

March 28, 2000

The Honorable Rodney E. Slater  
Secretary of Transportation  
United States Department of Transportation  
Washington, D.C. 20590

Dear Mr. Slater:

At the request of Dr. Fenton Carey, Chairman of the Research and Technology Coordination Council of the U.S. Department of Transportation (DOT), the National Research Council (NRC), acting through the Transportation Research Board (TRB), convened the Committee for Review of the National Transportation Science and Technology Strategy (see Attachment 1 for a list of the committee members). The committee is charged with fulfilling the congressional request in the Transportation Equity Act for the 21<sup>st</sup> Century (TEA-21) to review and comment on DOT's Strategic Plan, Performance Plan, and Program Performance Report (required under the Government Performance and Results Act [GPRA]) with respect to surface transportation research and technology (R&T) development.

While Congress specified "surface transportation research and technology development" in its request, DOT asked that all modes be included in the committee's task; thus the committee has not limited its scope to surface transportation. Moreover, although many of the issues and questions addressed by the committee apply to the above documents in a general way, in some cases it was necessary to perform a more focused analysis of specific strategic goals and how R&T supports them. In particular, at the request of DOT staff, the committee performed such a focused analysis on the safety goal. The selection of safety as a focus area reflects this goal's high level of importance to society and to the Department. At the same time, the committee believes that its observations on the safety elements of the documents are valid for the other goal areas as well since DOT has applied the same structure and process for all of its strategic goals.

The committee carried out its task by reviewing DOT's GPRA documents and the first edition of the Department's Research and Development Plan (R&D Plan), dated May 1999, as well as by holding a meeting in Washington, D.C., on February 3-4, 2000. During the open session of the meeting, the committee heard from Eugene Conti (Assistant Secretary for Transportation Policy, DOT) and Fenton Carey (Associate Administrator for Research, Technology and Analysis, DOT Research and Special Programs Administration [RSPA]) about the Department's strategic planning efforts and how its R&T activities support the achievement of its strategic goals. In addition, brief presentations were made by research managers from several DOT operating administrations.

## **BACKGROUND**

Transportation makes essential contributions to the nation's economy and quality of life. New knowledge and innovative technologies derived from research have played a critical role in supporting and enhancing those contributions, and in helping to mitigate some of transportation's less desirable impacts with regard to safety and the environment. Now more than ever, R&T offers promise for enhancing the performance of the transportation system. However, resources for research are limited. Strategic planning and analysis are required to direct these resources to their most beneficial uses.

During the last several years, DOT has made considerable progress in developing a strategic planning process for transportation R&T at the levels of both the Department and the federal government. Coordinating bodies at both levels—DOT's Research and Technology Coordinating Council (RTCC) and the National Science and Technology Council's (NSTC) Subcommittee on Transportation R&D, respectively—have been established or reinvigorated. Several partnership initiatives, involving federal agencies, the private sector, and state and local governments, have been undertaken to advance research in promising areas. Support for the role of R&T in enhancing transportation has been exhibited consistently at the highest level of the Department. It is the committee's hope that in the years to come, the strategic value of R&T will continue to be accorded significant visibility, backed by adequate institutional authority within the Office of the Secretary.

This NRC committee—which has undergone a number of transformations since TRB coordinated the DOT-sponsored Forum on Transportation R&D in 1995—has been privileged to participate in and witness the progress made to date. From 1997 through 1999, the committee reviewed elements of the NSTC's strategic planning process, and that effort will continue. The committee's new task—focusing on DOT's use of R&T to support its Strategic Plan—well complements the NSTC review. The two tasks promise to be mutually reinforcing in a way that should enhance the quality and usefulness of both reviews.

The remainder of this report contains the results of the committee's review of DOT's GPRA documents and R&D Plan. It begins with general observations regarding GPRA, research, and DOT's efforts to present its R&T program within the GPRA framework. This is followed by a description of the approach used by the committee to conduct its review. The committee's recommendations are then presented, arranged according to major topics relevant to research management. Attachment 2 contains the committee's more detailed findings, arranged according to the questions that guided its review.

## **GENERAL OBSERVATIONS**

Since GPRA was passed in 1993, some questions have been raised about its applicability to the research activities of government agencies. Because the process required by GPRA is based on a 5-year strategic planning horizon, concern exists within the committee that GPRA constrains, and perhaps prohibits, the long-term thinking and planning that should characterize the federal

role in research. This concern is particularly relevant for basic research, but even successes from highly applied research (the type sponsored by DOT) can require years before achieving widespread implementation. Nevertheless, the committee believes that if issues related to GPRA's short planning horizon are overcome, the requirement to align activities with strategic goals and to apply some form of performance measurement is entirely appropriate for R&T and a salutary discipline for agencies entrusted with the public good.<sup>1</sup>

The fact that R&T is an overarching corporate management strategy for DOT represents a strategic decision or policy to use R&T to advance the Department's goals. The documents reviewed by the committee comprise DOT's initial attempt to plan and portray its R&T activities under GPRA. Summarizing and presenting a large quantity of information about very diverse activities in a succinct way is a difficult task. There is a risk of oversimplifying a highly complex activity—transportation research—in trying to facilitate the reader's assimilation of the vast array of R&T that can contribute to the system's improved performance. Overall, the Department has made a commendable effort to accomplish this task. The main flaw of the current R&D Plan is that it does not fully articulate DOT's many important R&T activities and how they serve attainment of the Department's strategic goals. The committee understands that improvements are already being made in this regard for the next version of the R&D Plan.

## REVIEW APPROACH

As noted earlier, the congressional request that gave rise to this review requires that the NRC examine DOT's GPRA documents “with respect to surface transportation research and technology development” (TEA-21, Section 5108 “§508(c)(3)”). The committee reviewed the following specific GPRA documents:

- *U.S. Department of Transportation Strategic Plan 1997–2002*
- *U.S. Department of Transportation 1999 Performance Plan*
- *U.S. Department of Transportation 2000 Performance Plan*
- *U.S. Department of Transportation 2001 Performance Plan and 1999 Performance Report*

In addition, TEA-21 (Section 5108 “§508(c)(1)”) requires DOT to develop an “integrated surface transportation research and technology development strategic plan.” Since this document—the R&D Plan (first edition, May 1999)—is intended to present more detail about the role of R&T in meeting DOT's strategic goals, it was included in the committee's review as well

To perform its review, the committee began by assessing the R&D Plan with regard to the contents required by TEA-21 (Section 5108 “§508(c)(2)”). In addition, the committee posed several questions based on the required contents of GPRA documents. Both the TEA-21

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<sup>1</sup> For more detailed treatment of the importance of evaluating research activities and the need to use appropriate measures of performance for different types of research, see *Evaluating Federal Research Programs: Research and the Government Performance and Results Act*, Committee on Science, Engineering, and Public Policy, National Academy Press, Washington, D.C., 1999.

requirements and these additional questions are used to structure the committee’s more detailed findings in Attachment 2.

## **KEY RECOMMENDATIONS**

The committee believes the R&D Plan should articulate explicit R&T priorities, the methodology used to determine those priorities, and how each priority is reflected in the Department’s budget. The committee formulated two key recommendations for improving the R&D Plan, as well as the other documents reviewed, in this regard.

### **Recommendation 1: Alignment of R&T with Strategic Plan**

**R&T priorities and activities should be tied more explicitly to the Department’s strategic and performance goals,<sup>2</sup> and their relationship to these goals should be articulated more clearly.**

The overall strategy of the Department with respect to R&T mirrors the NSTC strategy, the main elements of which are strategic planning, partnership initiatives, enabling research, and training and education. It is not always clear from the GPRA documents, or the R&D Plan, however, exactly how R&T supports the Department’s strategic goals. R&T activities—those listed in the GPRA documents as well as the partnership initiatives and enabling research in the R&D Plan—should be tied clearly to the Department’s strategic goals through articulation of their relationship to the performance goals associated with each strategic goal. While it may not be appropriate for the Strategic Plan or the Performance Plans to include such explanations, it would be appropriate for the R&D Plan to do so.

The R&D Plan should be organized primarily in accordance with DOT strategic and performance goals, rather than the partnership initiatives and enabling research of NSTC. However, the committee supports the use of the NSTC categories as a way of reflecting the overall R&T corporate management strategy and demonstrating that DOT’s R&T activities are consistent with the multidepartment cooperative perspective of the NSTC framework.

R&T is often many steps removed from the outcome goals in the Strategic Plan, and the GPRA documents cover so many DOT activities that they cannot provide detailed rationales for specific R&T activities. The R&D Plan should show how the R&T activities are driven (directly or indirectly, in the short or the long term) by the goals of the Strategic Plan.

### **Recommendation 2: Resources**

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<sup>2</sup> DOT’s Strategic Plan contains five “strategic goals.” Each of these goals is further broken down into “performance goals,” which reflect the specific ways in which the operating administrations will contribute to the strategic goals. The Department’s annual Performance Plans and Performance Reports are focused primarily on the performance goals, which may evolve over time as they are met or as other ways to achieve the strategic goals are deemed more effective. Attachment 3 lists the strategic and performance goals for safety, taken from DOT’s fiscal year (FY) 2000 Performance Plan.

**The R&D Plan should include the funding budgeted for specific R&T activities and performance goals, since budgets are a tangible reflection of the real priorities of an agency.**

The R&D Plan contains no discussion of resource needs for R&T. Funding devoted to specific R&T activities and performance goals should be specified so the level of R&T effort toward each goal can be ascertained. As mentioned in Recommendation 4, below, funding should also be characterized according to the types of R&T activities so that the mission focus of DOT will be more apparent from its R&T investments.

Funding is not the only resource need. Human capital is just as critical, particularly in the area of R&T. It is necessary to have people who can discover new knowledge and develop and use new technologies. The R&D Plan does not address the human resource needs of DOT to support specific R&T efforts. Without the proper knowledge base within DOT and its partner organizations, the promise of R&T will not be realized.

## **OTHER RECOMMENDATIONS**

In addition to the key recommendations presented above, the committee formulated the following more specific recommendations.

### **Recommendation 3: Criteria and Methodologies for Program Development**

**DOT should employ rational criteria and methodologies in prioritizing and budgeting for its R&T programs and should include these criteria and methods in the R&D Plan.**

The documents reviewed do not indicate what criteria and systematic methodologies, if any, were used in determining the R&T activities to be carried out by the Department. Alignment with strategic goals is necessary, but not sufficient, since it is possible to identify many more activities that are related to the goals than can be undertaken with the limited resources available. As recommended in the committee's previous letter report of September 3, 1999, the practices of technology scanning<sup>3</sup> and technology mapping<sup>4</sup> are useful initial R&T activities. In addition, in the safety area in particular, risk analysis based on careful analysis of statistical data can help identify the most promising approaches.

Various criteria and methods can be used to prioritize R&T activities. The committee would like to suggest that in preparing future versions of the R&D Plan, DOT consider adopting a methodology such as that presented by the Federal Railroad Administration (FRA) during the committee's meeting. A description and diagram depicting FRA's methodology are presented in Attachment 4. While the method was developed specifically to prioritize rail safety R&D, it is a

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<sup>3</sup> Technology scanning is a review of research in a variety of areas that could be applied to a subject of interest.

<sup>4</sup> Technology mapping is a careful analysis that indicates those points in specific systems that offer the highest leveraging potential so the research to be undertaken can be directed toward critical problems.

good example of a rational approach that could be adapted to broader research prioritization efforts. The practice of focused and transparent priority setting would help increase the credibility of DOT's R&T programs by ensuring responsible and competent use of the public funds entrusted to the Department.

#### **Recommendation 4: Types of R&T Activities Undertaken**

**The documents should clearly explain DOT's role in transportation R&T by identifying where its R&T activities are most appropriately focused and demonstrating that its investments are, in fact, in areas not likely to be covered by other agencies or the private sector.**

The documents express a greater emphasis on "technology" than on "research." For instance, the Research and Development Corporate Management Strategy of the 1999 Performance Plan was revised for the 2000 Performance Plan. Language referring directly to alignment and harnessing of research and to building of intellectual capital was deleted. At the same time, language focused on innovation—"capacity to transform new technologies, concepts, and ideas rapidly into new products, processes and services..."—was added (see pages 5–6 of the revisions to the final DOT FY 2000 Performance Plan). Since DOT's specific role in transportation R&T is not explained in the documents, the reason for placing more emphasis on innovation than on research is unclear.

It might be helpful, as the Department of Defense has done, to employ a taxonomy for distinguishing longer-term or more advanced research, shorter-term applied research, development, testing and evaluation, and implementation support. Then DOT could articulate which portions of the R&T spectrum are most clearly associated with its role and indicate its level of investment in each, taking into consideration possible variations among the operating administrations in this regard. The issue of agency roles and missions is addressed further under Recommendation 5 below.

#### **Recommendation 5: Public-Sector Organizational Roles and Coordination**

**The roles of various public-sector participants (other federal agencies, DOT operating administrations, state and local governments) and the mechanisms for coordinating their participation should be described in the R&D Plan. The R&T activities DOT has chosen to pursue should reflect these coordination efforts.**

Although required in TEA-21, there is no general discussion in the R&D Plan of the missions of the various federal departments and agencies, their (presumably) complementary responsibilities, the consequent differences in their roles in R&T, and the potential for interaction and synergy. For instance, in 1997, approximately \$5.1 billion<sup>5</sup> was invested by federal agencies in transportation-related R&D, of which DOT accounted for about 8 percent. The R&D Plan should explain how DOT's efforts fit with those of other agencies; which agencies, given their

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<sup>5</sup> National Science and Technology Council, *Transportation Strategic Research Plan*, Washington, D.C., May 1999.

missions, focus more on specific portions of the R&T spectrum; and what is provided by DOT efforts that is not covered by the other agencies.

The R&D Plan also contains no overall discussion of the roles of each operating administration within DOT over the next 5 years, as required by TEA-21. For instance, given that 94 percent of fatalities in transportation are highway-related, it would be appropriate to point out the primary role of particular operating administrations (Federal Highway Administration [FHWA], National Highway Traffic Safety Administration [NHTSA], and Federal Motor Carrier Safety Administration [FMCSA]; and FRA in the case of crashes involving highway–rail grade crossings) in reducing transportation fatalities.

There is also no discussion of state and local R&T activities in the plan. In particular, there is no acknowledgment of the role of these agencies as owners and operators of important parts of the transportation system and as major investors in research, and therefore as critical partners in the prioritization and conduct of research and the development and implementation of new technologies.

Regarding coordination, the R&D Plan refers to the RTCC at the DOT-wide level, and to the NSTC Subcommittee on Transportation R&D and its strategic planning documents at the federal government-wide level. The committee applauds the RTCC and DOT's interaction with the NSTC subcommittee; clearly, however, coordination does not take place through the mere existence of committees and documents, but through their impacts on priorities, budgets, and activities. The connection between the committees and the operational realities of DOT's R&T programs is not evident.

### **Recommendation 6: Outreach**

**The R&D Plan should be developed with input from the public, private, and academic sectors. The methods of obtaining this input and results of the outreach should be documented in the plan itself.**

TEA-21 requires that DOT obtain comments on the R&D Plan from outside sources and include responses to significant comments in the plan itself. While comments from this NRC committee could not be included since the committee first met after the initial version of the R&D Plan had been published, it is not evident from the plan that DOT solicited any comments from outside sources. Even though significant outreach may not have been possible for this version of the plan, the plan could have described the nature and extent of outreach to be conducted for future editions. The plan would benefit from the input of stakeholders in the public, private, and academic sectors.

### **Recommendation 7: Performance Measurement**

**Performance measurement of DOT's R&T activities should extend beyond theoretical discussion. Specific measures, methods of applying them and**

**analyzing the results, and the actions to be taken in response should be specified in the R&D Plan.**

Chapter V of the R&D Plan, “Measuring Success,” provides a general discussion of GPRA and performance measurement, but does not indicate how the general theory has been applied to DOT’s R&T programs. A list of impact-based performance measures is included in Table V-2, but these differ from the performance goals and indicators in the Department’s Strategic Plan and Performance Plans. Since R&T activities are often far removed in time and in the chain of causality from the ultimate outcomes expressed in DOT’s strategic goals, it may be necessary to establish intermediate goals for R&T activities. It should be made clear, however, how achievement of these intermediate goals will bring the Department closer to achievement of its ultimate goals.

The Strategic Plan indicates that the Department will measure the impact of R&T on transportation system performance through benchmarking efforts. However, this activity is not mentioned in the Performance Plans. Instead, benchmarking efforts aimed at measuring the performance of DOT R&T facilities are proposed. It is not clear that an assessment of R&T facilities will serve as an assessment of R&T results.

**CONCLUDING REMARKS**

These recommendations focus on a small number of the important issues surrounding the implementation of GPRA to research and technology activities. In future years, the committee may choose to address other issues, such as human resource requirements and the need to balance planning and flexibility.

The committee is pleased to have had the opportunity to provide feedback on DOT’s efforts to use R&T to advance national transportation goals, and hopes that its comments and recommendations will prove useful. The committee looks forward to continued participation in the Department’s strategic planning efforts.

Sincerely,

Joseph Sussman,  
Chair, Committee for Review of the National Transportation Science and Technology Strategy

## Attachment 1

### Committee for Review of the National Transportation Science and Technology Strategy

**Joseph M. Sussman**, *Chairman*, Japan Rail East Professor and Professor of Civil and Environmental Engineering and Engineering Systems, Massachusetts Institute of Technology (MIT), and Director of MIT's Association of American Railroads Affiliated Laboratory

**H. Norman Abramson** [NAE], *Vice Chairman*, Executive Vice President (retired), Southwest Research Institute

**A Ray Chamberlain**, Vice President and Area Manager, Parsons Brinckerhoff

**Irwin Feller**, Director and Professor of Economics, Pennsylvania State University Institute for Policy Research and Evaluation

**Robert E. Gallamore**, Assistant Vice President, Communications Technologies and General Manager of the Positive Train Control Program, Transportation Technology Center, Inc.

**William C. Harris**, President and Executive Director, Columbia University's Biosphere 2 Center

**Christopher T. Hill**, Vice Provost for Research and Professor of Public Policy, George Mason University

**Margaret T. Jenny**, Vice President, Corporate Business Development, ARINC

**C. Ian MacGillivray**, Director, Engineering Division, Iowa Department of Transportation

**Sue McNeil**, Braun/Intertec Visiting Professor, University of Minnesota

**Steve T. Scalzo**, Senior Vice President, Operations, Foss Maritime Company

**Dale F. Stein** [NAE], President Emeritus, Michigan Technological University

**Michael S. Townes**, Executive Director, Transportation District Commission of Hampton Roads

## Attachment 2

### Detailed Assessment of Documents

#### Questions Guiding Assessment

To conduct its review, the committee began by assessing the R&D Plan with regard to the contents required for this plan in TEA-21 (Section 5108 “§508(c)(2)”). These required elements are as follows:

- (A) an identification of the general goals and objectives of the Department for surface transportation research and technology development;
- (B) a description of the roles of the Department and other Federal agencies in achieving the goals identified under subparagraph (A), in order to avoid unnecessary duplication of effort;
- (C) a description of the overall strategy of the Department, and the role of each of the operating administrations of the Department, in carrying out the plan over the next 5 years, including a description of procedures for coordination of the efforts of the operating administrations of the Department and other Federal agencies;
- (D) an assessment of how State and local research and technology development activities are contributing to the achievement of the goals identified under subparagraph (A);
- (E) details of the surface transportation research and technology development programs of the Department, including performance goals, resources needed to achieve those goals, and performance indicators as described in [GPRA – see Tab 1, Section 1115(a)], for the next 5 years for each area of research and technology development;
- (F) significant comments on the plan obtained from outside sources; and
- (G) responses to significant comments obtained from the National Research Council and other advisory bodies, and a description of any corrective actions taken pursuant to such comments.

The committee also developed additional questions derived from the requirements found in GPRA. These questions are as follows:

- 1) Do the Strategic Plan and Performance Plans include R&T as contributors to achieving strategic goals?
- 2) If so, is the R&T related to the goals and is the relationship clearly explained in the documents?
- 3) Does the Performance Report or the R&D Plan include:
  - a) A summary of results of previous fiscal years’ R&T?
  - b) An analysis of the relationship between R&T results and DOT’s strategic goals?
  - c) A description of the methodology used for assessing results?
  - d) A description of significant changes in the R&T undertaken compared with what was included in that year’s plan (planned R&T that was not performed and why, unplanned R&T that was performed and why)?
- 4) How are the following processes handled:
  - a) Gathering input from stakeholders and incorporating it into the plan and report
  - b) Mechanisms for coordination and cooperation among public and/or private entities
  - c) Tracking of progress on R&T activities

## Detailed Findings

The committee's detailed findings based on the TEA-21 requirements and the additional questions listed on the previous page are in italics below.

### **Conformity of the R&D Plan to the requirements specified in TEA-21, Section 5108 "§508(c)(2)":**

- (A) an identification of the general goals and objectives of the Department for surface transportation research and technology development

*The goals and objectives of the DOT Strategic Plan are stated in the R&D Plan. However, the "impact-based performance measures" stated in Chapter V of the R&D Plan differ from the performance goals in DOT's Strategic Plan and Performance Plans. For instance, in the area of safety, the R&D Plan includes reference to motorcycle-related fatalities and injuries and child occupant fatalities, which are not mentioned in DOT's performance goals. Conversely, the R&D Plan does not mention other DOT safety performance goals, such as those related to seat belt use and large-truck fatalities and injuries, or any of the safety performance measures in nonhighway modes.*

- (B) a description of the roles of the Department and other Federal agencies in achieving the goals identified under subparagraph (A), in order to avoid unnecessary duplication of effort

*The R&D Plan lists other (non-DOT) federal agencies involved with each of the partnership initiatives (Chapter III). A few specific interagency activities are mentioned in the descriptions of the initiatives. Under "Enabling Research" (Chapter IV) there are a few references to joint activities with other agencies, but there is no discussion of related research that is not under DOT sponsorship. There is no general discussion of the various missions of the different agencies, their (presumably) complementary responsibilities, the consequent differences in their roles in R&T, and the potential for interaction and synergy. Chapter II mentions the NSTC Subcommittee on Transportation R&D as a mechanism for coordinating federal transportation R&D; however, the only effort of this committee that is mentioned is the production of a strategic plan. It is not clear how actual coordination of federal activities is to take place.*

*Also, regarding roles, there is more focus on "technology" than on "research" (see p. 6 of the 2000 Performance Plan, for example), which is considered more the classic federal role. On the other hand, the distinction between the technology partnership initiatives and the enabling research is not well explained.*

- (C) a description of the overall strategy of the Department, and the role of each of the operating administrations of the Department, in carrying out the plan over the next 5 years, including a description of procedures for coordination of the efforts of the operating administrations of the Department and other Federal agencies

*DOT's overall strategy with respect to R&T mirrors the NSTC Strategy, the main elements of which are strategic planning, partnership initiatives, enabling research, and*

*training and education. It is not always clear from the GPRA documents or the R&D Plan, however, exactly how R&T supports the Department's strategic goals.*

*The efforts of the operating administrations are coordinated through DOT's Research and Technology Coordinating Council, which is mentioned in Chapter II. No further description of coordination procedures is offered. The operating administrations involved in each partnership initiative are listed under the initiative, and many of the research activities of the operating administrations are described under enabling research. There is no overall discussion of the roles of each administration over the next 5 years. (For instance, it would be appropriate to point out the primary role of FHWA, NHTSA, and FMCSA in reducing transportation fatalities, given that 94 percent of these fatalities are highway related. Other operating administrations may have stronger roles in supporting other strategic goal areas.)*

- (D) an assessment of how State and local research and technology development activities are contributing to the achievement of the goals identified under subparagraph (A)

*There is no discussion of state and local R&T activities in the document. Even under the section "Issues as Seen by the Stakeholders" there is no direct reference to state DOTs. Under "Paving the Way for R&D Implementation" there is a brief reference to "state, tribal, county, and city government agencies," but no acknowledgment of the role of these agencies as owners and operators of important parts of the transportation system, and therefore as critical partners in the conduct of research and the development and implementation of new technologies.*

- (E) details of the surface transportation research and technology development programs of the Department, including performance goals, resources needed to achieve those goals, and performance indicators as described in [GPRA – see Tab 1, Section 1115(a)], for the next 5 years for each area of research and technology development

*Chapter V, "Measuring Success," provides a general discussion of GPRA and performance measurement, but this discussion is not applied concretely to DOT's R&T programs. A list of impact-based performance measures is included in Table V-2, but these differ from the performance goals and indicators in the Department's Strategic Plan and Performance Plans. It may be necessary to establish intermediate goals for R&T activities, but it should be clear how accomplishment of these intermediate goals will bring the Department closer to achievement of its ultimate goals. The goals in the R&D Plan are not clearly associated with the specific R&T activities described in the plan; that is, it is not clear which enabling research or partnership initiatives are aimed at each performance goal and how they are expected to contribute to achieving that goal. There is no discussion of resource needs. The only reference to time frame appears to be the categorization of enabling research as near-term (5 years or less) or long-term (more than 5 years).*

- (F) significant comments on the plan obtained from outside sources

*Understandably, there are no comments from the NRC committee since the committee met for the first time in February 2000. However, there are also no comments from other outside sources.*

- (G) responses to significant comments obtained from the National Research Council and other advisory bodies, and a description of any corrective actions taken pursuant to such comments

*Again, it was not possible for responses to the NRC committee to be included, but if other outside sources were consulted, their comments should have received responses. If none were consulted, such consultation should take place before the next version of the plan is published.*

**Assessment of GPRA documents and the R&D Plan with respect to the committee-developed questions derived from the requirements found in GPRA:**

- 1) Do the Strategic Plan and Performance Plans include R&T as contributors to achieving strategic goals?

*The Strategic Plan and Performance Plans include R&T among the activities DOT will undertake to achieve its goals. In fact, R&T is identified as an overall management strategy for the Department. The 1999 Performance Plan presents additional R&T activities under each strategic goal area, categorizing them by mode. The 2000 Performance Plan aligns R&T more directly with performance goals under each strategic goal area. There is little mention of research in the 2001 Performance Plan. Many of the activities for 2001 are the same as or similar to those in the 1999 Performance Plan. There is no explanation of how the activities in each year differ.*

- 2) If so, is the R&T related to the goals and is the relationship clearly explained in the documents?

*The specific R&T activities in the Strategic Plan appear to be merely illustrative since they clearly do not represent all the R&T activities of the Department. It is not clear whether these examples are the most closely related to DOT's strategic goals.*

*The format used in the 2000 Performance Plan gives a better sense of how R&T supports the goals of the Department and appears to have led to a better categorization of the R&T activities. For instance, in the 1999 Performance Plan, the Partnership for a New Generation of Vehicles and testing of intelligent transportation systems (ITS)/commercial vehicle operator technologies at border crossings are categorized under highway safety. While these activities may have safety implications, they are more directly focused on the Human and Natural Environment and Economic Growth and Trade goals, respectively, which is where they are categorized in the 2000 Performance Plan.*

*The relationship between specific R&T activities and the performance goals is not explained in the Performance Plans; however, it is probably not reasonable to expect such explanation without these plans becoming overly long. A more detailed explanation of how R&T activities support DOT goals would more appropriately be included in the Department's R&D Plan.*

*In the R&D Plan, the descriptions of the partnership initiatives provide better explanations, in some cases, of the need for the technologies involved than is found in the Performance Plans. However, while the partnership initiatives are correlated with the strategic goals, they are not clearly linked to the performance goals, which focus on more specific outcomes. For instance, many of the partnership initiatives and enabling research efforts are directed toward "safety," but it is difficult to tell whether they are oriented strategically to address the issues and problems whose resolution offers the most promise for reducing specific kinds of fatalities and injuries. Therefore, the rationale for the R&T focus is not always clear.*

3) Does the Performance Report or the R&D Plan include:

a) A summary of results of previous fiscal years' R&T?

*Such a summary is not included in either document.*

b) An analysis of the relationship between R&T results and DOT's strategic goals?

*Since the results of R&T are not included in the plan, such an analysis is also not included.*

c) A description of the methodology used for assessing results?

*The R&D Plan addresses performance measurement somewhat theoretically, but does not apply it to specific R&T activities. The Strategic Plan (p. 64) indicates that DOT will measure the impact of R&T on transportation system performance through benchmarking efforts. This particular activity is not mentioned in the 1999 Performance Plan, although that plan does indicate that DOT will consider using International Organization for Standardization (ISO) 9000 certification and Malcolm Baldrige or President's Quality Award criteria to perform baseline assessments of the performance of DOT R&T facilities. The 2000 Performance Plan indicates that this baseline assessment will be completed in FY 2000. However, it appears that the criteria to be used had still not been chosen when the plan was written since the three mentioned above are still listed as possible criteria, and a fourth (Software Engineering Institute's Capability Maturity Model certification) is added. Also, it is not clear that an assessment of R&T facilities will encompass an assessment of R&T results. The reports do not assess the contributions of DOT R&T to the achievement of goals and performance measures relative to the contribution of other DOT actions and programs. Although not explicitly called for in TEA-21 or GPRA, DOT may wish to include this type of assessment in its benchmarking efforts.*

- d) A description of significant changes in the R&T undertaken compared with what was included in that year's plan (planned R&T that was not performed and why not, unplanned R&T that was performed and why)?

*This description does not appear to be provided in any of the documents.*

- 4) How are the following processes handled:

- a) Gathering input from stakeholders and incorporating it into the plan and report

*Answered under (F), above.*

- b) Mechanisms for coordination and cooperation among public and/or private entities

*Coordination among modal administrations is addressed under (C), above. Coordination among federal departments is addressed under (B), above. The R&D Plan also lists nonfederal entities that are (or could be) involved in particular partnership initiatives. Coordination with these entities is not discussed.*

- c) Tracking of progress on R&T activities

*There is no progress tracking in the R&D Plan. Since this is the first plan of its kind under the GPRA regime, it may be more reasonable to expect progress tracking in later versions of the document.*

### **Additional Specific Comments About R&D Plan**

In reviewing the R&D Plan, the committee identified some additional specific areas in which the plan could be improved. Some of these are matters of format, structure, or editing. Others refer more to the substance of the plan. Addressing these observations should help create a document that better reflects the transportation R&T enterprise and is more understandable to the reader.

#### **Chapter III: Partnership Initiatives and Technology Sharing**

- The partnership initiatives are ordered differently in the text and in the tables of Chapter III. This makes it somewhat difficult to compare the two.
- It might be clearer to list DOT programs (pp. III-33 to III-43) directly under the corresponding partnership initiatives (pp. III-3 to III-25) so that it would be easier to see how they are related.
- The Next Generation Vehicle initiative is referred to by different names in various parts of the document. Consistent use of one name would be clearer.

- Descriptions of partnership initiatives and how they are related to the strategic goals are not consistent. For instance, PNGV is included under Next Generation Surface and Marine Transportation Vehicles on page III-9 and under the Intelligent Vehicle Initiative on page III-34. Safety is indicated as a primary DOT strategic goal for the Monitoring, Maintenance, and Rapid Renewal of the Physical Infrastructure initiative, but does not figure significantly in the descriptions of this initiative on pages III-19 to III-20 and III-39 to III-41. Next Generation Global Air Transportation is said to support Mobility and Economic Growth and Trade on p. III-30, but the description of the initiative on p. III-35 suggests a significant contribution to Human and Natural Environment.

#### **Chapter IV: Enabling Research**

- The distinction between short-term and long-term in this chapter is interesting, but somewhat confusing. Much of the research characterized as long-term appears to be aimed at about the same time horizon as some of the partnership initiatives, which might be expected to be more short-term in nature. Where is the truly long-term, high-risk, “enabling” research being done?

#### **Chapter VI: Implementation Issues and Incentives**

- The discussion of “user stakeholder” issues generally emphasizes user obstacles to implementation, such as liability, economic, and privacy concerns. This section should also include the opportunities for implementation and the motivations users may have to support implementation.
- The chapter goes into some detail on implementation of a few specific technologies (free flight and ITS technologies). It might make more sense to include these discussions under the appropriate partnership initiatives or enabling research areas and reserve this chapter for analysis of overarching issues in the implementation of R&T, such as institutional, procurement, educational, and liability issues, which tend to arise in many technology areas.
- The section on “Paving the Way for R&D Implementation” focuses solely on procurement reform. Though this is a critical implementation issue to address, it is not the only one. Studies have identified various factors that appear to be associated with successful implementation of R&T. For example, implementation is more successful when users are involved with the research from the beginning (a good argument for partnerships) and when there are champions at different levels of an organization. This chapter could address some of these factors.

## Attachment 3

### DOT Strategic and Performance Goals for Safety

These goals are taken from the *U.S. Department of Transportation Performance Plan for Fiscal Year 2000*.

DOT has strategic goals in five areas:

- Safety
- Mobility
- Economic Growth and Trade
- Human and Natural Environment
- National Security

The strategic goal for safety is:

“Promote the public health and safety by working toward the elimination of transportation-related deaths, injuries, and property damage.”

The performance goals contributing to the achievement of the strategic goal for safety are:

*Highway Fatality and Injury Rates:* Reduce the rate of highway-related fatalities per 100 million vehicle miles traveled (VMT) from 1.7 in 1996 to 1.5 in 2000. Reduce the rate for injuries from 141 in 1996 to 124 per 100 million VMT in 2000.

*Alcohol-Related Highway Fatalities:* Reduce the percentage of highway fatalities that are alcohol-related to less than 35% in 2000, from a 1996 baseline of 40.9%.

*Seat Belt Use:* Increase seat belt usage nationwide to 85 percent by 2000 and 90 percent by 2005. Usage in 1997 was 69 percent.

*Large Truck-Related Fatality and Injury Rates:* Reduce the rate of fatalities involving large trucks per 100 million truck VMT from 2.8 in 1997 to 2.5 in 2000. Reduce the rate of injuries involving large trucks per 100 million truck VMT from 69.3 in 1997 to 64.4 in 2000.

*Air Carrier Fatal Accident Rate:* Reduce the fatal aviation accident rate for commercial air carriers from a 1994-1996 baseline of 0.037 fatal accident per 100,000 flight hours. The 2000 target is 0.033 per 100,000 – with the reduction to be achieved in 6 key areas outlined in the Safer Skies Agenda.

*General Aviation Fatal Accident Rate:* Reduce the general aviation fatal accident rate from a 1994-96 average of 1.67 per 100,000 flight hours to (specific target to be developed).

*Runway Incursions:* Reduce the number of runway incursions to a level 15% below a 1997 baseline of 318 incursions. The FY 2000 target is at or below 270 incursions.

*Operational Errors and Deviations (Air Traffic):* Reduce the rate of operational errors and deviations by 10% from the 1994 baselines of 0.54 errors and 0.11 deviations per 100,000 facility activities. The 2000 target rates are 0.486 for errors and 0.097 for deviations.

*Recreational Boating Fatalities:* Reduce recreational boating fatalities to 720 (or fewer) fatalities in 2000. The 1997 baseline is 819 fatalities.

*Maritime Search and Rescue:* Save at least 93% of all mariners, and at least 80% of all property, reported in imminent danger.

*Passenger Vessel Safety:* Reduce the number of high-risk passenger vessel casualties to 47 per 1000 vessels in 2000. The 1996 baseline is 48 per 1000.

*Rail Crash and Fatality Rates:* Reduce the rate of rail-related crashes from 3.91 per million train-miles in 1995 to 3.32 (or less) in 2000. Reduce the rate of rail-related fatalities from 1.71 per million train-miles in 1995 to 1.54 (or less) in 2000.

*Rail Grade-Crossing Crash Rate:* Reduce the rate of grade-crossing crashes from 2.85 per the product of (million train-miles times trillion highway VMT) in 1995 to 2.14 (or less) in 2000.

*Rail Trespasser Fatality Rate:* Reduce the rate of rail-related trespasser fatalities from 2.81 per the product of (million train-miles times billion US population) in 1995 to 2.53 (or less) in 2000.

*Transit Fatality and Injury Rates:* Reduce the transit fatality rate from 0.52 fatalities per 100 million passenger-miles-traveled in 1996 to 0.50 (or less) in 2000. Reduce the injury rate from 127 per 100 million passenger-miles-traveled in 1996 to 122 (or less) in 2000.

*Pipeline Failures:* Decrease the number of natural gas transmission pipeline failures from 4,933 in 1994 to 4,451 in 2000.

*Hazardous Material Incidents:* Reduce the number of serious hazardous materials incidents in transportation to 411 or fewer in 2000 from a peak of 464 in 1996.

## Attachment 4

### FRA R&D Project Development and Selection Process<sup>1</sup>

Currently, the FRA R&D program is developing a structured process to document the method by which FRA R&D management identifies research areas and selects specific R&D projects for funding. FRA R&D management currently uses such a process when identifying projects for funding and submitting budget requests. However, the current effort is intended to provide documentation of the process so it is visible to all FRA R&D stakeholders. FRA R&D is developing this structured approach with guidance from the Transportation Research Board (TRB) Committee for Review of the FRA R&D Program. Most recently, the FRA R&D presented the proposed approach to the TRB Committee during November 1999 and the Committee recommended the FRA R&D program employ the approach in FY 2002 budget submissions.

The structured approach for FRA R&D project development and selection is presented below. The approach consists of five logical steps which, initially, will be applied to the entire R&D program. Subsequently, as new information becomes available about sources of harm, the logical steps may be followed for specific types of harm to add to the list of potential R&D projects.

#### **Step 1: Review of Rail Industry Historical and Potential Harm**

The first step in the FRA R&D project development and selection process is a review of recent rail industry harm data and an estimation of causes of potential for harm. Historical harm data is compiled in FRA rail accident databases and accident investigation reports. Potential for future harm can be understood by reviewing rail industry operating trends with expert knowledge of how railroad accidents occur.

The four relevant databases which hold historical rail incident data are the FRA's Rail Accident/Incident Reporting System (RAIRS), Highway-Rail Grade Crossing Accident/Incident Database, Railroad Injury and Illness Summary Database, and RSPA's Hazardous Materials Incident Database. The information in these databases is very detailed in terms of circumstances that contribute to accidents. However, these databases, typically, do not address specific causes of the harm that results from railroad accidents or incidents.

Detailed accident reports from the NTSB and the FRA are the most important source of information, compiled by experts, about accident circumstances that contribute to harm. While detailed investigations are undertaken for relatively few railroad accidents, the most serious accidents, in terms of harm, have been intensively investigated and much can be learned through review of these reports.

Finally, since accident databases and accident reports can only reflect historical accident causes and circumstances, meaningful countermeasures to prevent harm must also address railroad

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<sup>1</sup> This material was provided by the Federal Railroad Administration Office of Research and Development.

industry operational trends. In this way countermeasures may be developed to address causes for harm that are not reflected in the historical databases.

### **Step 2: Conduct Failure Analysis**

For a given accident cause or factor contributing to harm, fault-tree logic is applied to identify specific items to be addressed by countermeasures. These specific items represent points along the accident chain-of-events at which the accident, or subsequent harm, or both, could have been prevented. Countermeasures are proposed with the goal of breaking the accident or harm chain-of-events at the points identified. These countermeasures are proposed with an understanding of current regulatory and industry practices for the relevant area of rail operations. Examples of types of countermeasures proposed include:

- Regulation
- Industry standards and best practices
- Equipment and infrastructure improvements
- Enforcement
- Education

### **Step 3: Survey Government and Industry Countermeasures and R&D Requirements**

Once specific countermeasures are identified, FRA R&D will review current and potential industry and government countermeasures to identify areas of opportunity for R&D. That is, FRA R&D will identify countermeasures that would be enabled by R&D. For example, a potential operating rule may need research into the train speed regimes at which a type of train control system affords safe operation.

### **Step 4: Develop and Rate Individual Projects**

For each countermeasure that may be aided by R&D, one or more R&D project summaries are developed to describe projects that provide information to enable the countermeasures. The project summaries are structured descriptions of projects that will be used to compare and select projects during R&D program development. Project summaries address expected outputs and outcomes, project costs and durations, as well as implementation issues for project results. Based on the project summaries, projects are then rated according to objective criteria for expected contribution to safety and likelihood of success. For a given program area, these project ratings are plotted in two-dimensions (likelihood of success versus contribution to safety) to provide a high-level comparison tool for the project selection process.

### **Step 5: Select Projects and Assign to Program Areas**

The last step in the FRA R&D program development process entails selecting projects for each program area based on the two-dimensional plots and project summaries. The goal is to select the best research opportunities available to obtain the best return on investment possible from the FRA R&D budget. That is, the most highly rated projects, regardless of program area, are selected until the desired overall funding request level is reached. Once the list of funded projects is completed, each project is assigned to one of the FRA R&D program areas. The FRA R&D budget request, for each program area, is the sum of the funding required for each of the selected projects in the program area.

# FROM HARM TO FRA R&D PROGRAM

