

Federal Highway Administration

RESEARCH AND TECHNOLOGY

Corporate Master Plan for Research and Deployment of Technology & Innovation



U.S. Department
of Transportation
**Federal Highway
Administration**

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Preface

The Federal Highway Administration (FHWA) has a history of success in playing a lead role in national highway research and technology (R&T). In an effort to further improve its R&T Program, the Agency developed a *Corporate Master Plan for Research and Deployment of Technology & Innovation* (Plan). The purpose of the Plan is to continue to improve the effectiveness and efficiency of R&T, including the end goal of deploying and implementing technologies and innovations that improve the quality, cost-effectiveness, and timeliness of products, procedures, processes, and practices.

The Plan presents a role, new focus, and clear direction for the Agency's R&T Program within the context of improving highway transportation. In addition, it outlines FHWA's corporate strategy for investing in and conducting research in cooperation with its partners and stakeholders. The initiative to develop the Plan gained early momentum from opportunities to "raise the bar" for R&T deployment that were identified by the Agency's 2002 Restructuring Assessment. It was also propelled by the recommendations of the Transportation Research Board (TRB) Research and Technology Coordinating Committee (RTCC) and the General Accounting Office (GAO).

Last spring, the Agency investigated R&T best practices from other Federal agencies as a prelude to developing the Plan and organized an Agencywide planning group to advise on the initiative. Group members included Pete Markle (chair), Bobby Blackmon, Joe Conway, Joyce Curtis, Deb Elston, Ian Friedland, Gary Henderson, Jane Lappin (Research and Special Programs Administration (RSPA), Volpe Center), John McCracken, Shelley Row, Mike Ryan (Pennsylvania Department of Transportation (DOT)), and Rudy Umbs. Last fall, the group helped design and lead a highly productive 2-day invitational workshop with core external and internal stakeholders that confirmed and amplified an R&T framework for applied and advanced research.

FHWA formulated the Plan from these stakeholders' ideas, bolstered by earlier recommendations and studies. While the Plan does not contain detailed or descriptive "how to" language, it clearly lays out guiding principles, commitments, and key actions to strengthen the FHWA roles as innovator and leader in national highway R&T. FHWA's guiding principles and commitments for pursuing these opportunities for improvement are outlined in appendix A.



The Role of FHWA in Research and Technology

The U.S. surface transportation system is critical to the continued growth of the country's economy and the American way of life. Despite the successes of the past, the surface transportation program will be hard pressed to meet the challenges of the future as demands for safety and efficiency grow faster than the available resources. The U.S. population is expected to increase by 45 million people in the next 20 years, vehicle-miles traveled is growing twice as fast as the population, and concerns over land use and the environment are driving new approaches to address infrastructure needs.

Highway research has provided substantial benefits and has yielded many advances and innovations that have contributed to improvements in all aspects of the highway system, including longer lasting pavements, structurally sound bridges, and advanced traffic systems. Such research is crucial to advances that will save lives, time, and money. Increasing demands, limited resources, and greater expectations will be the driving themes for transportation in the new century. To meet the challenges ahead, transportation managers will need the benefits of technology and innovation development and deployment that only a carefully considered, well-developed, and clearly communicated R&T program can provide.

Existing highway R&T programs are highly decentralized and are comprised of multiple individual programs, including the

FHWA R&T Program, State R&T programs, the National Cooperative Highway Research Program (NCHRP), University Transportation Center (UTC) programs, and many private-sector activities. In addition, these programs involve ongoing collaboration with international organizations such as the Organization of Economic Cooperation and Development, and the World Road Congress. Highway programs also involve bilateral and multilateral relations with countries in both the northern and southern hemispheres. In this environment, FHWA plays an indispensable leadership role in sponsoring, sustaining, and guiding highway research. The Agency also ensures R&T quality and coverage of all needed R&T areas.

Traditionally, FHWA has worked closely with its many partners in highway R&T, and the Agency's involvement is vital to the community's efforts to develop innovative technologies that will be needed to meet future challenges. FHWA intends to meet these challenges by realizing its full potential as a leader in the transportation R&T field. As part of that effort, FHWA is working to improve its R&T Program¹ and to deploy technology and innovation more effectively. In addition, FHWA will continue working to facilitate the wide-ranging and shared efforts of its R&T partners and stakeholders.

To accomplish these goals, FHWA developed the Plan described in this document.

¹The term "R&T Program" is used in the Plan to refer to the combined responsibility and actions of Congress, the Administration, and FHWA in funding highway research, determining research needs, setting research program priorities, executing the research, and deploying/implementing technologies and innovations. Technologies and innovations include procedures, practices, processes, products, and/or techniques.

The Plan has been crafted to provide sufficient direction for FHWA's R&T Program, yet it allows flexibility for FHWA program managers to conduct their research activities in an efficient and timely manner. The Plan directly supports a broader corporate stewardship role as defined and discussed in the Deputy Administrator's white paper on that subject. FHWA has had many successes within individual R&T functional areas. The actions advanced by the FHWA Leadership Team in the Plan will help improve stewardship and coordination in research and innovation, while providing a clear definition of success for the Agency as a whole. Finally, given the decentralized responsibilities for U.S. research and innovation, it is clear that a strategy of persuasive rather than directive leadership with FHWA's partners, as advanced by the Deputy Administrator's stewardship paper, will be critical to success. The Plan builds on FHWA's solid relationships within the research and innovation community.

The Plan was drafted with the recognition that FHWA plays a number of critical roles in developing, deploying, and implementing transportation innovations, and shares all of the roles with its partners in the public and private sectors, academia, and the international community. One of the Agency's strengths, for example, has been the ability to work with these partners to create a comprehensive and robust innovation program.

The critical niche that FHWA fills within this community varies with different parts of the R&T Program. For State Planning and Research (SP&R), FHWA works directly with its State partners to define research needs and to integrate complementary efforts around the country. An example of how FHWA adds value can be seen through the peer exchange program. FHWA also plays a collaborative role in NCHRP, providing States with expertise, funding, and

support. Collaboration with other institutions, such as UTCs, national laboratories, and international entities, is yet another way that the Agency supports a robust national transportation research program.

Another important role for FHWA is in the deployment and implementation of technology and innovation, one of the Agency's key business processes. FHWA is uniquely positioned to implement this process through its organizational structure of a Resource Center with multiple locations and Division Offices across the Nation. Such a structure permits rapid deployment and implementation on the Federal, State, and local levels, independent of which organization or agency developed a technology or innovation. The Agency is known to advance technology and innovation from all possible sources.

FHWA also plays a leadership role in shaping and executing a national R&T program. In many cases, the Agency acts as convener, bringing the R&T community together to define priorities and future directions. By advocating technology and innovation, tracking its benefits, and communicating those benefits to key decision-makers, FHWA also exercises leadership.

In fact, FHWA's leadership role in R&T begins with the Agency mission of "enhancing mobility through innovation, leadership, and public service," and grows from the role that FHWA defined for itself, to be "*innovators for a better future.*" Taking such a leadership role does not exempt FHWA from working collaboratively with its partners. On the contrary, in today's customer-driven atmosphere, it implies an even greater responsibility to work with partners in defining the direction of and developing the roadmaps needed to achieve results, especially because many times these partners will be implementing the technologies and innovations.

Background

The movement to substantively review and evaluate FHWA's R&T Program grew from the Agency's 2002 Restructuring Assessment. It was also given impetus by the recommendations found in TRB RTCC Special Report 261, *The Federal Role in Highway Research and Technology* (Special Report 261), and the GAO report 02-573 to Congress in May 2002, *Highway Research: Systematic Selection and Evaluation Processes Needed for Research Program* (GAO report).

The Agency conducted its Restructuring Assessment to review FHWA's roles and responsibilities in the changing transportation environment. Of particular interest was how FHWA headquarter functions might complement a restructured field organization after eliminating all nine regional offices and establishing a Resource Center in four locations. The Restructuring Assessment focused on the need to continue and improve FHWA's successful lead role in R&T and identified the following opportunities for improvement:

- Strengthen the definition of priorities.
- Designate a champion for technology deployment.
- Clarify the deployment process.
- Increase corporate ownership, coordination, and commitment for delivering technology and innovation.

One theme articulated by the Restructuring Assessment was that "FHWA *must* significantly 'raise-the-bar' in deploying technology and innovation." The assessment proposed specific actions for implementation, including:

- Commitment through performance plans (objectives, strategies, and measures) linked to the "vital few" Agency priorities, including multiyear roadmaps for R&T.
- Units' appropriate allocation of resources to implement plans.
- Redefinition of the Technology Innovation Network (TIN) role as a cross-functional team with representatives from all FHWA units.
- Definition of the key business process for technology and innovation deployment, supported by performance metrics.
- Formulation and execution of an implementation plan for R&T recommendations from Special Report 261 (see below).

Stakeholder views also are critical to the Agency's evaluation and improvement of its research program. Such input was provided through Special Report 261. The purpose of this report was to examine the Federal role in the national highway R&T effort, and to determine whether the focus and activities of the Federal program were appropriate for the overall highway system, stakeholder needs, and the roles and activities of other national highway R&T programs. Special Report 261 states that "the Federal role in highway R&T is vital to highway innovation;" however, FHWA's R&T Program "is missing an opportunity to address this critical Federal responsibility." To address this concern, RTCC recommended that the FHWA R&T Program:

- Focus on fundamental, long-term research aimed at achieving breakthroughs in understanding transportation-related phenomena.

- Undertake research to address “significant highway gaps” and emerging issues with national implications.
- Be more responsive to major stakeholders and balance stakeholder problem identification with expert external technical review.
- Include external stakeholders and technical experts on merit review and evaluation panels.
- Promote innovation by surveying worldwide research and practices to identify promising technologies.
- Subject the UTC’s program to the same guidelines as the FHWA R&T Program.
- Support Future Strategic Highway Research Program (F-SHRP) findings and recommendations.

The GAO report reinforced several recommendations from the Restructuring Assessment and Special Report 261. Specifically, the GAO report recommended that the Agency adopt a systematic approach for obtaining input from external stakeholders and also “develop a systematic process for evaluating significant ongoing and completed research that incorporates peer review or other best practices in use at Federal agencies that conduct research.”

The message to the Agency from its internal and external stakeholders is clear: opportunities exist for FHWA to continue to improve its R&T leadership role, its program processes, and its effectiveness in working with partners to deliver technology and innovation.

Purpose and Approach

To ensure the effectiveness and efficiency of the FHWA R&T Program, the purpose of this Plan is to provide a framework for its continuing efforts. Elements of the framework include: a systematic R&T process; stakeholder engagement throughout the process; performance evaluation and measurement; and deployment and implementation of technology and innovation that improves the quality, cost-effectiveness, and timeliness of products, procedures, processes, and practices. The framework and the Plan were developed with input from stakeholders, including participants in a structured workshop held in October 2002. Attendees included internal and external stakeholders representing a broad range of transportation community interests. The workshop identified issues to be addressed in the Plan. Approaches to R&T from other Federal agencies (see “Background Paper Matrix” in appendix B for a summary of this data) and from the U.S. Department of Energy were also considered in developing the Plan.

The Plan outlines a strategy and a Federal role for investing in and conducting research on behalf of FHWA partners and stakeholders. It incorporates three elements considered to be essential by other well-established Federal R&T programs:

- Involving stakeholders throughout the process.
- Employing merit reviews.
- Evaluating research and deployment on an ongoing basis.

The Plan outlines an environment for developing and deploying technology and innovation in the transportation community

through tool development, technology transfer, technical assistance, and training. It describes approaches to research, deployment, and evaluation of FHWA key business processes for research and deployment of technology and innovation. The Plan also attempts to incorporate the R&T investment criteria of relevance, quality, and performance as defined by the Office of Management and Budget (OMB). To ensure a corporate approach, it identifies an FHWA R&T Leadership Team and provides for an internal R&T Network to help coordinate across functional areas and to disseminate information inside and outside of the Agency. This R&T Network will replace TIN.

Historically, FHWA has successfully played the lead role for national highway R&T. At the same time, the Agency and others have identified opportunities to further improve FHWA’s role in R&T and more effectively deploy technology and innovation. Specific commitments in this plan constitute the Agency’s actions in pursuing these opportunities for improvement. The outcome of these actions will consist of the rapid and extensive deployment of new technologies and innovations from all sources to all users.

The task is a challenging one and to achieve results, the success of the FHWA R&T Program will require the support of the entire Agency. To help garner and shape this support, the Plan offers guiding principles for FHWA’s role in R&T:

Guiding Principle #1

The FHWA R&T process, from research through implementation, is systematic and begins with the end in mind.

Guiding Principle #2

FHWA engages in advanced and applied research, and innovation deployment activities where there is an appropriate Federal role.

Guiding Principle #3

Stakeholders are engaged throughout the R&T process.

Guiding Principle #4

The R&T process is grounded in the FHWA mission and goals, and guided by multiyear plans.

Guiding Principle #5

The R&T budget allocation is based on and driven by multiyear plans and priorities.

Guiding Principle #6

FHWA measures the performance of R&T on the Agency, program, and project levels.

Guiding Principle #7

FHWA effectively communicates its R&T Program and projects.

Guiding Principles and FHWA Commitments

The following guiding principles include both commitments and intended actions that describe how FHWA will adapt its leadership role to improve the R&T process. What follows is a statement and discussion of each principle. The next chapter contains information about how FHWA will measure its success in fulfilling the commitments laid out in the Plan.

Guiding Principle #1 – The FHWA R&T process, from research through implementation, is systematic and begins with the end in mind.

The Agency commits to:

- An R&T process that clearly identifies the end user and intended impact.
- An R&T process that is predictable, repeatable, and well documented.
- An R&T process that is proactive, visible, and accessible to all stakeholders.
- Establishment of an internal R&T Network for coordinating and sharing R&T information within the Agency and with FHWA's stakeholders.
- Efficiency improvements of FHWA staffing and funding resources for effectively deploying technology and innovation.

The R&T process will clearly identify the end user and an intended outcome. To clarify this process, the Plan provides a framework for the FHWA applied and advanced R&T programs, the activities that lead to stakeholder implementation of technologies and innovations, and the actions for involving external stakeholders and peers throughout the process. See figure 1 for a visual presentation of the R&T framework.

FHWA commits to ensuring that the R&T process is predictable, repeatable, and well documented. The outcome will be a strategic, long-term, continuous process that is visible and accessible to all stakeholders. By engaging stakeholders throughout the R&T process, FHWA will proactively obtain insight on policy, technical, and operational issues (See guiding principle #3 and appendix C.). The expected result is an Agency R&T program that aligns closely with stakeholder needs and addresses research with national and international implications.

R&T Leadership Team. To ensure a corporate approach to R&T and implementation of the Plan, FHWA will form an R&T Leadership Team consisting of Associate Administrators for Environment and Planning, Federal Lands, Infrastructure, Operations, Policy, Professional Development, Safety, and Research, Development, and Technology (RD&T); the Directors of Field Services; and Division Administrators' Council members. Initially, the R&T Leadership Team will meet quarterly.

R&T Network. Deployment of technology and innovation is a key FHWA business process. To facilitate this process, the Agency commits to establishing an internal network for R&T (referred to as the "R&T Network"), which will include representatives from the Office of International Programs, other program offices, Division Offices, and Resource Center, including field leadership and Resource Center team leaders. Initially, the R&T Network's primary role will be to assist in corporate support functions, including communication, coordination, and collaboration across functional R&T areas and throughout the organization. Examples of the R&T Network's expected tasks may

include: communicating FHWA's R&T Program; collecting and analyzing data on corporate investment in technology and innovation; measuring performance and sharing the results; and supporting the R&T Leadership Team. In addition, the R&T Network could become a forum for a proposed Division Administrators' Advisory Group for R&T.

The R&T Network design will provide Agencywide service without limiting functional area flexibility or replacing R&T Leadership Team decisionmaking. FHWA Resource Center managers and the R&T Leadership Team will take the lead in formulating the R&T Network's specific roles, functions, and membership. Recognizing the field's critical role in achieving successful implementation and deployment of tech-

nology and innovation, the R&T Leadership Team will also seek input from field leadership and field representatives. In addition, FHWA may look to techniques used by large State DOTs with established R&T networks as benchmarks.

The R&T Network's primary functions may include:

- Providing a focal point for sharing information on FHWA technology and innovation activities, both within the Agency and with FHWA stakeholders.
- Developing templates for technology and innovation deployment processes.
- Tracking accomplishments and sharing the results of the technology and innovation deployment program.
- Helping identify objective tools to measure performance.
- Imparting a cross-Agency focus on individual functional areas.
- Supporting functional areas and R&T Leadership Team with agenda setting, multiyear planning, budgeting, priority setting, deployment, and overall evaluation.
- Furnishing staff support to the R&T Leadership Team.

Finally, while FHWA is committed to effectively deploying technology and innovation, it is clear that implementing the Plan will require FHWA to improve and efficiently use its human and financial resources. Figure 1

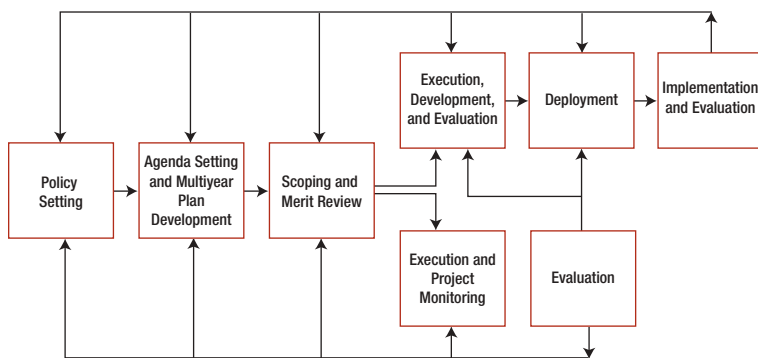


Figure 1. FHWA R&T framework for applied and advanced research.²

²The FHWA R&T framework for applied and advanced research consists of eight elements:

Policy Setting refers to the FHWA R&T policy-setting process.

Agenda Setting and Multiyear Plan Development refers to establishing program area agendas (that include understanding the current R&T development, identifying and prioritizing current needs, and verifying needs) and the development of multiyear plans to carry out the program area agendas.

Scoping and Merit Review refers to using merit review (peer panels) for establishing research project Statements of Work, Requests for Proposals, performance measures, and proposal evaluations.

Execution, Development, and Evaluation (Applied) refers to executing the research project and/or developing the research product, along with evaluating current and completed research.

Deployment (Applied) refers to piloting, showcasing, or demonstrating a technology or innovation (field testing) where the technology or innovation has the potential to become state-of-the-art. This element includes recommending technology or innovation revisions or modifications before implementation.

Implementation and Evaluation (Applied) refers to deploying on a full- or wide-scale basis a technology or innovation to become state-of-the-practice, and evaluating the effectiveness on project and program levels.

Execution and Project Monitoring (Advanced) refers to executing the research project or developing the research technology. Project monitoring is conducted throughout the research project.

Evaluation (Advanced) refers to evaluating research on both the project and program levels to ensure that research is conducted in a quality manner and that the research is relevant (meets program goals/objectives).

displays a framework for managing the FHWA R&T Program and ensuring that FHWA commitments and actions are realized. In addition to the framework, Plan implementation and application are expected to produce a variety of functional area approaches for engaging stakeholders, developing agendas, and producing multiyear plans. These approaches, or *current practices*, will be captured and combined into a handbook, or *book of details*, for distribution to FHWA staff and external stakeholders.

Guiding Principle #2—FHWA engages in advanced and applied research, and innovation deployment activities where there is an appropriate Federal role.

The Agency commits to:

- Focusing on long-term, high-cost, high-risk research with a high payoff potential; significant highway research gaps not addressed in other highway R&T programs; and emerging issues with national implications.
- Working with stakeholders to increase FHWA's advanced research effort.
- Developing an advanced research plan with consolidated goals addressing FHWA needs.

The Transportation Equity Act for the 21st Century (TEA-21) was created to support the Nation's economic growth and improve the quality of life for its citizens. The R&T provision of TEA-21 highlighted the need to formulate and implement a truly collaborative national, not just Federal, R&T agenda. To engage the highway transportation community and work with partners and stakeholders from other modes in assessing highway R&T

needs, the National Highway R&T Partnership (Partnership) was created. This Partnership identified needs to be carried out by FHWA and its partners and stakeholders in the States, academia, and private industry. In addition, the Partnership created a new framework for programmatic coordination of highway R&T activities, including both applied³ and advanced⁴ research.

However, FHWA's R&T funding was reduced under TEA-21. In addition, earmarks and designations have reduced the flexibility of Federal R&T funds. Furthermore, only a small portion of the Agency's R&T Program funding—about \$900,000—supports advanced research, that is, research aimed at breakthrough technologies capable of effecting improvements in highway performance as well as cost reductions.⁵ Such speculative, high-risk research has a high payoff potential, but is unlikely to be addressed in other highway R&T programs because of the risk or cost involved. Instead, the pressure to show results in the near future to meet the Agency mission often drives research agendas in the direction of applied research.

Decreased funding for the R&T Program, coupled with reduced flexibility from increased earmarks and designations, has affected FHWA's ability to carry out its portion of the national highway agenda. This includes FHWA's ability to contribute a national perspective to the collective research undertaking and the Agency's efficiency in conducting research. These factors also impact FHWA's ability to carry out carefully conceived multiyear plans according to established product schedules and can thwart expectations of deployment by FHWA's stakeholders and customers.

³Applied research is problem-solving research that addresses a defined need with a specific outcome that can be readily implemented.

⁴Advanced research is research that involves and draws upon basic research results to provide better understanding of problems and that develops innovative solutions. Advanced research is sometimes referred to as *exploratory research* to convey its more fundamental character, its broader objectives, and the greater uncertainty in expected outcomes compared to problem-solving research.

⁵Transportation Research Board, Special Report 261: *The Federal Role in Highway Research and Technology*, National Research Council, Washington, DC, 2001.

Nevertheless, FHWA recognizes the importance of the Federal role in advanced research and is committed to working with stakeholders and partners to increase the Agency's advanced research effort. Specifically, this focuses on long-term, high-cost, high-risk research with a high payoff potential; on identifying significant gaps not addressed in other highway R&T programs; and on emerging issues with national implications. At the same time, an appropriate Federal role for advanced and applied research must be explicitly linked with FHWA program goals and objectives, and must meet stakeholder needs. In the end, greater stakeholder commitment to address applied research may be required to achieve overall results.

In focusing on advanced research, FHWA remains committed to developing an advanced research plan with consolidated goals that address Agency needs. Specific criteria are yet to be established, but the effort may well include an exploratory team that will consult with other Federal agency laboratories or universities involved in basic research to share information and identify potential applications for the transportation community.

Guiding Principle #3—Stakeholders are engaged throughout the R&T process.

The Agency commits to:

- Expanding the disciplines and diversity of stakeholders engaged in the R&T process.
- Engaging stakeholders in FHWA R&T policy decisions.
- Engaging stakeholders in FHWA R&T agenda setting, and multiyear plan development.
- Including stakeholders in merit review during various phases of the R&T process.
- Incorporating stakeholders in research

project, program, and Agency-level evaluations and reviews.

- Involving stakeholders in deployment and implementation of technologies or innovations.

Over the years, FHWA functional area personnel have developed extensive ad hoc networks for outreach and stakeholder involvement. This plan maintains a degree of flexibility, building on the continuing efforts of individual functional areas. The aim is to create a systematic R&T process that effectively uses available resources while creating opportunities for more stakeholder involvement and a wider breadth of stakeholders. Stakeholder involvement is collaborative, and in some cases, partners and stakeholders may be asked to help provide some of the resources needed to support such involvement.

Under the Plan, stakeholders will take up multiple roles. They will be invited to assist FHWA in such tasks as:

- Providing focus and direction in the R&T Program.
- Identifying innovations, opportunities, needs, and gaps.
- Identifying innovations or technologies developed by others that show potential for inclusion in the FHWA R&T Program.
- Setting R&T agendas and priorities.
- Understanding end use and intended impact.
- Identifying and acting as champions to assist in deployment.
- Evaluating R&T quality, relevance, and performance.

FHWA is committed to engaging stakeholders throughout the R&T process. This process improvement is about engaging more diverse stakeholders from a variety of disciplines, who will reflect and address the growing range of FHWA program areas and emerging issues (such

as public health, energy, and land use). Technology or innovation end users will be engaged early in the process to ensure successful research, deployment and implementation, and evaluation.

FHWA considers merit reviews by stakeholders to be vital to the continued success of the R&T Program, and is committed to using merit reviews during the R&T process. Merit reviews help ensure the quality of research projects, and more significantly, the quality of research programs. Recognized as an excellent way to assess the relevance of research programs to the Agency's mission and strategic goals, merit reviews also may be used on the project level, depending on a project size and complexity.

To help ensure that merit reviews are conducted by a broad and diverse range of stakeholders, consideration may be given to stakeholder nominations by third-party transportation organizations. Some overlap of individual stakeholders throughout the various stages of the process may also occur. The extent of stakeholder involvement in all stages of the R&T process will be documented for each FHWA functional area to ensure that diverse interests within the transportation community are understood and that available resources are used appropriately to achieve the desired results.

During each phase of the R&T process, as illustrated in the framework (see figure 1), the Agency will engage representatives from State and local agencies, resource agencies, metropolitan planning organizations, academia, and industry as appropriate. FHWA may seek stakeholders who have management experience, technical skills, or end-user familiarity, depending on the situation. (See appendix C.)

Guiding Principle #4—The R&T process is grounded in the FHWA mission and goals, and guided by multiyear plans.

The Agency commits to:

- Developing multiyear plans that support FHWA goals, and that guide and direct the FHWA R&T Program.
 - Establishing a priority list of market-ready technologies or innovations.
-

Performance Planning. The FHWA performance plan and individual unit plans identify the role of R&T, including R&T activities with specific strategies and actions intended to contribute to achieving goals and objectives. Managers and staff with R&T roles will incorporate those roles in their individual performance plans. Guiding principle #6 focuses on improving R&T performance measurement on the program and Agency levels. This will increase objectivity in assessing the overall contribution of the FHWA R&T Program toward achieving the organization's overall goals and objectives.

Agencywide R&T Program. The managers and staff responsible for R&T in particular functional areas develop and set their own R&T agendas. Their agenda setting already reflects FHWA mission and goals, and link to strategic goals, engage external stakeholders, and involve coordination across FHWA. At some point, the FHWA R&T Leadership Team will agree on an overall FHWA R&T agenda that incorporates the functional area agendas. At such a time, the R&T Network may be able to assist the R&T Leadership Team in collaborations across functional areas to adequately address the participation of multiple offices or cross-cutting initiatives, and national R&T gaps.

Again, the overall R&T Program will be grounded in the FHWA mission and goals. The Plan outlines a process that will increase the synergy of R&T efforts across FHWA functional areas, and other agencies and organizations.

Use of Multiyear Plans. Research and technology can be employed to achieve the Agency mission and goals. In establishing R&T Program initiatives, functional area staff, as well as international activities that are not part of a functional area, are guided by multiyear plans developed around and related to goals and agreed-upon program agendas. FHWA commits to developing multiyear plans that provide guidance and direction for future R&T activities, with the option of developing an overall “program multiyear plan” that clearly highlights R&T initiatives, or developing R&T multiyear plans. Multiyear plans for R&T activities include the following elements:

- Goals.
- Objectives, initiatives, budgets, and performance measures—all tied to the FHWA mission and goals.
- Research, technology, and innovation initiatives.
- Activities and resources for deployment and implementation.
- Roles and responsibilities.
- Inputs and outputs.
- Stakeholder roles.
- Timelines, with a 3-year minimum.

As with setting agendas, the FHWA R&T Network may be able to assist the R&T Leadership Team in successfully incorporating cross-functional contributions to multiyear plans. Because R&T multiyear plans contain budget estimates, it is expected that multiyear plans will be adjusted or revised to reflect R&T funding allocations. In addition, FHWA multiyear plans will be made available and shared with all stakeholders.

FHWA Top-Priority, Market-Ready Technologies and Innovations. The FHWA R&T Network will develop and propose a process for establishing a list of FHWA top-priority, market-ready technologies and innovations to the R&T Leadership Team. The following criteria

will be considered in developing the process for generating that list:

- Market-ready for immediate deployment.
- Corporate priorities reflected (linked to strategic goals and objectives, and the “vital few”).
- High payoff potential of achieving results (ability to “move the dial”).
- Stakeholder involvement (FHWA headquarters, Divisions, and Resource Center; and external stakeholders, including end users).
- Legal requirements considered.
- Agency resource support (full-time equivalent and funding) for marketing and helping deploy the technology or innovation.
- Technologies or innovations developed by others or identified as part of the FHWA International Scanning Program and other international collaborative R&T programs.

The top priorities will be updated and/or reconfirmed by August 31 each year. This will provide sufficient time for each office to take the list into account when developing their annual performance plans. In generating these top priorities, consideration will be given to the length of time needed for deploying and implementing technologies or innovations, and the need to keep the list stable. Because FHWA is working with and supporting the American Association of State Highway and Transportation Officials (AASHTO) Technology Implementation Group (TIG), the top priorities will include technologies and innovations recognized by AASHTO TIG.

The FHWA R&T Network may be able to assist in several areas of this effort, such as providing top-priority recommendations to the R&T Leadership Team for final approval, or reviewing and evaluating the top-priority, market-ready technologies and innovations for deployment efficiency and effectiveness. Details of the R&T Network

involvement will be finalized after the network is established.

Guiding Principle #5—The R&T budget allocation is based on and driven by multiyear plans and priorities.

The Agency commits to:

- Ensuring that national needs and the Agency’s goals and priorities are met.
- Providing adequate resources for advanced research and unsolicited proposals.
- Providing adequate resources for deployment and implementation.
- Providing adequate resources for stakeholder involvement

Personnel in each functional area will identify an R&T budget based on that specific area’s established R&T agenda and multi-year plans. Working from a corporate approach to meet national needs and FHWA goals and priorities, the R&T Leadership Team will integrate the proposed functional area budgets. The FHWA R&T Leadership Team also will reach agreement and make overall R&T budget recommendations based on FHWA goals, emphasizing the “vital few.” They will consider: anticipated accomplishments addressing multiple program needs; anticipated accomplishments for the current fiscal year; new or emerging initiatives for the fiscal year of the R&T Program budget; and anticipated technologies or innovations and milestones in future fiscal years.

FHWA recognizes the importance of the Federal role in advanced research and is committed to working with its stakeholders and partners to expand FHWA’s advanced research efforts. In addition, an effort will be made to consider the merits of unsolicited proposals for funding during the budget allocation process. The FHWA R&T Leadership Team will reach agree-

ment on funding allocations for the R&T Program and will recommend them to the Administrator.

Guiding Principle #6—FHWA measures the performance of R&T on the Agency, program, and project levels.

The Agency commits to:

- Developing, defining, and adopting a framework for measuring performance.
- Using merit review for conducting research evaluations and measuring performance.

The framework to be developed for measuring performance will enable FHWA to evaluate R&T on the Agency, program, and project levels. FHWA will use the framework to identify objective tools for measuring R&T performance. It will include ties to the overall FHWA performance measurement framework, and the Agency strategic plan and performance plan. A work group will be established to address R&T performance measures.

Applied research can be evaluated on three levels: project, program, and Agency. Under the Plan, a merit review panel will conduct evaluations and reviews by collaborating with FHWA personnel, technical experts, peers, special interest groups, senior management, and contracting officers. The use of merit review on the project level will depend on the project size and complexity.

- Project-level evaluations will:
 - Encompass criteria established during the scoping and merit review process.
 - Ensure that the project remains on schedule and within budget as intermediate progress evaluations are conducted.
 - Ensure that the project objectives and stakeholder needs are met.

- Ensure that the project is deployed according to the implementation plan.

Project evaluations will be conducted at a time determined by established milestones.

- Program evaluations will be based on:
 - Program goals and outcomes.
 - Program budgets.
 - Contribution to FHWA goals, objectives, and multiyear plans.

Program evaluations will be conducted by merit review on a periodic basis, such as, yearly.

- Agency evaluations will be based on:
 - Whether the collection of programs aligns with and contributes to the Agency's strategic goals and objectives. This would include periodic Agency-level peer exchanges.
 - Positive benefits of the technology or innovation through an economic analysis, such as benefit-cost ratio, return on investment, etc.

Agency evaluations will be performed by merit review and will be conducted on a periodic basis, such as every 3 years.

Guiding Principle #7— FHWA effectively communicates its R&T Program and projects.

The Agency commits to:

- Developing a uniform, overall FHWA R&T Program message.
 - Working with FHWA stakeholders to ensure that the R&T Program and projects are communicated consistently and with the appropriate level of detail required by each stakeholder.
 - Publishing an Agencywide R&T performance report.
 - Including communication, marketing, training, and education in the implementation plans.
-

FHWA recognizes a strong need to effectively communicate its overall R&T Program, within the Agency and with external stakeholders. The Agency must consistently make a clear case and communicate the value of investing in transportation research activities. This communication effort must be compelling and coordinated. The uniform message should consistently address the audience needs being met by the research and the accomplishments of a corporate R&T Program.

The FHWA approach to communicating its R&T Program will be strategic, providing timely links to the transportation community to improve the mobility and safety of the Nation's highways. FHWA has a variety of mechanisms for effectively communicating technical information from R&T with its stakeholders. In addition, FHWA commits to publishing an Agencywide R&T annual performance report that covers all R&T activities conducted, managed, and/or coordinated by FHWA.

Additional communication functions include:

- Preparing an Agencywide report of products and services to be delivered each year as a compendium of the different multiyear plans.
- Assembling data for the annual congressional report on technology deployment.
- Informing stakeholders about FHWA R&T activities.

Measuring the Success of FHWA Commitments in the Corporate Master Plan

The guiding principles and FHWA commitments in this plan do not lend themselves to traditional “implementation plan” measures of success; however, there are clearly critical milestones to meet as corporate processes improve. For example:

- Activities such as setting agendas and allocating R&T budgets will apply to the next R&T programming and budget cycle.
- The principles for engaging external stakeholders, using merit reviews, measuring performance, and communicating to stakeholders will be implemented as part of key processes related to agenda setting, multiyear plan development, and deployment and implementation.
- When this plan is implemented, staff in each functional area will conduct self-

assessments against FHWA commitments in the Plan as a baseline for measuring subsequent progress.

If progress is to be made, each of the Agency’s commitments will require some level of resources. While a very rough estimate of overall Agency resource requirements was completed as part of developing this plan, the self-assessment will include an estimate of resources by functional area.

Recognizing that some commitments and actions depend on completion of related activities, such as the selection of the Resource Center team leaders, the following milestones, nevertheless, offer a reasonable timeline for some key initial actions to implement the Plan:

Date	Action
Beginning with FY 2004 performance plans	Identify how R&T activities contribute to achieving goals and/or objectives in all unit performance plans.
<i>FY 2004 Performance Plan</i>	Incorporate into the “Organizational Excellence Goal” an R&T objective that includes measuring performance related to implementing the Plan and obtaining feedback from internal and external stakeholders.
9/30/03	Establish specific roles and composition of FHWA R&T Network.
12/31/03	Complete self-assessment, including resources needed, against the Agency’s commitments in the Plan for each functional area as a baseline for assessing subsequent progress; perform subsequently on a frequency determined by the R&T Leadership Team.
12/31/03	Define a process for developing a top-priority, market-ready technology and innovation list.
3/31/04	Develop and use multiyear plans within each functional area.
3/31/04	Develop implementation plans for ongoing research.
3/31/04	Document improved or planned enhancements to stakeholder involvement by functional area.
3/31/04	Develop templates for the technology and innovation deployment process.

FHWA leaders, in particular those holding stewardship over the FHWA R&T resources, are accountable for achieving the success envisioned in this plan. The R&T Leadership Team members, assisted by the R&T Network, Resource Center team leaders, and field office leadership will have overall accountability for ensuring the intended outcomes of FHWA's improved business process for research and deployment of technology and innovation. Their responsibilities will include ensuring that the intent of the guiding principles and commitments are met and that Agency-level performance results are addressed.

As part of their responsibility to advance the Agency's goals, FHWA goal owners will take the lead in implementing multi-year R&T Program plans, enhancing stakeholder involvement, and using merit review processes for individual functional R&T areas.

As the Agency's designated champion for R&T, the Associate Administrator for RD&T, with the support of the R&T Leadership Team, will be responsible for leading and coordinating FHWA's R&T

communication activities. This will include articulating FHWA's R&T goals and objectives, as well as specific accomplishments, in an effort to "raise the bar" for research and deployment of technology and innovation.

How will FHWA know from a corporate perspective when it has successfully achieved the desired results? While specific measures have yet to be developed, some of the overall indicators likely to be considered include:

- Improved stakeholder trust and confidence.
- Better data availability as input to R&T investment decisions.
- Increased deployment and implementation of technologies and innovations.
- Broadened communication of the R&T vision and program.

Positive results in areas such as these will provide strong early evidence that FHWA is moving toward a fuller leadership role for improving the R&T Program, and ultimately, the Nation's highway transportation system.

Appendix A. Summary of Guiding Principles and FHWA Commitments

Guiding Principle #1—The FHWA R&T process, from research through implementation, is systematic and begins with the end in mind.

The Agency commits to:

- An R&T process that clearly identifies the end user and intended impact.
- An R&T process that is predictable, repeatable, and well documented.
- An R&T process that is proactive, visible, and accessible to all stakeholders.
- Establishment of an internal R&T Network for coordinating and sharing R&T information within the Agency and with FHWA's stakeholders.
- Efficiency improvements of FHWA staffing and funding resources for effectively deploying technology and innovation.

Guiding Principle #2—FHWA engages in advanced and applied research, and innovation deployment activities where there is an appropriate Federal role.

The Agency commits to:

- Focusing on long-term, high-cost, high-risk research with a high payoff potential; significant highway research gaps not addressed in other highway R&T programs; and emerging issues with national implications.
- Working with stakeholders to increase the FHWA advanced research effort.
- Developing an advanced research plan with consolidated goals addressing FHWA needs.

Guiding Principle #3—Stakeholders are engaged throughout the R&T process.

The Agency commits to:

- Expanding the disciplines and diversity of stakeholders engaged in the R&T process.
- Engaging stakeholders in FHWA R&T policy decisions.
- Engaging stakeholders in FHWA R&T agenda setting and multi-year plan development.
- Including stakeholders in merit review during various phases of the R&T process.
- Incorporating stakeholders in research project, program, and Agency-level evaluations and reviews.
- Involving stakeholders in deployment and implementation of technologies or innovations.

Guiding Principle #4—The R&T process is grounded in the FHWA mission and goals, and guided by multiyear plans.

The Agency commits to:

- Developing multiyear plans that support FHWA goals, and that guide and direct the FHWA R&T Program.
- Establishing a priority list of market-ready technologies or innovations.

Guiding Principle #5—The R&T budget allocation is based on and driven by multiyear plans and priorities.

The Agency commits to:

- Ensuring that national needs and the Agency's goals and priorities are met.

- Providing adequate resources for advanced research and unsolicited proposals.
- Providing adequate resources for deployment and implementation.
- Providing adequate resources for stakeholder involvement.

Guiding Principle #6—FHWA measures the performance of R&T on the Agency, program, and project levels.

The Agency commits to:

- Developing, defining, and adopting a framework for measuring performance.
- Using merit review for conducting research evaluations and measuring performance.

Guiding Principle #7—FHWA effectively communicates its R&T Program and projects.

The Agency commits to:

- Developing a uniform, overall FHWA R&T Program message.
- Working with FHWA stakeholders to ensure that the R&T Program and projects are communicated consistently and with the appropriate level of detail required by each stakeholder.
- Publishing an Agencywide R&T performance report.
- Including communication, marketing, training, and education in the implementation plans.

Appendix B: Background Paper Matrix, Examples of Approaches to R&T Development, Evaluation, and Deployment from Other Federal Agencies

Agency	Stakeholder Involvement	Proposal Merit Review	Research Evaluation	Deployment
<p>Agricultural Research Service (ARS)</p>	<ul style="list-style-type: none"> National Agricultural Research, Extension, Education, and Economics Advisory Board annually reviews programs and evaluates research results. The Board is composed of 30 members appointed by the Secretary of Agriculture and ex officio members. Stakeholders also provide input through planning workshops held every 5 years for each ARS program. Workshop results are used to develop a research agenda and a 5-year Action Plan. 	<ul style="list-style-type: none"> The ARS Office of Scientific Quality Review conducts peer reviews of all research projects at least once every 5 years. Review panels are composed mostly of non-ARS scientists from universities, industry, or other Federal agencies. Review criteria focus on: (1) merit and significance as aligned with the 5-year Action Plan, (2) adequacy of approach and procedures, and (3) probability of success. 	<ul style="list-style-type: none"> In addition to panel reviews, ARS employs a number of methods to evaluate research: <ul style="list-style-type: none"> – Reviews of ARS laboratories. – Ad hoc panels to address immediate issues. – Reviews of publications prior to submission. – In-house peer evaluations of scientists' accomplishments. – Annual progress reports. 	<ul style="list-style-type: none"> Using Cooperative Research and Development Agreements (CRADA), ARS scientists collaborate with private firms to commercialize ARS technologies. ARS grants technology licenses to qualified firms and individuals. ARS enters into strategic partnerships to deliver new technologies, including a State Partnership Initiative that coordinates technology transfer with State governments.
<p>National Institutes of Health (NIH)</p>	<ul style="list-style-type: none"> Each NIH Institute has an external National Advisory Council that makes recommendations on policy and research. As required by Congress, two-thirds of the members are external scientists and one-third are lay members. Each Institute also has a Board of Scientific Counselors that evaluates and advises on scientific direction, tenure actions, resource allocation, projects, and other matters. 	<ul style="list-style-type: none"> Study Sections of 18–20 external researchers review proposals using five criteria: (1) originality and feasibility of approach, (2) training and experience of investigators, (3) adequacy of research design, (4) suitability of facilities, and (5) appropriateness of requested budget. National Advisory Councils review Study Section recommendations to ensure that proposals are relevant to Institute priorities. 	<ul style="list-style-type: none"> Study Sections evaluate ongoing extramural research along with new proposals at the time a request for additional support is made. Intramural research is reviewed by each Institute's Board of Scientific Counselors and National Advisory Council. 	<ul style="list-style-type: none"> NIH joins in CRADAs to pursue common research goals with industry and transfers technologies through licensing to the private sector for further development. The Agency frequently seeks patent protection on its inventions to ensure the rapid development of technologies that will benefit the public health.
<p>National Institute of Standards and Technology (NIST)</p>	<ul style="list-style-type: none"> NIST has an external advisory committee, the Visiting Committee on Advanced Technology, which meets quarterly to review and make recommendations on policies, organization, budgets, and programs. The committee is composed of 15 members from industry and academia appointed by the NIST Director to staggered 3-year terms. 	<ul style="list-style-type: none"> For NIST's Advanced Technology Program (ATP), a Federal Source Evaluation Board evaluates proposals against two criteria: (1) scientific and technological merit, and (2) potential economic benefits. The Board considers independent peer reviews by panels of technical and business experts. A multiple-stage process reduces the information required at the time a proposal is submitted. 	<ul style="list-style-type: none"> All programs use extensive internal peer review. The NRC's Board on Assessment of NIST Programs provides an annual external review of the NIST laboratory programs. Composed of about 150 scientists and engineers from industry and academia, the Board assesses the technical merit and relevance of laboratory programs in the context of NIST's missions. 	<ul style="list-style-type: none"> NIST's Office of Measurement Services facilitates access to the measurement and standards activities of the NIST laboratories. For ATP, NIST has completed a Technology Diffusion Pilot Project evaluating the feasibility of using NIST's Manufacturing Extension Partnership centers to accelerate the diffusion of ATP technologies to smaller manufacturers.
<p>National Science Foundation (NSF)</p>	<ul style="list-style-type: none"> Composed of members from universities, industry, and other Federal agencies, Advisory Committees provide each NSF directorate with input on direction and performance at two formal meetings per year. Set up as subcommittees of the Advisory Committees, Committees of Visitors (COV) review NSF programs on a 3-year cycle, with about one-third of the programs evaluated each year. 	<ul style="list-style-type: none"> Almost all new NSF awards are selected through competitive merit review by external experts. Programs are peer reviewed by three methods: (1) panel-only review, (2) mail-only review, and (3) mail-plus-panel review. NSF's review process considers two broad criteria: <ol style="list-style-type: none"> (1) the intellectual merit of the proposed activity, and (2) the activity's broader impacts. 	<ul style="list-style-type: none"> NSF relies on varied evaluation processes: <ol style="list-style-type: none"> (1) review by external experts of large, ongoing projects; (2) COV assessments of research results; (3) Advisory Committee assessments of the directorates' progress in relation to performance goals; and (4) investigators' annual reports. NSF plans to followup for years after a project's completion to identify the resulting impacts. 	<ul style="list-style-type: none"> Although NSF's mission does not formally include deployment, the Agency advances technology through partnerships with academia, industry, and State and local governments. Among these efforts is an initiative with FHWA and State DOTs on the long-term durability of materials and structures.
<p>Federal Highway Administration (FHWA)</p>	<ul style="list-style-type: none"> R&T needs are generally identified by internal stakeholders; however, various informal processes are used to engage external stakeholders. RTCC and National Highway R&T Partnership Forum provide external guidance on an occasional basis. Although FHWA engages stakeholders in elements of its R&T Program, it does not engage them on a sustained basis. 	<ul style="list-style-type: none"> FHWA has no formal process for external peer review of planned intramural or contract research. While most contract research is based on open competition and internal merit review, RTCC recommends that FHWA include external experts on review panels. RTCC also suggests that FHWA provide an opportunity for researchers to submit unsolicited proposals. 	<ul style="list-style-type: none"> Currently, FHWA evaluates R&T through the annual GPRA process, ad hoc input from RTCC, and "success stories." There is no formal systematic process for external stakeholder peer review. GAO has recommended a process that incorporates peer review and other practices in use at various Federal research agencies. 	<ul style="list-style-type: none"> Deployment is one of four key FHWA business processes. FHWA headquarters, Resource Center, and Divisions are responsible for technology and innovation deployment. FHWA is currently identifying high-priority technologies that are ready for deployment.

Appendix C. Approaches for Stakeholder Involvement

The Agency commits to engaging stakeholders during each phase of the R&T process. Understandably, the appropriateness and level of stakeholder engagement will vary by program area and individual R&T project size and complexity. The details of stakeholder engagement for the various phases of the R&T process are:

■ **R&T Policy Setting**

select representatives from State and local policymakers, program technical experts, and end users.

This will provide input for FHWA's consideration in policymaking decisions.

■ **Agenda-Setting and Multiyear Plan Development (Applied/Advanced)**

select representatives from the management, technical, academic, and end-user communities.

- Identify program and technical experts.
- Assist in gathering data and information on current and completed R&T.
- Analyze current position of stakeholders and identify problems and scope.
- Assist in defining criteria for ranking problems.
- Prioritize needs and validate results (“reality check”).
- Assist in developing multiyear plans.

- Assist in developing R&T implementation plans, such as Technology Facilitation Action Plans (TFAP).

■ **Scoping and Merit Review (Applied/Advanced)**

select representatives from the management, technical, and end-user communities.

- Assist in developing Statements of Work and Requests for Proposals on all major projects and—to the maximum extent practicable—on other research projects, including proposals for university research.
- Assist in establishing performance measurement criteria and evaluate the outcome and/or performance of R&T activities.
- Assist in “next step” options/decisions.

■ **Execution, Development, and Evaluation (Applied)**

select reviewers/evaluators with specific expertise in/knowledge of the research problems and methodologies from the technical and end-user communities.

- Assist in reviewing, evaluating, and comparing the research with the desired or intended outcome as stated in the Requests for Proposals, throughout execution.
- Recommend deployment or termination of research.

- Recommend the necessary adjustments to innovation or technology to achieve successful transfer to the customer(s).
- Assist in refining implementation plans.

■ **Deployment (Applied)**

select representatives for the specific technology or innovation from the end-user and technical communities.

- Assist in completing and carrying out the implementation plan; become champions and agree to pilot a specific innovation or technology.
- Assist in determining the best avenue for deploying a specific innovation or technology for each customer.
- Assist in evaluating a specific technology or innovation (track progress and measure results) and recommend revisions to ensure full-scale implementation. This will include consideration of technologies and innovations from other sources, such as from the FHWA International Scanning Program, international technical exchange programs, Federal agencies, State DOTs, universities, and local agencies.

■ **Implementation (Applied)**

select representatives for the specific technology or innovation from the end-user and technical communities.

- Assist in identifying potential stakeholders for further implementation.
- Assist in “telling the story” of the technology or innovation.
- Assist in outreach activities (education, training, and presentations).
- Assist in the evaluation of research (on the project and program levels) related to the intended outcomes.

■ **Evaluation (Applied)**

select representatives from the management, technical, and end-user communities.

- Assist in evaluating research (merit review) on the program and Agency levels.

- Communicate to the sponsors of research programs the nature of and the rationale for investing in transportation research activities.

■ **Execution and Project Monitoring (Advanced)**

select representatives from technical and end-user communities.

- Monitor and review research at periodic intervals (the criteria and timeframes are established during Request for Proposal development).
- Recommend “next step” options, such as, continue research “as is;” revise, revamp, or cancel research; and/or identify any components ready for deployment.

■ **Evaluation (Advanced)**

select representatives from the technical and end-user communities.

- These representatives would assist in evaluating research on the project and program levels. Program-level evaluations would be conducted on a periodic basis. The program evaluation would address:
 - Quality of overall research project outcomes in addressing initial needs.
 - Extent that program cycle met the needs of the program areas as originally defined.



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