



July 9, 2013

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

Dear Mr. Mendez:

On April 15 and 16, 2013, the Research and Technology Coordinating Committee (RTCC) met with the Federal Highway Administration's (FHWA's) Research, Development, and Technology (RD&T) staff. The meeting on April 15 was held at the Turner–Fairbank Highway Research Center in McLean, Virginia, and the meeting on April 16 was held at the Keck Center in Washington, D.C. The roster of the committee, which indicates the members in attendance, is included in Attachment 1. 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 for accelerating the deployment and adoption of innovation; and (c) areas in which research may be needed. At this meeting, FHWA staff sought guidance on their use of performance measures¹ for their research portfolios, evaluation of research programs, and coordination of highway research. These performance measures are an integral part of creating and coordinating a successful research plan.

The committee developed the content of this letter report in closed-session deliberations and subsequent correspondence. The letter report was then subject to the National Research Council's peer-review process. The first section of the letter report summarizes the presentations made by FHWA staff regarding a proposed approach to performance measurement and evaluation of RD&T programs and a presentation made regarding a possible mechanism for informing stakeholders and improving coordination with FHWA's RD&T. The second section addresses the committee's general thoughts on FHWA's performance management process, and the third provides the committee's recommendations.

The assessment and recommendations of this report represent the committee's best collective judgment on the basis of the information provided and discussed at the meeting. I would like to thank the invited guests, presenters, and FHWA staff for the productive presentations and subsequent discussions that informed the development of this report.

¹ As defined by FHWA (http://ops.fhwa.dot.gov/perf_measurement/fundamentals/), performance measures are statistical evidence to determine progress toward specific defined organizational objectives. This includes both evidence of actual fact, such as measurement of pavement surface smoothness, and measurement of customer perception such as would be accomplished through a customer satisfaction survey.

BACKGROUND AND FHWA PRESENTATIONS

FHWA has a unique set of customers because of the federal structure of the national highway program and the strong role of the public sector in highway transportation. States, counties, cities, toll operators, and public-private ventures own and operate the highway system. Congress chose long ago to provide research funds for the state departments of transportation instead of funding a single, central federal research laboratory. As a result, the highway research enterprise is highly decentralized. FHWA's role also has implications for RD&T strategic planning because so much of the FHWA portfolio is responsive to the needs of other levels of government with regard to designing, building, maintaining, and operating highways, rather than simply supportive of federal policy and regulation.

FHWA staff described for the committee the current state of performance management in FHWA's RD&T program. The agency proposes using a portfolio management approach; portfolios are based on national highway challenges and include projects directed at addressing those challenges. For example, the portfolio on Advancing Highway Safety contains research projects on reducing intersection crashes, roadway departures, and speed-related crashes, among other topics. Each portfolio has its own performance measures, which are connected to the RD&T life cycle.² These measures consider the available resources, the customers and partners, and the short-, intermediate-, and long-term outcomes of each portfolio. FHWA staff acknowledged that the outcomes of FHWA's RD&T are often under the direct control of entities outside the research program and are influenced by the broader socioeconomic climate and other outside forces. However, measuring outcomes is critical to determining whether the portfolio is successful. Additionally, FHWA and other U.S.DOT agencies face pressure from the Office of Management and Budget, along with regular reporting requirements under the Government Performance and Results Act.

Performance management would be organized under a balanced scorecard approach, which incorporates the mission of the project; the perspectives of stakeholders, customers, and internal actors; and the value of the learning and growth that result from each project. FHWA proposes to use this strategy to assess all of its portfolios, particularly as they connect to specified national highway challenges and trends.

FHWA staff provided the committee with a description of FHWA's proposed research coordination website. The website would describe the RD&T program and explain how each research portfolio aligns with FHWA's strategic objectives. The portfolios would also be displayed by traditional topic areas such as infrastructure, safety, and operations. Within each topic area, the site would describe each portfolio, the portfolio's objectives, and current projects addressing each objective. The site is intended to improve the accessibility of the RD&T portfolios to all stakeholders and also provide a mechanism for stakeholder input.

COMMITTEE OBSERVATIONS

The committee commends the FHWA staff for voluntarily undertaking a significant effort to develop a performance-based approach to managing RD&T and an evaluation framework for

² The RD&T life cycle, as defined by FHWA staff, includes five phases: (1) problem definition, (2) exploratory and applied research, (3) product development and testing, (4) deployment support, and (5) impact evaluation.

assessing the benefits of the FHWA RD&T program. These are important and challenging tasks that require the efforts of FHWA's talented staff with the skills to develop a robust system. The committee also appreciates FHWA's endeavors to address issues that the committee has raised in previous letter reports.

Regarding the presentation on an overall framework for performance management and program evaluation, FHWA staff appear to be trying to incorporate and integrate too many alternative methodologies relating to both performance management and program evaluation into one approach. For example, staff have proposed using the balanced scorecard technique, a program evaluation and return on investment (ROI) estimates methodology, and performance measurement assessment. The approaches taken, data requirements, and cost of implementation of performance management differ markedly from those of program evaluation. A key first step in any of the three approaches proposed by staff is identifying various audiences—including Congress, the Office of Management and Budget, administration officials, and other stakeholders—and understanding the nature of the questions these audiences are asking. Questions about research program quality, relevance, and performance can be addressed through performance metrics such as research quality, relevance to user needs, and portfolio risk balance. Questions about impact require some form of evaluation linking research investments to measures of outcomes related to the agency's RD&T objectives.

FHWA staff indicated that some stakeholders are particularly interested in knowing the benefits achieved by the RD&T program. The return on research investment at the program level is very difficult to measure objectively, but measuring success in deployment is a relatively straightforward process. Therefore, even though deployment is only an intermediate step on the path to final impact, evaluation of select project deployments may provide the kind of evidence needed to assure policy makers that the research program is on the right track.

PREVIOUS PROGRAM EVALUATION ADVICE

In past years, FHWA staff have employed outside advisors to assist in the development of program evaluation frameworks. Rosalie Ruegg, a program evaluation specialist with TIA Consulting, joined the RTCC committee and FHWA staff at the committee's meeting in June 2011.³

In distinguishing between project evaluation and program evaluation, Ruegg described an approach that begins with specific case studies and flows upward to an overall portfolio analysis (see the attached slide titled "Multi-Tier Approach to Bridge from Project Case Study to Portfolio Analysis"). Her presentation provided some clarification on the relationship between an overall RD&T logic model and the phasing and measuring of the impact of RD&T at different stages. The committee believes FHWA staff would benefit from a review of the structure described in the attached presentation when considering the overall structure of the program evaluation framework.

Ruegg's presentation described many issues that the committee discussed again in its April 2013 meeting. She emphasized the importance of having a clear purpose for an evaluation, noting that different audiences require different frequencies of reporting as well as different types and levels of

³ The title of Ruegg's presentation was "Development and Technology Evaluation." A selection of the slides from her presentation is given in Attachment 2.

information and methods for developing that information. She also discussed the importance of clearly distinguishing internal and external audiences when designing program evaluations. Committee members made many of the same points at this most recent meeting. Drawing both on Ruegg's 2011 presentation and the discussion at the April 2013 meeting, the committee has developed the following recommendations.

RECOMMENDATIONS

The committee offers recommendations in two areas: (a) performance measures and program evaluation and (b) coordination with the many stakeholders in FHWA's research program. Details on both of these recommendations follow.

Performance Measures

The topic of performance measures is a broad one, and there are multiple appropriate levels on which to measure performance. External performance measures are intended for a broad audience, are straightforward, and range across multiple research areas; these measures show the overall importance to stakeholders of the research conducted. Internal performance measures are much more numerous and detailed; these measures provide the research organization with a means of tracking its progress and improving its processes. For both types of performance measures, staff must use good judgment to ensure that the measures chosen are reliable, valid, cost-effective, and policy relevant. Program evaluation is a series of techniques that can feed into both external and internal performance measures and that allow a research organization to have a better understanding of the effects of its own work. The four purposes of program evaluation are (1) an assessment of merit and work; (2) program and organizational improvement; (3) oversight and compliance; and (4) knowledge development, all of which are of significant importance to FHWA.⁴

External Performance Measures

External performance measures are not the final product of a research program; rather, they are a means of telling the story of the effectiveness of research to the outside world. The initial step in developing a series of external program measures is determining the audience for this story and the information needs of that audience. For example, Congress, as the funding source, may want to know that the money is being well spent, while OMB will be focused on quality, relevance, and performance. U.S. Department of Transportation (DOT) officials may be concerned about both program impact and the efficiency with which the program is managed. Other research organizations, including state DOTs, will want to understand their connection to the federal research program and its potential impact on their state's design, construction, maintenance, and operations practices. Once the appropriate audiences have been determined, FHWA can design methods for developing the information each audience will need.

Therefore, **FHWA should first clearly define its audiences; next, it should select a small number (less than 10) of cross-cutting performance measures that are appropriate for all of its research efforts.** An example of one such performance measure could be the level of risk to the stakeholders of the innovation. Outside audiences are not likely to be concerned about which

⁴ Mark, M.M., G.T. Henry, and G. Julnes. Evaluation: An Integrated Framework for Understanding, Guiding, and Improving Policies and Programs. Jossey-Bass: San Francisco. 2000.

research lab originated the data or about the many layers of detail behind a final measure. Congress, for example, may benefit most from a very small but clear set of performance measures that measure program outputs and impacts at an aggregate level. FHWA maintains several portfolios, including Enhancing System Performance and Maintaining Infrastructure Integrity; each of these portfolios has multiple goals. External performance measures at the portfolio level may be too disaggregated to serve the needs of Congress, but may be useful to OMB and U.S. DOT officials.

FHWA should more fully exploit its ability to measure the states' level of deployment of FHWA and SHRP 2 RD&T, which is potentially one of the most effective intermediate measures of the agency's RD&T. Most current measures include the number of states that are using a new technique or innovation, but this measure is not a particularly useful gauge of effectiveness. With this measure, techniques that states have deployed once in a remote location are equated with techniques that have been used widely and successfully in another state. The committee recognizes that FHWA, like other federal agencies, is limited in its ability to survey its stakeholders. To develop better measures of deployment, FHWA could enlist the states or the American Association of State Highway and Transportation Officials (AASHTO), or both, to help determine how extensively innovations are being adopted.⁵ The committee recognizes that state DOTs already face significant reporting burdens and may need incentives to report another category of information. FHWA may also enlist its own division offices to collect and report on state activities with respect to federal research.

Research conducted at FHWA laboratories is proving to be valuable beyond the deployment of specific products or processes. For example, the hydraulics lab at the Turner–Fairbank Highway Research Center is conducting research that is feeding straight into the development of specifications by AASHTO committees. In other cases, outside parties are taking elements of the research products and creating new ideas, techniques, or devices that states and private industry find useful. With current performance measures, these types of outside impacts are lost, as there is no mechanism for tracking them. **FHWA should examine how it might track how its research is being used by all outside audiences, even those that are unexpected, and include these impacts when measuring the performance of its RD&T program.**

Finally, **FHWA should develop measures of relevance and quality for external audiences.** Input from outside audiences will help FHWA understand the needs and desires of those most affected by its research efforts; as states are the users and implementers of federal research, they are a key audience. Many consultants specialize in managing focus groups for this purpose, and FHWA may be able to enlist the assistance of various professional and organizational associations. Identifying the needs of the states, other highway owners, and other audiences, and then basing the federal program on those needs, will entice these audiences to become more involved in the federal research program.

Internal Performance Measures

The role of performance measures intended for an internal audience is very different from the role of those intended for external audiences. External measures are limited in number and aggregate in

⁵ The distinction between the number of adopting units and the extent to which each adopter uses the innovation can be found in early diffusion literature.

nature and thus provide stakeholders and interested parties with information about the output and effectiveness of the entire program. Internal measures ensure that programs and processes are being established and managed efficiently; these measures provide milestones throughout R&D projects and clear descriptions of the responsible personnel at each stage. Unlike broad external performance measures, internal performance measures can be specific to research portfolios. **The managers of each portfolio should be involved in the creation of internal performance measures, as these managers will be directly involved in keeping each program on time, on budget, and on task.**

Program Evaluation

FHWA should take advantage of existing expertise in the field of research performance management and program evaluation. This field is relatively small, but FHWA staff know and have worked with relevant specialists. **FHWA should continue to enlist the assistance of such qualified experts.** In addition, other federal research programs have put a great deal of effort into evaluating their own performance, and FHWA can learn from their experience.

One particular example of a federal program with a strong evaluation framework in place is the Mind–Body Interactions and Health Program of the National Institutes of Health (NIH). Although this program obviously addresses a topic very different from FHWA research, it is similar in size and structure to FHWA’s research program.⁶ The NIH program, which uses the Payback Framework to evaluate the outcomes of research centers and research projects funded over a 10-year period, would be a strong starting point for FHWA’s own analysis. More information about NIH’s implementation of the Payback Framework can be found in a 2011 paper by Scott and colleagues.⁷

When developing a program evaluation framework, managers are routinely faced with how to measure ROI, and, indeed, this measure is popular with agency officials and state DOT research managers. As noted, measuring the return on investment in research is difficult; for projects that result in new knowledge rather than a product or process, this kind of measurement is nearly impossible.⁸ **To best understand how to approach measures of ROI, FHWA should start with pilot tests on clear and specific projects.** FHWA staff made presentations on the effects of roundabout research to the committee; this concrete example could inform other pilots. There is even a role for developing estimates of potential ROI or the cost–benefit potential of products that are already in development. For example, even though roundabouts were already in use in Europe before their success was documented in the United States, and some states were already starting to implement modern roundabouts before FHWA began its unifying and standardizing efforts, FHWA’s efforts appear to have persuaded additional states to begin using them. In another example, FHWA’s Operations R&D program estimated through demonstration efforts the potential benefit–cost ratio of Adaptive Control Systems (ACS) Lite, a technology for improving the

⁶ The Advanced Technology Program at the National Institute of Standards and Technology (NIST), which may be the most rigorously and extensively evaluated federal research program ever, also uses the Payback Framework, but NIST’s research program is not comparable to FHWA’s.

⁷ J. E. Scott, M. Blasinsky, M. Dufour, R. J. Mandal, and G. S. Philogene. An Evaluation of the Mind–Body Interactions and Health Program: Assessing the Impact of an NIH Program Using the Payback Framework. *Research Evaluation*, Vol. 20, No. 3, 2011, pp. 185–192.

⁸ Further discussion of this issue can be found in *Measuring the Impacts of Federal Investments in Research: A Workshop Summary*. National Research Council of the National Academies, Washington, D.C., 2011.

performance of traffic signals—and thus arterial roadways—before it was deployed.⁹ In addition, **FHWA should build into its research program a category of research project funding for evaluating specific RD&T initiatives and portfolios, both to estimate anticipated benefits and to evaluate select examples after the fact to determine the longer-term impact.**

Despite the emphasis on the quantitative impacts and effects of research, it is important to acknowledge that good quality research can occur without producing quantifiable benefits. Many research projects result in knowledge, which itself is valuable, even though it is difficult to measure. Even projects that do provide quantifiable benefits may not realize those benefits until long after the project's completion, when the innovation has begun to have a significant effect on highway management practices or travel behavior. Moreover, not every project pays off, but if projects are carefully considered and designed well, every project may aid in advancing the state of practice, even if the new knowledge is only with regard to techniques or innovations that do not work. It is important, however, for any research organization to explain the value of learning from unsuccessful RD&T projects.

Coordination

FHWA expressed the goal of improving coordination with other highway research agencies, stakeholders, and interested parties. FHWA has systems in place to coordinate with its main customers—the state DOTs—both through involvement in the National Cooperative Highway Research Program and through field office outreach to state planning and research programs. The agency also uses periodical publications to disseminate research results and to enhance external communications. However, FHWA lacks a systematic process that would allow states, metropolitan planning organizations (MPOs), and other highway organizations to be more aware of the federal program and to influence it.

The proposed RD&T website is a step in the right direction; it would be beneficial to have a single place where the different FHWA RD&T portfolios were accessible and clearly explained. FHWA might strengthen the proposed website by using it to develop partnerships with others who are addressing similar problems and by inviting and hosting dialogue with practitioners and researchers who are trying to solve particular problems being addressed by FHWA's research. FHWA has developed many research roadmaps on various topics, and providing links to these roadmaps, RD&T plans, and similar documents for related research programs outside FHWA could be helpful. FHWA could also link to other modal research programs to allow for greater cross-modal coordination. However, **no website is a substitute for face-to-face interaction through meetings of stakeholder associations and committees. Through such meetings, FHWA should work to inform and involve state, county, and city DOTs; MPOs; and other highway owners early in its agenda-setting process.** Working with state DOTs and other organizations seeking to know more about research opportunities would help the FHWA division offices strengthen ties with these organizations. If FHWA builds a research agenda around solving the problems experienced by the main implementers of its products, it will have more support and customers willing to implement the products produced. The success of the SHRP 2 partnership is a model in this regard.

⁹ *Special Report 295: The Federal Investment in Highway Research 2006–2009: Strengths and Weaknesses.* Transportation Research Board of the National Academies, Washington, D.C., 2008.

Coordination with University Transportation Centers (UTCs) is more challenging than coordination with state DOTs. States have more direct influence on UTCs than does the federal research program because many states provide matching funds. FHWA may consider using its research coordination website to communicate with UTCs about the kind of work the agency is undertaking and to invite collaboration on those projects.

Communicating the FHWA research program to the wider world is essential. The research coordination website is a good start, but it is not a complete strategy. **Research program managers should be communicating with customers in settings where they naturally gather together, including association and Transportation Research Board (TRB) meetings. In addition, researchers should be publishing and presenting results in appropriate forums, such as TRB's annual meeting and specialty conferences.**

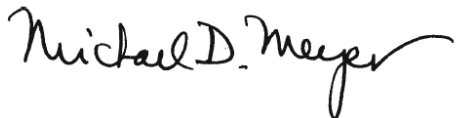
CONCLUSION

The committee very much appreciated the opportunity to tour several of the labs at the Turner–Fairbank Highway Research Center as part of the April 2013 meeting and enjoyed interacting with staff actively conducting research. From the hydraulics lab to the driving simulator, the lab facilities impressed the committee members, who found these facilities noticeably improved since the committee's previous tour.

The committee also acknowledges FHWA's efforts to collaborate with others conducting highway research, both in the United States and abroad. In particular, FHWA's 2009 entrance into the Forum of European National Highway Research Laboratories has facilitated collaboration with more than 30 international highway research centers. This collaboration may lead to more efficient outputs through leveraging resources, learning from partners' achievements, and avoiding duplicative efforts.

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 useful as the RD&T programs and performance management process moves forward.

Sincerely,

A handwritten signature in black ink that reads "Michael D. Meyer". The signature is written in a cursive, flowing style.

Michael Meyer, Chair

Attachment 1: Participants

Attachment 2: Selections from Ruegg 2011 presentation

PARTICIPANTS

Research and Technology Coordinating Committee

Michael Meyer, Modern Transport Solutions, LLC, Atlanta, Georgia, *Chair*
Kevin Chesnik, Applied Research Associates, Madison, Wisconsin
Karen Dixon, Texas A&M Transportation Institute, College Station
Patricia Gillette, Colorado Motor Carriers Association, Denver
Timothy Henkel, Minnesota Department of Transportation, Saint Paul
Wayne Kittelson, Kittelson & Associates, Portland, Oregon
Michael Morris, North Central Texas Council of Governments, Arlington
Ronaldo Nicholson, District Department of Transportation, Washington, D.C.
Harold Paul, Louisiana Transportation Research Center, Baton Rouge
David Roessner, SRI International, Washington, D.C.
Robert Sack, New York State Department of Transportation, Albany
Kumares Sinha, Purdue University, West Lafayette, Indiana
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FHWA Staff

Michael Trentacoste
Debra Elston
Monique Evans
Jack Jernigan
John Moulden

TRB Staff

Robert Skinner
Steve Godwin
Katherine Kortum
Timothy Devlin

The names of those who attended the meeting are shown in bold.

*Attended via conference call.

Attachment 2

SELECTIONS FROM RUEGG 2011 PRESENTATION