avoidance</i>                            | 9,788                     | 12,065                     | 9,165                      |
| Driver/Vehicle Performance                        | 3,488                     | 6,980                      | 6,750                      |
| National Advanced Driver Simulator                | 3,591                     | 0                          | 0                          |
| Heavy Vehicles                                    | 2,098                     | 4,470                      | 2,115                      |
| Pneumatic Tire Research                           | 611                       | 615                        | 300                        |
| <i>Data Programs (T)</i>                          | 32,608                    | 34,188                     | 33,883                     |
| Fatal Accident Reporting System (T)               | 6,543                     | 6,992                      | 7,063                      |
| National Accident Sampling System (T)             | 12,046                    | 12,108                     | 12,230                     |
| Data Analysis Program (T)                         | 1,970                     | 1,980                      | 2,000                      |
| State Data Program (T)                            | 2,504                     | 2,515                      | 2,890                      |
| Special Crash Investigations (T)                  | 1,675                     | 1,683                      | 1,700                      |
| National Motor Vehicle Crash Causation Survey (T) | 6,887                     | 7,920                      | 7,000                      |
| Early Fatality Notification System (T)            | 983                       | 990                        | 1,000                      |
| <i>Crash Avoidance</i>                            | 492                       | 495                        | 0                          |
| <i>Vehicle Research and Test Center</i>           | 1,004                     | 1,002                      | 1,012                      |
| <i>Hydrogen New Initiative</i>                    | 0                         | 916                        | 925                        |
| <i>NAS Tire Study</i>                             | 246                       | 0                          | 0                          |
| <i>Plastic and Composite Vehicles</i>             | 0                         | 248                        | 0                          |
| <b>Highway Safety Research</b>                    | <b>4,571</b>              | <b>4,621</b>               | <b>6,833</b>               |
| <b>Administrative Expenses</b>                    | <b>19,625</b>             | <b>15,169</b>              | <b>13,458</b>              |
| <b>Subtotal, R&amp;D</b>                          | <b>60,989</b>             | <b>57,510</b>              | <b>50,619</b>              |
| <b>Subtotal, Technology Investment (T)</b>        | <b>32,608</b>             | <b>34,188</b>              | <b>33,883</b>              |
| <b>Subtotal, Facilities (F)</b>                   | <b>0</b>                  | <b>0</b>                   | <b>0</b>                   |
| <b>Total NHTSA</b>                                | <b>93,597</b>             | <b>91,698</b>              | <b>84,502</b>              |

**Table C-22. OST RD&T Funding (\$000)**

| <b>OST RD&amp;T Program</b>                        | <b>FY 2005<br/>Actual</b> | <b>FY 2006<br/>Enacted</b> | <b>FY 2007<br/>Request</b> |
|--|---------------------------|----------------------------|----------------------------|
| Transportation Planning, Research, and Development | 19,490                    | 14,850                     | 8,910                      |
| <b>Total OST</b>                                   | <b>19,490</b>             | <b>14,850</b>              | <b>8,910</b>               |

**Table C-23. PHMSA RD&T Funding (\$000)**

| <b>PHMSA RD&amp;T Program</b>        | <b>FY 2005<br/>Actual</b> | <b>FY 2006<br/>Enacted</b> | <b>FY 2007<br/>Request</b> |
|--------------------------------------|---------------------------|----------------------------|----------------------------|
| <b>Research and Special Programs</b> | <b>2,733</b>              | <b>0</b>                   | <b>0</b>                   |
| Hazardous Materials                  | 1,831                     | 0                          | 0                          |
| Research and Technology              | 374                       | 0                          | 0                          |
| Administrative Expenses              | 528                       | 0                          | 0                          |
| <b>Hazardous Materials Safety</b>    | <b>0</b>                  | <b>1,829</b>               | <b>2,093</b>               |
| Administrative Expenses              | 0                         | 464                        | 480                        |
| <b>Pipeline Safety</b>               | <b>9,591</b>              | <b>9,458</b>               | <b>9,663</b>               |
| Pipeline Safety                      | 8,986                     | 8,907                      | 9,093                      |
| Administrative Expenses              | 605                       | 551                        | 570                        |
| <b>Total PHMSA</b>                   | <b>12,324</b>             | <b>11,751</b>              | <b>12,236</b>              |

**Table C-24. RITA RD&T Funding (\$000)**

| <b>RITA RD&amp;T Program</b>   | <b>FY 2005<br/>Actual</b> | <b>FY 2006<br/>Enacted</b> | <b>FY 2007<br/>Request</b> |
|--------------------------------|---------------------------|----------------------------|----------------------------|
| Hazardous Materials R&D        | 80                        | 79                         | 0                          |
| Hydrogen R&D                   | 500                       | 495                        | 495                        |
| R&D Planning and Management    | 171                       | 536                        | 247                        |
| Administrative Expenses        | 1,170                     | 1,360                      | 1,392                      |
| Transportation Futures Program | 0                         | 0                          | 2,228                      |
| <b>Total RITA</b>              | <b>1,921</b>              | <b>2,470</b>               | <b>4,362</b>               |

## Appendix D: Operating Administration Advisory Committees, Stakeholder Activities, and RD&T Plans

### FAA

Research, Engineering, and Development Advisory Committee

<http://research.faa.gov/redac/>

National Aviation Research Plan

<http://nasdocs.faa.gov/nasiHTML/RED/index.html>

RD&T Annual Reviews and Accomplishment Reports

<http://research.faa.gov/publications/annual/>

### FHWA

Research and Technology Coordinating Committee

<http://www8.nationalacademies.org/cp/projectview.aspx?key=154>

Corporate Master Plan for Research and Deployment of Technology & Innovation

<http://www.fhwa.dot.gov/legsregs/directives/policy/cmp/03077.htm>

RD&T Performance Plans and Reports

<http://www.tfrc.gov/>

### FMCSA

Research and Technology Stakeholder Forums

<http://www.fmcsa.dot.gov/facts-research/research-technology/report/2004-stakeholder-report.htm>

<http://www.fmcsa.dot.gov/facts-research/research-technology/report/Forum-Report-digital-version-all.htm>

Research and Technology 5-Year Strategic Plan

<http://www.fmcsa.dot.gov/facts-research/research-technology/report/rt-5year-strategicplan.htm>

## **FRA**

Committee for Review of the Federal Railroad Administration Research, Development, and Demonstration Programs  
<http://www8.nationalacademies.org/cp/projectview.aspx?key=SAIS-P-01-08-A>

Five-Year Strategic Plan for Railroad Research, Development, and Demonstrations  
<http://www.fra.dot.gov/us/content/225>

## **FTA**

Transit Research Analysis Committee  
<http://www8.nationalacademies.org/cp/projectview.aspx?key=71>

Strategic Research Plan  
[http://www.fta.dot.gov/documents/FTA\\_Strategic\\_Research\\_Plan\\_Final.doc](http://www.fta.dot.gov/documents/FTA_Strategic_Research_Plan_Final.doc)

## **NHTSA**

Vehicle Safety Rulemaking and Supporting Research Priorities: Calendar Years 2005-2009  
<http://www.nhtsa.gov/cars/rules/rulings/PriorityPlan-2005.html>

Research and Development Public Meetings  
<http://www-nrd.nhtsa.dot.gov/departments/nrd-01/presentations/presentations.html>

## **PHMSA**

Office of Pipeline Safety R&D Strategic Plan  
<http://primis.phmsa.dot.gov/rd/splan.htm>

Pipeline Safety Internal, External, Stakeholder, and Peer Reviews  
<http://primis.phmsa.dot.gov/rd/reviews.htm>

## RITA

Committee for Review of the DOT RD&T Strategic Plan

<http://www8.nationalacademies.org/cp/projectview.aspx?key=48663>

Research Activities of the Department of Transportation: A Report to Congress

[http://www.rita.dot.gov/publications/research\\_activities\\_of\\_the\\_department\\_of\\_transportation\\_a\\_report\\_to\\_congress/](http://www.rita.dot.gov/publications/research_activities_of_the_department_of_transportation_a_report_to_congress/)

