Research and Technology Coordinating Committee Letter Report: March 2012

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AUTHORS

TRB TRANSPORTATION RESEARCH BOARD
OF THE NATIONAL ACADEMIES

March 5, 2012

Victor Mendez
Administrator
Federal Highway Administration
1200 New Jersey Avenue, SE
Washington, DC 20590

Dear Mr. Mendez,

On December 15–16, 2011, the Research and Technology Coordinating Committee (RTCC) met with the Federal Highway Administration's (FHWA's) Research, Development, and Technology (RD&T) staff at the Keck Center in Washington, D.C. The roster of the committee, indicating members in attendance, appears in Attachment 1. For this meeting FHWA staff posed two broad questions on which they were seeking guidance: whether FHWA's RD&T program is (*a*) investing in the right things and (*b*) carrying out its program in the right ways. RTCC's charge is to monitor and review FHWA's research and technology activities and advise FHWA on (*a*) the setting of a research agenda and coordination of highway research with states, universities, and other partners; (*b*) strategies to accelerate the deployment and adoption of innovation; and (*c*) areas where research may be needed. RTCC's review includes the process of research agenda setting, stakeholder involvement, the conduct of research, peer review, and deployment. The committee's role is to provide strategic, policy-level advice on topical priorities, processes, and strategies to accelerate the adoption of innovation.

At FHWA's request, this letter addresses FHWA RD&T priority setting, program management, and performance measurement. The content of the letter was developed in closed-session deliberations and subsequent correspondence among the members. The letter was then subject to the National Research Council's peer-review process. The letter is organized as follows: the first section addresses FHWA RD&T priority setting, the second addresses program management topics raised at the meeting, and the third addresses performance measurement. In each of these sections, a brief overview of the corresponding FHWA presentation is provided, followed by RTCC commentary on the subject. The final section lists suggested follow-up items on which FHWA has requested RTCC guidance.

FHWA RD&T Priority Setting

Context

To set the stage for discussion about RD&T priority setting, Michael Trentacoste, Associate Administrator for RD&T, and Debra Elston, Director, Corporate Research, Technology, and

THE NATIONAL ACADEMIES
Advisers to the Nation on Science, Engineering, and Medicine

500 Fifth Street, NW
Washington, DC 20001

Phone (202) 334-2934
Fax (202) 334-2003
www.TRB.org

Innovation Management, explained that the absence of RD&T earmarks in the extensions of current authorizing legislation has provided FHWA with flexibility in choosing projects and allocating funding within the designated categories of the Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU). The Senate reauthorization bill, Moving Ahead for Progress in the 21st Century, provides FHWA with even more discretion within broad guidance laid out in the bill. The bill passed in the House of Representatives, the American Energy and Infrastructure Jobs Act of 2012, provides similar flexibility to FHWA. Both bills are free of research project earmarks. Thus, if these provisions are maintained in a final bill approved by Congress, FHWA could be resuming its role of setting priorities and allocating resources across what may be a substantial program for the first time in many years. The fixed shares of funding across infrastructure, safety, planning and environment, operations, and policy that have prevailed during SAFETEA-LU need not be continued. Thus, FHWA RD&T staff asked RTCC for guidance on research priorities and identification of possible gaps in its RD&T program. To aid the committee in its discussion, the R&D priority-setting process of the Office of Infrastructure was described as one example of how various FHWA offices determine what RD&T to invest in. This process is discussed next.

Infrastructure RD&T Strategic Planning

Peter Stephanos, Director, Office of Pavement Technology, described the Office of Infrastructure's comprehensive research and technology strategic planning and programming process, which aligns proposed research projects and deployment efforts with the office's strategic objectives. The process gathers input from technical staff throughout the office and provides information that office directors can use in setting priorities and allocating resources. Included within the process is the development of a strategic plan, research road maps,[1] detailed work plans, and a project reporting system for monitoring progress.

The committee is impressed by the comprehensive and systematic planning process followed by the Office of Infrastructure but sees room for improvement in one area. With regard to stakeholder input, individual Office of Infrastructure staff members have apparently consulted with stakeholders and have selected projects from comprehensive road maps developed by the pavement and concrete industries. [Stakeholders interested in FHWA's RD&T programs include state departments of transportation (DOTs), metropolitan planning organizations (MPOs), local governments, highway industry groups, and researchers, among others.] Mr. Stephanos acknowledged, however, that stakeholder engagement in the development of the plan has not been as systematic as it could have been. The sharing of FHWA research road maps and plans with the wider community is an important next step in opening up the RD&T planning process. As plans are refined and developed, an earlier and more systematic outreach process would be helpful in soliciting stakeholders' views on the issues they face and on their strategic goals for research. To develop buy-in for FHWA's program, this process needs to be transparent to external stakeholders.

Many staff members are involved in the development of the infrastructure research and technology strategic plan, road maps, and work plans, and external stakeholders are interested in these documents. Thus, communication of the extensive planning process to internal and external stakeholders is important and challenging. In this regard, FHWA will need a simplified,

[1] Research road maps are generally multiyear plans for research within a discrete area or subarea that lay out objectives, projects, benchmarks, timelines, and expected deliverables.

higher-level presentation of its research plans and related documents to external stakeholders. (RTCC understands that the Office of RD&T has engaged the Volpe National Transportation Systems Center to assist in the development of an accessible report.) Nevertheless, the documents will need to be sufficiently detailed to allow stakeholders to identify the strategic goals for R&D and the major initiatives being planned to meet those goals. Some stakeholders will also be interested in specific R&D projects; to the extent that they are defined, it may be necessary to include appendix material that lists proposed projects and the rationale for including them.

Two additional items are offered for FHWA's consideration with regard to priority setting. First, although a transparent and systematic process is needed for developing a research strategic plan and related implementation plans, the process should not become so elaborate that the cost and effort of engaging in the process begin to erode its benefits. Second, it will be helpful for FHWA to view the agency's investments in research as a portfolio, with the understanding that relatively few ideas explored through research, whether in government or in industry, ever mature into usable products. As with any portfolio of investments, the goal is to have enough investments pay off in ways that justify the entire effort.

Preliminary Plans for Allocating Resources to Deployment

On the assumption that a future authorization will specify an amount for deployment and give FHWA broader discretion over particular initiatives to pursue, Jack Jernigan, Team Director, Research and Technology Program Development and Partnership Team, shared FHWA staff's preliminary thinking about how resources would be devoted to deployment and technology transfer. The proposed strategy, which would distribute some funds to program offices by formula and award other specific funds to projects on the basis of merit, appeals to RTCC. As part of the process of determining merit, solicitation of the views of stakeholders and customers concerning the kinds of products they need and the support required to implement them would be important. The proposal to allocate some funds for further pilot testing and evaluation of promising products is also logical, since it is important to identify products for deployment that are truly "market-ready."

Additional RTCC Observations on Priority Setting

With regard to priority setting, FHWA's RD&T can be conceived of as a federal, rather than a national, highway research program. The federal program would be one that serves FHWA's goals and objectives; the national program would include highway research funded by other modal administrations, agencies, states, and universities. Clearly, FHWA must invest in some research to carry out its role as a mission agency. FHWA also has an important coordination role in the entire national program, including highway research carried out by other modal administrations. The distinction between federal and national, however, breaks down beyond FHWA's regulatory role because FHWA depends on others, primarily state DOTs, MPOs, counties, and cities, to implement innovations coming out of FHWA's R&D program. Thus, a substantial element of FHWA's program must be responsive to the needs of these stakeholders, and a major part of its deployment program must be devoted to delivering products that they need.

RTCC is pleased that FHWA recognizes the challenges it faces in allocating resources to its R&D and technology delivery programs. How much to invest in infrastructure as opposed to

safety, mobility, or any other functional area of FHWA RD&T is unclear. Any guidance that RTCC might offer would reflect the biases and the areas of expertise of the current members. The committee can, however, comment on the process that FHWA follows. Clearly, an important element of this process is early and regular engagement of stakeholders at the right levels.

CEOs, chief engineers, and heads of planning and operations of state DOTs are the appropriate audiences to engage with regard to what the strategic goals should be for FHWA RD&T. Similarly, transportation directors at MPOs could help inform FHWA's R&D strategic goals. Technical staff at DOTs and other organizations can also provide input, particularly on the potential payoffs from specific R&D initiatives. Most important is to understand what FHWA's customers would value. Similar engagement with private industry is also important; however, the kinds of RD&T identified need to be appropriate for the federal government.

If authorization passes in the next few months, FHWA may be handed substantially more discretion over RD&T resource allocation before it has fully developed its RD&T plans. If that occurs, it may be advisable to maintain some consistency, at least initially, with how resources have been allocated across infrastructure, operations, safety, planning and environment, and policy. Future shares of funding across functional areas can be driven by customer and stakeholder needs as they are better articulated and by decisions about specific research investments based on merit.

PROGRAM MANAGEMENT

To provide context for possible RTCC guidance on program management, FHWA staff briefed RTCC on the Every Day Counts (EDC) initiative and the Exploratory Advanced Research (EAR) Program.

Every Day Counts

Michael Trentacoste provided the committee with a status report on EDC, which RTCC views as a valuable technology deployment program. Mr. Trentacoste noted that success in implementing the initial round of market-ready technologies promoted in EDC has resulted in a broad-based agency solicitation of other innovations that are appropriate for a high-level effort to secure widespread adoption. RTCC acknowledges the benefits of soliciting suggestions about specific market-ready innovations. It would also be beneficial for FHWA to ask stakeholders about areas where they are most in need of assistance. A clearer focus on the problems that stakeholders are addressing would feed back to the R&D priority-setting process described above to inform the kinds of research that FHWA should invest in to yield useful products. RTCC was pleased to learn that FHWA's division offices have become involved in the delivery of EDC. Federal staff at the state level could also be used to gather input on what states, MPOs, and local governments need most with regard to future research and product development.

Exploratory Advanced Research

David Kuehn, Program Manager for the EAR Program, presented a status report to the committee, which is pleased with the program's progress. RTCC has long held the view that FHWA's special niche in highway research is to carry out investigations that are further

upstream, and therefore riskier, than the kinds of research carried out by the National Cooperative Highway Research Program and the states through their individual programs. Investing in riskier, long-term initiatives where the payoffs are the least certain but the benefits are potentially the largest is a role best filled by the federal government.

PERFORMANCE MEASUREMENT

FHWA staff asked for RTCC guidance on developing performance measures for its R&D and technology delivery efforts. As Michael Trentacoste and Jack Jernigan indicated, they are interested in advice about measures that would be appropriate at the initiative and program levels rather than at the project level. Many federal RD&T programs have developed program-level performance measures. Most of them are appropriate for basic research, which is the largest area of federal investment in science, engineering, and health care research. Whereas they would not be effective for FHWA's applied R&D, they could be informative for the EAR Program. Most of FHWA's R&D is applied, and for these efforts, performance measures can be more easily related to outputs and outcomes than can performance measures for basic research. The attached white paper prepared by Transportation Research Board staff identifies potential performance measures for applied research and criteria for selecting them (Attachment 2). With regard to criteria for selection, choosing measures that are meaningful to policy makers within the U.S. Department of Transportation, Congress, and key stakeholders is particularly important. Performance measures are useful in communicating program progress to those who allocate and influence the allocation of resources. R&D program managers themselves also have to be concerned about the technical merits of the initiatives they fund and whether the initiatives are being accomplished. On this point, the learning opportunities offered by projects that do not reach their anticipated goals can be valuable. Even research projects that fail to reject the null hypothesis can be meaningful. Program managers should evaluate RD&T results to gain from the lessons learned and improve their processes regardless of how individual projects turn out. Finally, as FHWA identifies possible measures, it would benefit from considering measures appropriate for each step of the innovation cycle, recognizing that different measures will be appropriate for different steps.

The committee would be pleased to assist FHWA staff in identifying appropriate performance measures. Among the important issues to be addressed are the difficulties of obtaining appropriate and reliable measures at an affordable cost; the general lack of careful evaluation of innovations introduced by highway agencies and MPOs; the challenges of evaluating the benefits of innovations, particularly long-lived assets; and incentives to choose measures that are readily obtained rather than those that would be most appropriate.

NEXT STEPS

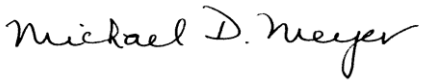
As planning begins for the next meeting, RTCC suggests the following topics for consideration:

- The committee would like learn more about how FHWA plans to carry out communicating its RD&T plans, both externally and internally.
- Once FHWA's road maps and program plans are posted online, the committee is interested in how FHWA will solicit stakeholder input and revise its plans.

- RTCC would benefit from hearing how other program offices within FHWA set priorities for RD&T.
- The committee would like to continue the discussion of FHWA's coordination role, both with the states and with other agencies funding highway research. The committee is particularly interested in how FHWA will communicate with the new university transportation centers concerning its overall national research agenda and strategy and how it plans to coordinate with them.
- RTCC would be pleased to continue to assist in performance measurement and welcomes the opportunity to comment on measures that the staff proposes to adopt.

On behalf of RTCC, I offer my thanks to Michael Trentacoste and his staff for excellent presentations that set the stage for a useful, productive discussion. I hope you find this letter to be similarly useful as the RD&T programs move forward.

Sincerely,



Michael D. Meyer, Chairman and Professor, Department of Civil and Environmental Engineering, and Director, Georgia Transportation Institute, Georgia Institute of Technology

Attachments

Participants, December 2011 Meeting

Staff White Paper on Identifying Potential Performance Measures for FHWA RD&T

Attachment 1

Research and Technology Coordinating Committee

(Members in attendance in bold)

Michael D. Meyer (Chair), Professor, Civil and Environmental Engineering, and Director, Georgia Transportation Institute, School of Civil and Environmental Engineering, Georgia Institute of Technology

Frances T. Banerjee, President, Banerjee and Associates, San Marino, California

Kevin Chesnik,* Principal Engineer, Applied Research Associates, Madison, Wisconsin

Timothy A. Henkel, Assistant Commissioner, Modal Planning and Program Management Division, Minnesota Department of Transportation

Wayne K. Kittelson, Principal, Kittelson & Associates, Inc., Portland, Oregon

Michael R. Morris, Director of Transportation, North Central Texas Council of Governments, Arlington, Texas

Daniel C. Murray, Vice President, Research, American Transportation Research Institute, Roseville, Minnesota

Ronaldo T. "Nick" Nicholson, Chief Engineer, District Department of Transportation, Washington, D.C.

Lawrence H. Orcutt,* Division Chief, Research and Innovation, California Department of Transportation, Sacramento

David Roessner, Senior Fellow, SRI International, Center for Science, Technology, and Economic Development, San Mateo, California

Robert L. Sack, Deputy Chief Engineer, New York State Department of Transportation

Kumares C. Sinha, Olson Distinguished Professor of Civil Engineering, Purdue University

James M. Winford, **Jr.,** President, Prairie Contractors, Inc., Opelousas, Louisiana

*Participated via teleconference.

Attachment 2

Identifying Potential Performance Measures for FHWA RD&T

FHWA has asked RTCC to assist it by helping the RD&T staff think through potential performance measures for the agency's RD&T. This paper is provided as background. The first section briefly reviews the general literature on performance measures for public R&D programs, and the second section reviews the literature on this topic as it applies to federal and state transportation RD&T programs. The third section identifies criteria that could be used to help identify and select R&D performance measures.

PERFORMANCE MEASURES FOR FEDERAL R&D PROGRAMS

Since the passage of the Government Performance and Results Act (GPRA) in 1993, considerable attention has been paid in Washington to assessing the impacts and outcomes of federal government programs, including R&D programs (Cozzens 1997). "GPRA requires all federal agencies to set measurable performance goals and report on whether they are meeting them. . . . These requirements add up to a simple prescription for agencies: set goals, choose indicators that will tell you whether you are meeting them, and report annually using those indicators" (Cozzens 1997).

GPRA has also influenced terminology, which has become fairly standard across the literature.

- "Inputs" are defined as governmental activities that are intended to produce benefits.
- "Outputs" are the immediate results of government efforts, which for R&D programs might include such things as published reports, workshops to share results, and activities supporting implementation of research results.
- "Outcomes" are the results of the activities, which in the case of applied R&D programs might be implementation of new knowledge that benefits society in some way. Outputs are typically measures of short-term impacts while outcomes typically measure longer-term benefits.
- "A *performance indicator* is a particular value or characteristic used to measure output or outcome" (Cozzens 1997). It is assumed that no single performance indicator will be adequate and that some combination of measures will be required to assess program performance appropriately.

In addition to GPRA's emphasis on outputs and outcomes, the Office of Management and Budget (OMB) has influenced evaluation of federal R&D programs by specifying three criteria by which R&D programs should be assessed: relevance, quality, and performance (see text box). The performance criterion links specifically to GPRA performance measures, but such measures can also be developed for relevance and quality (e.g., through customer satisfaction surveys).

OMB Criteria for Assessing Federal R&D (from OMB's Program Assessment Rating Tool Guidance)

I. **Relevance**

R&D investments must have clear plans; must be relevant to national priorities, agency missions, relevant fields, and "customer" needs; and must justify their claim on taxpayer resources.

II. **Quality**

Programs should maximize the quality of the R&D they fund through the use of a clearly stated, defensible method for awarding a significant majority of their funding. A customary method for promoting R&D quality is the use of a competitive, merit-based process. The National Science Foundation's process for the peer-reviewed, competitive award of its R&D grants is a good example.

III. **Performance**

R&D programs should maintain a set of high-priority, multiyear R&D objectives with annual performance outputs and milestones that show how one or more outcomes will be reached. Metrics should be defined not only to encourage individual program performance but also to promote, as appropriate, broader goals, such as innovation; cooperation; education; and dissemination of knowledge, applications, or tools. OMB encourages agencies to make the processes they use to satisfy GPRA consistent with the goals and metrics they use to satisfy these R&D criteria.

Development and implementation of performance indicators can be beneficial in several ways: they can demonstrate to the public that agencies are good stewards of tax dollars; facilitate dialogue with funders, performers, users, and others; focus managers' attention on the ultimate goals of public policy; and even help avoid being deflected by short-term "fads" (Olson and Merrill 2011). Performance indicators also have their limits: "returns to research are uncertain, long term, and circuitous," which makes it difficult to attribute outcomes to outputs; they depend on the efforts of others outside the federal government; they do not reflect the value that comes from research that results in a negative finding; and they can divert managers' attention from achieving long-term goals if they focus instead on narrower output measures (Olson and Merrill 2011, 9–10). The benefits of investments in R&D, particularly in basic and fundamental research, are broad and diffuse, and the ultimate payoffs are often difficult to ascertain. The immediate goal of basic research, after all, is to develop new knowledge and understanding, the benefits of which play out in myriad and unpredictable ways. As Einstein noted, "Not everything that counts can be counted and not everything that is counted counts." Applied research, however, has more immediate goals, such as developing a new product, service, or innovation, the impacts of which better lend themselves to measurement. Irwin Feller, a former member of RTCC and expert in R&D assessment, cautions, however, that it is particularly important to relate performance measures to what policy makers (administrators, OMB, Congress) want to know, since different questions asked by different policy makers

require different measures, and not all questions that policy makers ask about R&D investments can be answered by performance measures (Feller 2011).

PERFORMANCE MEASURES FOR TRANSPORTATION R&D PROGRAMS

Growing interest over the past decade in the use of performance measures has led to a small number of studies on developing and applying performance measures for surface transportation research programs (Sabol 2001; Krugler et al. 2006; Ksaibati and Redd 2009). This section provides a brief synopsis of the results of these efforts.

Sabol (2001) found that about half of the respondents to his survey of state DOTs (60 percent response rate) had some system of formal performance measurement in place for their RD&T units. Performance measures were in use for project management, postproject implementation, project selection, program benefits, staff productivity, and others (Sabol 2001, 17). Project management measures track adherence to schedule and budget. Postproject implementation measures, when used, typically depended on research administrators' judgment about implementation of research results. Project selection measures were being used in some states to estimate how well the program was selecting topics that proved useful to customers and stakeholders, either through subjective estimates of benefits relative to costs or by customer satisfaction surveys. Performance measures for program benefits were atypical but when applied were based on either estimated benefits of the R&D projects relative to their costs (with acknowledgment of the inherent uncertainty of these estimates) or customer satisfaction surveys. Performance measures for staff productivity tended to be based on the states' DOT-wide personnel evaluation, and some states openly acknowledged the difficulty of measuring the productivity of research administrators.

Sabol (2001) draws out a few lessons that state DOTs could apply in developing and applying performance measures for their RD&T programs.

- Measures should be directly tied to agency strategic goals, understandable to upper management, and cost-effective to collect.
- State peer-to-peer exchanges were already under way at that time and were found by RD&T managers to be constructive.
- State DOTs value human capital development as an output of their investments in research, and performance measures should attempt to capture this benefit.
- The greatest need in strengthening performance measures was in the area of program-level benefits. States tend to rely on some form of prospective benefit–cost assessment, and such measures are popular with upper management, but often these measures are based on subjective and speculative estimates of future benefits.
- Also in need of strengthening were measures of implementation, including whether research results were deemed implementable, whether they were implemented, and the extent to which they were implemented.

In 2006 the National Cooperative Highway Research Program released a web-only document that summarizes the results of a project to develop an online system to aid state DOT R&D managers in developing and reporting performance measures for research programs (Krugler et al. 2006). As part of this project, the research team and project panel developed a menu of performance measures from which managers could select, which are classified as outcome, output, resource allocation (portfolio management), efficiency, and stakeholder satisfaction. The entire list, along with the team's description of it, is contained in Appendix A. Some of these measures, or some variation of them, might be appropriate for use by FHWA.

One state DOT R&D program has reported on its efforts to select R&D performance measures (Ksaibati and Redd 2009). Apparently the DOT staff began with the menu of measures proposed by Krugler et al. (2006), which it narrowed to 11 measures through a series of workshops, presumably with program stakeholders. This list appears below.

Group 1—Strategic Portfolio Measures

1. Funding by strategic intent
2. Number of projects by strategic intent
3. Number of proposals responding to Wyoming DOT solicitation (based on research agenda)
4. Number of needs statements submitted by programs

Group 2—Project Output Measures

1. Results of a project and its impact:
   - Specifications revised
   - New methodologies implemented
   - Dollars saved/costs avoided
   - Facilities with extended life
   - Crashes reduced
   - Fatalities reduced
   - New products evaluated and implemented
   - Policy and legislative impacts

2. Number of research reports completed each year and number of research reports not completed within 3 years

Group 3—Program Efficiency and Management Measures

1. Cost–benefit analysis for individual projects
2. Cost–benefit analysis for overall program
3. Percentage of administrative costs to overall program funding
4. Funds requested by research community versus funds available
5. Percentage of projects completed on time and within budget (internal tracking only)

Whereas they appear to be a reasonable set of measures, outputs such as crashes and fatalities reduced appear to require subjective judgment of research managers unless a formal evaluation following implementation was undertaken to provide more rigorous estimates. Similarly, the

benefit–cost analyses would be subject to the concerns about validity raised by Sabol (2001) and summarized above.

CRITERIA FOR SELECTING PERFORMANCE MEASURES

Selection of performance measures would be aided by clear criteria concerning the purpose and intent of collecting necessary data. A recent report of the U.S. Environmental Protection Agency's Office of Inspector General (2010) compiled a list of criteria for evaluating performance measures. This list (U.S. Environmental Protection Agency 2010, Appendix B), which was drawn from a variety of publications, is replicated below, in part and slightly rearranged from the original, on the basis of elements that appear appropriate for FHWA. One caveat: these criteria appear to be appropriate for application to a whole set of performance measures selected by an R&D agency, since presumably no single performance measure could satisfy every criterion.

1. **Well-Defined**
   a. Is the measure clear, focused, and unambiguous?
   b. Does the measure duplicate information provided by another measure?
   c. Are data sources and specific requirements identified?
   d. Are any computations for the measure clearly specified?

2. **Measurable, Quantifiable, and Comparable**
   a. Is it objectively measurable?
   b. Does the measure allow for comparison over time, or with other organizations, activities, or standards?

3. **Feasible**
   a. Does the measure fit into the organization's resource constraints (i.e., budget, expertise, etc.)?
   b. Is the measure cost-effective to collect?

4. **Consideration of External Stakeholder Requirements**
   a. Are the interests and expectations of external customers reflected in the measure?

5. **Meaningful to Internal Stakeholders**
   a. Can management actions influence the results of the measure?
   b. Is the measure perceived as valuable by the organization?

6. **Logical Design**
   a. Is the measure clearly attributable to specific program activities?

7. **Functional**
   a. Does the measure encourage the right kind of behavior (i.e., does the measure align behavior with the program's strategy and organizational priorities)?

b. Is the measure vulnerable to producing unintended consequences?
c. Are the data timely enough for evaluating program performance?

8. Reliable

a. Are the data for the measure susceptible to biases, exaggerations, omissions, or errors that are likely to make the measure inaccurate or misleading?
b. Are data samples for the measure, if required, large enough to yield reliable estimates within acceptable confidence limits?
c. For survey data, have the survey questions and survey methodology been prepared, or at least reviewed, by professionals with demonstrated survey research qualifications?

9. Connection with Program Goals and Objectives

a. Is the measure clearly linked to the program's goals and objectives?
b. Does the measure provide a clear basis for measuring progress toward objectives and strategic goals?

CONCLUSION

Assuming FHWA tasks the committee further with assisting it in identifying and selecting performance measures, the first logical step would be to follow Irwin Feller's advice and identify performance measures that would help program managers answer questions being asked by the various policy makers to which FHWA must respond (the administration, the Secretary of Transportation, Congress). Presumably they would be outcome measures aligned with administration, departmental, agency, and congressional strategic goals. The next step could be to determine how well the menu of performance measures identified in Appendix A, supplemented or amended as appropriate, would stand up to the application of the criteria identified above.

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APPENDIX A

Potential Transportation Research Performance Measures

[Source: Krugler, P., M. N. Walden, B. Hoover, Y. D. Lin, and S. Tucker. 2006. *NCHRP Web-Only Document 127: Performance Measurement Tool Box and Reporting System for Research Programs and Projects*. Transportation Research Board of the National Academies, Washington, D.C., Table 3, pp. 14–17.]

Outcome Measurements

1 Dollars Saved

Estimated present value dollar savings in the cost of contract work, cost of agency-purchased materials, and cost of employee labor made possible by research products. A core justification for research budgets. Very important to agency administrators and all funding appropriators.

2 Lives Saved

Projected number of lives to be saved based on the number of fatalities associated with the problem prior to the product implementation and the estimated or determined effectiveness of the research products. A core justification for research budgets. Very important to both agency personnel and all elected officials.

3 Crashes Avoided

Estimated reduction in number of crashes based on the number of crashes associated with the problem prior to the research product's implementation and the estimated or determined effectiveness of the product. A core justification for research budgets. Very important to both agency personnel and all elected officials.

Output Measurements

4 Technical Products

Number of research products improving design processes, specifications, or technical standards or practices. Each product will either be a technical product, a management product, or a knowledge product. This is a general measure of the impact of the research program on the agency.

5 Management Products

Number of research products improving the agency's management procedures, policies, and non-technical training. Each product will either be a technical product, a management product, or a knowledge product. This is a general measure of the impact of the research program on the agency.

6 Knowledge Products

Number of research products improving basic knowledge or understanding in the subject area without creating a specific technical or management product. These are the products of basic research projects. This measure may be used to establish or maintain the desired level of basic research being funded by the agency.

7 Environmental Products

Number of research products improving or protecting the natural environment. Very important, and can be of primary importance to some state and federal appropriators and others.

8 Congestion Mitigating Products

Number of research products reducing or eliminating traffic congestion and other transportation system delays. Very important to the general public and all elected officials.

9 Traveler Comfort Products

Number of research products improving the physical or psychological comfort of the traveler or enhancing the aesthetic quality of the system or improving system security (safety products not included unless traveler comfort or well-being is improved in non-crash situations). Believed to be one of the most important factors to the traveling public.

10 Quality of Life Products

Number of research products improving quality of life, which is defined as the total of those product types meeting the criteria for Environmental Products, Congestion Mitigating Products, or Traveler Comfort Products. Important to the traveling public, the most important transportation agency customer.

11 Safety Products

Number of research products improving design methodologies, traffic management, roadside safety devices, and any other innovation or enhancement for the transportation system which improves safety for anyone on or near the transportation system. Safety is always a top priority. This is an indirect measure of the number of lives saved and reduced crashes made possible by the research program.

12 Cost-Saving Products

Number of research products reducing the cost of contract work, cost of agency-purchased materials, and cost of employee labor. This is an indirect measure of the amount of cost savings being obtained for the agency by the research project or program.

13 Research Reports

Number of published research reports and other technical publications emanating from completed research projects during the evaluation year. This measure combines two measures

currently used by agencies: "Number of Papers Written as a Result of Program" and "Number of Research Reports Completed per Year."

14 Graduate Students

Total number of graduate students financially supported or otherwise involved in transportation research. The value of the training given to future transportation professionals has been generally understated in the past.

Resource Allocation Measurements

15 Dollar-Saving Projects

Number of research projects pursuing lowered cost to provide the transportation system. This measure monitors funding balance in the research program and the extent to which agency cost savings are being pursued.

16 Safety Projects

Number of research projects pursuing safety enhancements. This measure monitors funding balance in the research program and the extent to which improved transportation safety is being pursued.

17 Quality of Life Projects

Number of research projects pursuing improved quality of life. This measure will be obtained by adding the number of projects including environmental products, traveler comfort products, and traffic congestion mitigating products.

18 Total Contractors

Number of unique entities with research projects that were active for any length of time during the evaluation period.

19 Minority Contractors

Percentage of total research program contract budget that is awarded to minority universities, as defined by the U.S. Department of Education and applicable federal regulations. A federal requirement, reported at least annually.

20 In-House Percentage

Percentage of the total funding for research projects being performed by agency personnel. This can be an indicator of growing or declining in-house technical strength.

Efficiency Measurements

21 Benefit–Cost Ratio

Total present value dollar savings associated with the project(s) compared to either the total present value cost of the project(s) plus implementation effort(s) or to the total present value cost of the fiscal year research program plus related implementation efforts. A key efficiency measurement for state and federal budget appropriators.

22 Percentage Administrative Costs

Dollar value of program overhead expenses divided by the total program cost. An internal efficiency measurement.

23 Percentage Requests Funded

Number of projects funded divided by number of projects requested. A lowering trend indicates probable need for additional research funding.

24 Percentage Projects Implemented

Number of projects with at least one product implemented (completely or partially implemented) divided by total number of projects completed during the evaluation period. An indicator of quality in the project selection process and research project execution.

25 Percentage Projects on Time

Number of projects completed on/before the scheduled completion date divided by total number of projects to have been completed during the evaluation period. This target should probably be around 80 percent due to the nature of research. A lower percentage can indicate generally poor contractor efforts in creating proposal work schedules.

26 Percentage Projects within Budget

Number of projects completed within budget divided by total number of projects completed during the evaluation period. This target should probably be around 80 percent due to the nature of research. A lower percentage can indicate generally poor contractor efforts in creating proposal budget estimates.

27 Percentage Projects with Reports

Number of projects completed during the evaluation period (FY one year prior) for which all research reports have been submitted within one year of project completion divided by the total number of projects completed during the evaluation period. This is a challenging area for most research programs. Monitoring performance and having a target can be used as a tool for the research manager to encourage or require improved contractor performance.

Stakeholder Measurements

28 Customer Satisfaction

Number of customers reporting satisfied or very satisfied on survey divided by total number of customers surveyed.

29 Agency Participation

Number of agency personnel involved in the program overseeing projects, serving on committees, assisting in project selection, etc. Most research programs need the participation of large numbers of agency personnel from outside of the research office. There are a number of benefits to the agency derived from this participation. This number should be provided to agency administrators.

30 Project Needs Statements

Number of project needs statements submitted by internal customers. This is a key indicator to research program managers for several reasons, particularly in that it shows the degree to which agency personnel understand that research provides solutions to everyday problems.