Strategic Plan

for the

Turner-Fairbank Highway Research Center

U.S. Department
of Transportation

**Federal Highway
Administration**

Strategic Plan

1200 New Jersey Avenue, SE
Washington, DC 20590

To the Reader:

I am pleased to present the Strategic Plan for the Federal Highway Administration's (FHWA) Turner-Fairbank Highway Research Center (TFHRC).

Located in McLean, VA, TFHRC is FHWA's core facility for research, development, and technology within the broader transportation research community. This document describes TFHRC's plans for providing national leadership in highway research, both by advancing its own endeavors and by coordinating those endeavors with activities managed by other offices within FHWA and the U.S. Department of Transportation (USDOT), and by other public, private, academic, and international entities. Indeed, partnerships constitute a key element of the Strategic Plan. Other major themes of the Plan include identification and implementation of the right research; systematic planning of TFHRC's research capabilities, both human resources and infrastructure; and accelerated transition of technology from the laboratory to the operating environment.

America's highway network affords immense potential for improved safety, efficiency, economy, mobility, and quality of life. Only research of the caliber, breadth, and depth that have characterized TFHRC since its inception can fully unlock that potential. With the ultimate benefits of the research clearly in view, this Strategic Plan presents the principles and strategies that will enable TFHRC to realize its vision and accomplish its mission, and thus foster a safer, longer-lasting, and more productive highway network for America.

Sincerely,

Michael F. Trentacoste
Associate Administrator for Research,
Development, and Technology

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EXECUTIVE SUMMARY

Located in McLean, VA, the Turner-Fairbank Highway Research Center (TFHRC), is the Federal Highway Administration's (FHWA) core facility for research, development, and technology within the broader transportation research community. This document describes TFHRC's plans for providing national leadership in highway research, both by advancing its own endeavors and by coordinating those endeavors with activities managed by other offices within FHWA and the U.S. Department of Transportation, and by other public, private, academic, and international entities. By conducting and catalyzing the right research in keeping with this Strategic Plan, TFHRC will better enable highway transportation to fulfill its potential for improved safety, efficiency, economy, mobility, and quality of life.

FHWA AND TFHRC IN THE STRUCTURE OF HIGHWAY RESEARCH

The existing highway research and technology (R&T) environment comprises multiple programs, including FHWA's R&T Program, State highway agency R&T programs, the National Cooperative Highway Research Program (NCHRP), Transportation Research Board (TRB) research programs, University Transportation Center (UTC) programs, the Intelligent Transportation Systems Program, and many others. Some of these programs involve ongoing collaboration with international organizations.

Within this structure, FHWA is in a unique leadership position to identify and address issues of national significance that require long-term or high-risk research, planning, and investment. In this role—and in partnership with many stakeholder organizations—FHWA shapes and executes an innovative national R&T program comprising eight research components: infrastructure; operations; safety; planning, environment, and realty; policy; innovative program delivery; Federal lands; and exploratory advanced research.

VISION, MISSION, AND CORE VALUES

TFHRC Vision

To shape the future of transportation as the Nation's premier center for highway research and innovation.

TFHRC Mission

We conduct and coordinate research and advance innovation for a mobile society. We provide objective, high-quality technical expertise, leadership, and results.

TFHRC Core Values

TFHRC shares FHWA's core values of public service, integrity, respect, personal development, collaboration, and family.

GOALS AND OBJECTIVES

TFHRC strives toward the following six goals, with accompanying objectives, to realize its vision and guide its mission.

Goal 1: FHWA conducts and sponsors the right research and technology development to improve performance of our Nation's highways

The right research and development focuses on problems of national significance, has the potential to provide significant benefit over the long term, and/or advances the state of the art or practice through higher-risk, higher-payoff research that FHWA is well suited to undertake.

Goal 2: FHWA engages in strategic partnerships to enhance and leverage research, development, and implementation.

Coordination of research programs, built upon TFHRC's advanced science and technology expertise, objectivity, and resources, enables FHWA and others to jointly achieve national transportation goals.

Goal 3: FHWA and TFHRC maintain a flexible organization and agile research workforce to meet evolving transportation challenges.

By engaging in farsighted planning for its human resources and internal structure, TFHRC positions itself to conduct the right research in the long term while maintaining the flexibility to seize on fast-developing opportunities.

Goal 4: First-rate research infrastructure is developed and sustained through long-range planning and adequate capital investment.

Strategic investment in research infrastructure—including engagement in partnerships as appropriate—ensures that resources are optimized and that current and future research needs are met.

Goal 5: Research activities and outcomes are appropriately advanced through effective alignment of resources, dissemination of knowledge, and technology transition.

Emphasizing effective communication, TFHRC plans and conducts research and technology development, while engaging transition partners early in the research process to facilitate knowledge transfer and technology transition.

Goal 6: TFHRC provides national leadership to highway and intermodal transportation research.

TFHRC strengthens its national leadership role by chairing the FHWA R&T Leadership Team, by actively engaging in an array of partnerships, by strategically managing its research capabilities, and by implementing strategic planning that provides a research vision for the Nation's highways.

Strategic Plan for the Turner-Fairbank Highway Research Center

INTRODUCTION

This Strategic Plan focuses on the activities, resources, and capabilities of the Federal Highway Administration's (FHWA) Turner-Fairbank Highway Research Center (TFHRC), both internally and as FHWA's core facility for research, development, and technology within the broader transportation research community. Accordingly, this document describes TFHRC's plans for providing national leadership in highway research by advancing its own endeavors and by coordinating those endeavors with activities managed by other offices within FHWA and the U.S. Department of Transportation (USDOT), other cooperative research programs, the States, other levels of government, the private sector, academic institutions, and international organizations. By conducting and catalyzing the right research, the center will better enable highway transportation—in concert with other modes of transportation—to fulfill its potential for improved safety, efficiency, economy, mobility, and quality of life.

FHWA'S TFHRC

FHWA's Office of Research, Development, and Technology (RD&T) is located at TFHRC, a federally owned and operated national research facility in McLean, VA.[1]

TFHRC provides the world highway community with research and development (R&D) related to new and existing highway technologies, leading to a safer, longer lasting, more reliable, and more cost-efficient highway transportation system. Housing multiple laboratories, data centers, and support facilities, the center conducts applied and exploratory advanced research in such vital areas as vehicle-highway interaction, nanotechnology, safety, pavements, highway bridges and structures, human-centered systems, operations and intelligent transportation systems, and materials. The center reviews, tests, studies, researches, and finds solutions to complex technical problems through the development of more economical and environmentally sensitive designs; more efficient, quality-controlled construction, operational, and safety practices; and more durable materials.

TFHRC engages in long-term planning of highway research, and assembles and actively participates in partnerships with other national laboratories, governmental agencies at all levels, and with the private sector, to address the transportation needs of our Nation.

Researchers at TFHRC are dedicated scientists and engineers. Their expertise encompasses more than 100 transportation-related disciplines, including civil, structural, and pavement engineering; chemistry; safety; mathematics; computational development; modeling and simulation; information technology; hydraulics; geotechnology; aerodynamics; imaging; geometric design; photometry; visibility; human factors; and many more.

A team of professionals devoted to technology transfer, marketing, and communications; program development; and national and international partnerships also supports the center.

STRUCTURE OF HIGHWAY RESEARCH

Highway research in the United States is highly decentralized, as described in the July 9, 2013, letter and report from the Transportation Research Board's (TRB) Research and Technology Coordinating Committee.[2] Accordingly, TFHRC's activities and resources function within and support larger structures of highway research within FHWA, in the United States, and internationally.

The existing highway R&T environment comprises multiple programs, including FHWA's R&T Program, State highway agency R&T programs, the National Cooperative Highway Research Program (NCHRP), TRB research programs, congressionally mandated studies under the Moving Ahead for Progress in the 21st Century Act (MAP-21), University Transportation Center (UTC) programs, the Intelligent Transportation Systems Program, and nonprofit and private sector programs. In addition, other federally sponsored programs, such as those of the National Science Foundation, the U.S. Department of Homeland Security, and the National Institute of Standards and Technology, fund and conduct highway- and bridge-related research. These programs involve ongoing collaboration with international organizations, such as the Organization of Economic Cooperation and Development and the Forum of European Highway Research Laboratories.

Within this decentralized, complex structure, FHWA is in a unique leadership position to identify and address issues of national significance that require long-term or high-risk research, planning, and investment. In this role—and in partnership with many stakeholder organizations—FHWA shapes and executes an innovative national R&T program that:

- Produces and delivers the solutions needed to meet current challenges, including deployment and training as integral components.
- Assesses future needs.
- Responds to those needs proactively and effectively.

For FHWA, success in R&T requires systematic collaboration with its public- and private-sector partners. In today's customer-driven atmosphere, there is an even greater responsibility to work with partners to define the direction of R&T and to develop the plans needed to achieve results, especially because many partners will implement the technologies and innovations. FHWA's leadership role includes conducting, sponsoring, sustaining, and guiding highway research; working with partners and stakeholders in the highway community to develop longer-term or higher-risk innovative technologies that address issues of national significance; and coordinating with partners and stakeholders to ensure that substantial research findings are placed into practice nationally.

To ensure a corporate approach to R&T, the FHWA R&T Leadership Team oversees FHWA's R&T Program and sets the R&T agenda for the FHWA. The Corporate Master Plan for Research and Deployment of Technology & Innovation describes the structure of the FHWA R&T Leadership Team, which consists of selected FHWA Division Administrators and senior staff at FHWA Headquarters, including the Associate Administrators responsible for achieving the agency's programmatic goals.[3] The Associate Administrator for Research, Development, and Technology is chair of the R&T Leadership Team and is responsible for integrating the individual components into a coherent R&T program. At every level and stage of the R&T program, priorities and agendas are set in accordance with FHWA's vision,

mission, and strategic goals, the results of stakeholder engagement, and the Department's RD&T Strategic Plan.[4,5] Although based on a solid structure and methodical procedures, FHWA's R&T Program strives always to keep multiple pathways open for innovation, which can originate—and is welcomed—at every level of the hierarchy both within and outside FHWA.

PURPOSE AND PRINCIPLES OF THE TFHRC STRATEGIC PLAN

The center aims to provide consistently high-quality, objective, and relevant leadership, technical expertise, and results to its stakeholders and partners, thus advancing its long-term pertinence, effectiveness, and success. To fulfill this aim requires a clear vision of TFHRC's future state and a well-defined trajectory to get there. That vision and its enabling trajectory must incorporate flexibility and encourage creativity, so that the center can anticipate future challenges, seize opportunities for innovation, and foster productive partnerships. Building on these purposes and principles, this Strategic Plan aims to guide the continued development—and capitalize on the substantive accomplishments—of TFHRC as the Nation's focal point for, and catalyst of partnerships in, highway research and innovation.

SOURCES AND IMPLEMENTATION OF THE TFHRC STRATEGIC PLAN

Initial input for developing the Strategic Plan came from the TFHRC research staff through a survey of future trends and issues and a staff workshop that addressed strengths, weaknesses, opportunities, and challenges for the center. Initial external stakeholder input consisted of an informal discussion with leaders from State highway agencies, academia, and industry, who emphasized TFHRC's long-term perspective and leadership role as key strengths and identified partnerships as essential to the center's success. TFHRC leadership, which includes the Associate Administrator for RD&T, the Chief Scientist, the office directors, and selected assistant directors and key senior staff at TFHRC, evaluated the information provided internally and externally, as well as the results of broader strategic planning efforts within USDOT and FHWA, and developed six strategic challenges, with accompanying goals and objectives, to frame the Strategic Plan. After reviewing the framework, the FHWA's Federal Advisory Committee on R&T—the Research and Technology Coordinating Committee (RTCC), which operates under the auspices of the TRB—provided valuable feedback that has been incorporated. Further reviews and comments by FHWA leadership and additional external stakeholder groups informed the final version of the Strategic Plan.

This Strategic Plan sets forth broad principles and long-term goals and objectives for programs that must ordinarily be planned and executed on a multiyear basis. Accordingly, updates would occur if underlying principles, goals, and objectives should need to be amended; for example, to reflect major settled redirections of USDOT or FHWA strategic plans. The most recent version of the FHWA Strategic Plan, for instance, last underwent revision in July 2012 to reflect changes and updates since the original document's release in December 2008.[6]

TFHRC's Federal staff and management are identifying, prioritizing, and undertaking the specific activities that will achieve the Strategic Plan's objectives. In accordance with the Plan's purpose and principles, this implementation process will be iterative, incorporating consultation (within TFHRC, with other units in FHWA, and with appropriate partners and stakeholders) and reflecting real-world developments and needs over time.


FHWA HYDRAULICS LAB
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STRATEGIC CHALLENGES

The six goals of this TFHRC Strategic Plan correspond to each of the following six strategic challenges. Successfully meeting all six challenges will ensure TFHRC's continued focus on priority research, quality conduct of R&T, and technology deployment for maximum benefit to the Nation and the public. The six strategic challenges are as follows:

1. Systematically and farsightedly setting priorities and effectively implementing. TFHRC must assure that it is conducting, sponsoring, and contributing to the right research and technology development, investing in priorities according to its Strategic Plan, and ensuring quality work.

2. Developing and balancing permanent (i.e., in-house) and partnership capabilities to maximize their long-term effectiveness. TFHRC must engage in partnerships in conjunction with, or in lieu of, permanent capabilities (especially for emerging or seldom-used capabilities) and must ensure that FHWA has effective methods, such as ad hoc as well as long-term agreements, to tap into the partnerships.

3. Applying foresight and acumen to position TFHRC's organization and staffing for the future. TFHRC's organization and staffing must be flexible and agile. TFHRC, working with FHWA's Office of Human Resources under the policy guidance of the Office of Personnel Management, must recruit the needed expertise and develop the workforce to guide, inspire, and capitalize on innovation.

4. Strategically investing in research infrastructure for maximal long-term benefit. With FHWA investing in TFHRC's research infrastructure in accordance with identified long-term research needs, TFHRC must, where appropriate, leverage external facilities for both emerging and important traditional research areas.

5. Engaging stakeholders substantively at the key stages in the research process to maximize and accelerate research and innovation product adoption. Because technology transfer and deployment are critical components to success for FHWA, stakeholder engagement must occur at key points in the research process to assure stakeholder participation, resource alignment, and technology transition.

6. Providing national and international leadership by envisioning, guiding, and catalyzing highway and intermodal transportation research. TFHRC and its leadership must play a key role in developing and advocating a vision as well as creating and implementing coordinated national highway and transportation research within the United States. TFHRC does this through its communication, coordination, and collaborative R&T efforts and representation on national and international research venues.

VISION, MISSION, AND CORE VALUES

TFHRC's vision, mission, and core values inspire the center's goals and objectives, motivate its work, and guide the day-to-day conduct of its affairs.

TFHRC VISION

To shape the future of transportation as the Nation's premier center for highway research and innovation.

TFHRC MISSION

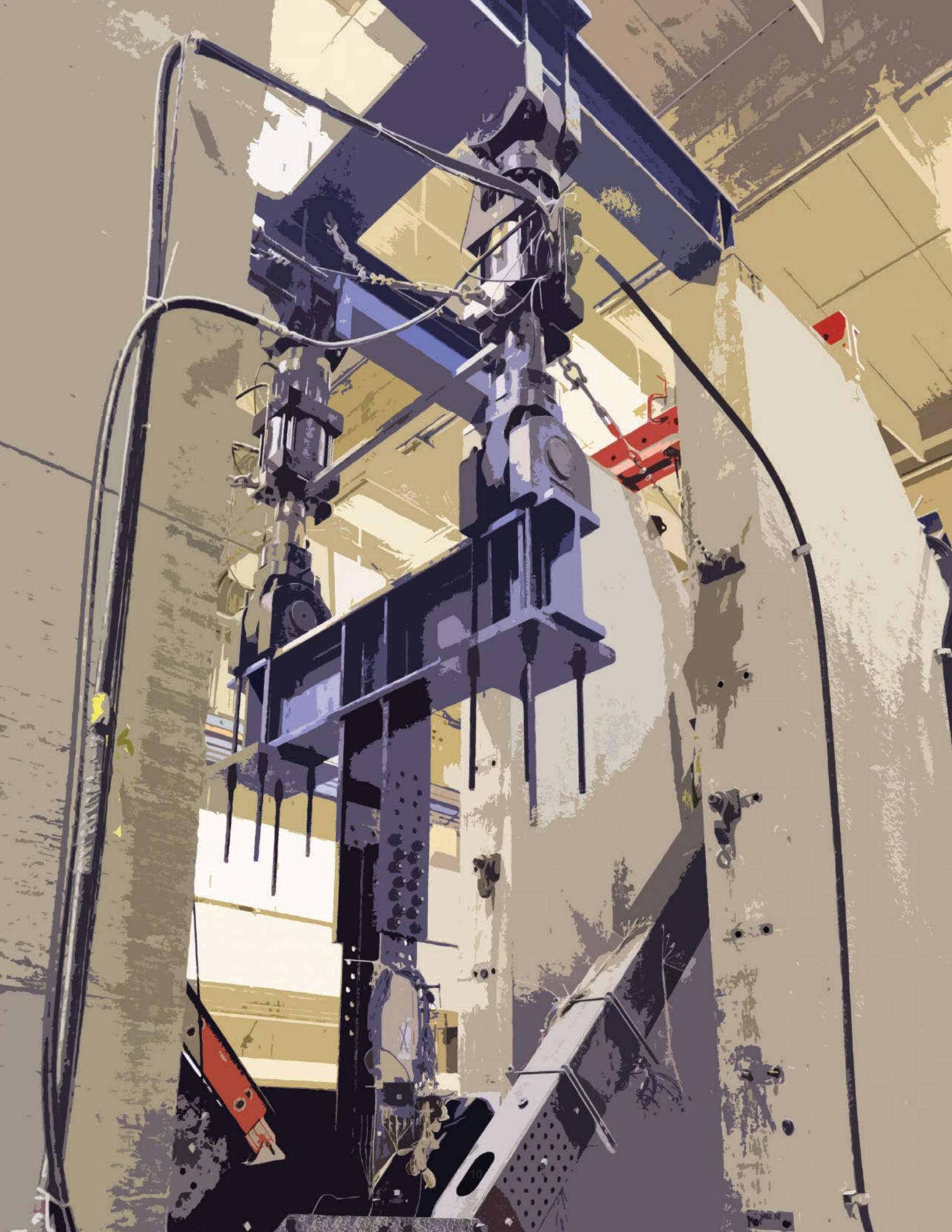
We conduct and coordinate research and advance innovation for a mobile society.
We provide objective, high-quality technical expertise, leadership, and results.

TFHRC CORE VALUES

Table 1 presents the core values of TFHRC, which are the core values for all of FHWA.

Table 1. FHWA and TFHRC shared core values.[18]

Public Service We are committed to the pursuit of professional excellence motivated by serving the public interest and providing high-quality products and timely services.	**Integrity** Ethics, fairness, and honesty define the way we do our work and conduct ourselves. We have the courage to be innovative and to make tough decisions.	**Respect** We value individual diversity and the unique strengths, skills, expertise, and backgrounds of our employees. We treat others in a polite and courteous manner.
Family We support, care about, listen to, and respond to employees and their family needs.	**Collaboration** We maximize our collective talents through teamwork and partnerships based on mutual trust, respect, support, cooperation, and communication.	**Personal Development** Through a wide variety of learning opportunities, we nurture the development and use of leadership, technical, and professional skills in all of our employees.



GOALS AND OBJECTIVES

The following six goals and their constituent objectives are at the heart of this Strategic Plan. Each goal responds directly to the corresponding strategic challenge, as presented previously.

- **Goal 1:** FHWA conducts and sponsors the right research and technology development to improve performance of our Nation's highways.
- **Goal 2:** FHWA engages in strategic partnerships to enhance and leverage research, development, and implementation.
- **Goal 3:** FHWA and TFHRC maintain a flexible organization and agile research workforce to meet evolving transportation challenges.
- **Goal 4:** First-rate research infrastructure is developed and sustained through long-range planning and adequate capital investment.
- **Goal 5:** Research activities and outcomes are appropriately advanced through effective alignment of resources, dissemination of knowledge, and technology transition.
- **Goal 6:** TFHRC provides national leadership to highway and intermodal transportation research.

GOAL 1: FHWA CONDUCTS AND SPONSORS THE RIGHT RESEARCH AND TECHNOLOGY DEVELOPMENT TO IMPROVE PERFORMANCE OF OUR NATION'S HIGHWAYS

The success of the FHWA R&D Program begins with an unwavering focus on the right R&D activities to support TFHRC's mission to conduct and coordinate research and advance innovation for a mobile society. The right R&D focuses on problems of national significance, has the potential to provide significant benefits over the long term, and/or advances the state of the art or practice through higher-risk, higher-payoff research that FHWA is well suited to undertake.

FHWA must ensure that its research programs address the long-term needs of the Nation and the public. The Nation continually demands improvements in highway safety, roads that are in a state of good repair, and sustainability. Increased focus is expected on congestion reduction; energy conservation; environmental concerns, including global climate change; alternative modes of transportation; and better management and use of significantly increasing amounts of data to optimize system condition and performance across the entire highway transportation system. These improvements must occur simultaneously with mounting budgetary challenges and escalating needs to accelerate delivery of innovation, which necessitate increasingly careful, productive, and cost-effective resource allocation. The strategic approach for FHWA R&D takes these and other factors into consideration to create and pursue those research efforts that best serve the Nation's immediate and long-term needs.

Objective 1.1: Shape the Future of Transportation Through Innovation and Technology Development, Addressing Problems of National Significance

TFHRC conducts research designed to achieve strategic national transportation goals. Successful achievement of these goals requires significant and sustained research efforts that are best provided or led by a Federal research program. TFHRC provides leadership and coordination and engages in partnerships designed to address national interests. These partnerships are particularly beneficial when other public and private sector research organizations are also tackling emerging or critical national issues.

Illustrative Pathways[1]

- Establish an effective procedure for identifying long- and short-term R&D needs and the best way to satisfy them.
- Establish FHWA-wide R&D strategic plans and roadmaps as blueprints for addressing functional area needs through research, development, and implementation.

Objective 1.2: Strategically Invest R&D Resources

Research investment decisions are based on strategic consideration of priorities, long-term plans, and core capabilities. Strategic plans and roadmaps that outline what FHWA wants to achieve and how best to achieve those goals form the foundation for the strategic investment process. The pursuit of desired outcomes drives investment decisions. The process is flexible, but sustains investment in key areas and satisfies the need to develop or evolve capabilities that address emerging issues. To ensure appropriate resource application, TFHRC leadership performs periodic investment reviews.

Illustrative Pathways

- Conduct the research that leads to achievement of national research objectives, and invest strategically in support of that research.
- Conduct periodic research investment reviews.

Objective 1.3: Establish and Maintain High Standards of Quality for the Conduct of Research and Research Products

Consistently high standards of quality for research activities and products are critical to delivering high-value research results and accelerating the transition of those results to practical application. TFHRC is committed to maintaining high standards, monitoring programs and projects against those standards, and continuously improving our research performance.

Illustrative Pathways

- Define, review, and update quality standards.
- Conduct periodic research quality reviews.
- Systematically control the quality of research products.

[1] All the "illustrative pathways" here and in the subsequent objectives are intended to convey examples of possible implementation mechanisms. They are subject to change or deletion.

GOAL 2: FHWA ENGAGES IN STRATEGIC PARTNERSHIPS TO ENHANCE AND LEVERAGE RESEARCH, DEVELOPMENT, AND IMPLEMENTATION

Providing advanced science and technology expertise, objectivity, and resources, we develop and lead partnerships to address problems of national interest and emerging research areas. Coordination of research programs provides a vision for FHWA and other stakeholder organizations to collaborate to achieve national transportation goals.

Partnerships can provide the capabilities, multidisciplinary approaches, and creativity that together conquer challenges, but that could be impossible to assemble within a single research enterprise. Facilitated by increasing global connectivity and necessitated by progressively tightened resource constraints, partnership engagement assists FHWA in achieving its long-term research goals. Depending on the goals, capabilities, and interests of the entities involved, specific partnership arrangements may focus on research coordination and scoping, conducting research, advancing research results, and/or implementing technologies into practice. Some partnerships begin unplanned, but provide mutual benefits in focused areas. TFHRC remains open to these unplanned and unexpected opportunities. To help accomplish our research mission on a more enduring and comprehensive basis, however, a strategic, proactive approach must be used to identify potential partners and develop appropriate relationships. This strategic approach demands an awareness of the complete landscape of highway research within the United States and internationally, and a commitment to create and sustain effective working relationships with partners.

Objective 2.1: Identify Opportunities for and Engage in Strategic Partnerships

Partnerships complement, extend, or substitute for in-house research capabilities deemed necessary for the successful achievement of research goals.

Illustrative Pathways

- Identify capabilities of potential partners.
- Match research needs as contained in FHWA roadmaps with potential partners.
- Sustain partnerships by periodically reviewing partnership agreements to ensure effectiveness, relevance, and commitment.

Objective 2.2: Expand Methods for Establishing Effective Partnerships

Maximizing the extent and benefits of partnerships hinges on the successful use of all authorities and mechanisms available to FHWA. To the extent that TFHRC provides for its core capabilities through industrial or academic partners, long-term agreements may be necessary to provide reasonable assurance of continuity. The motivations, incentives, and risks for implementation partners may differ from those for research partners. In cases where effective partnerships are limited by existing authorities, legislative or regulatory changes could be enabled for future collaborative relationships.

Illustrative Pathways

- Develop and take full advantage of partnership authorities and mechanisms, which may vary among partner types and partnership purposes.
- Encourage and facilitate international partnerships, bringing foreign innovations to America and potentially encouraging world demand for goods from the United States.

Objective 2.3: Develop Partnerships to Access External Research Infrastructure

When establishment or maintenance of needed research infrastructure—i.e., infrastructure solely or primarily dedicated to research—at TFHRC does not make long-term sense technically or fiscally, or does not assure adequate capacity to fulfill projected research requirements, external partners are considered for provision of the necessary infrastructure capabilities. Managers at TFHRC evaluate both domestic and international research facilities for this purpose.

Reliable external research facilities must be capable of producing credible work, must have a plan for and likelihood of sustaining capabilities over the required period of time, and must have a genuine interest in partnering with FHWA.

Likewise, FHWA has a profound interest in encouraging performance-based management and operations of transportation infrastructure. TFHRC neither manages nor operates transportation infrastructure; the R&D performed onsite is restricted to developing enabling technologies, modeling and simulating their capabilities, and performing limited onsite testing. Consequently, TFHRC must partner with transportation facility owners and operators to test promising prototypes on public facilities. These partnerships are mutually beneficial because facility owners and operators, such as State transportation departments, can benefit from early implementation of advanced technology, and TFHRC can benefit by obtaining real-world data from the measurement systems installed in what becomes a living laboratory.

Illustrative Pathways

- Execute agreements with other Federal research enterprises to access high-performance computing resources.
- Develop partnerships with State and local transportation agencies to augment internal experimental facilities with research in living laboratories.

GOAL 3: FHWA AND TFHRC MAINTAIN A FLEXIBLE ORGANIZATION AND AGILE RESEARCH WORKFORCE TO MEET NEW AND EVOLVING TRANSPORTATION CHALLENGES

Future transportation challenges, along with quickly emerging technologies and practices, call for a highly adaptable research workforce to respond with workable solutions. Transportation problems—and the technological opportunities for addressing them—are becoming increasingly complex, requiring multidisciplinary teams, effective partnerships, and a workforce that can adapt its skills to meet immediate and evolving needs.

Thus, greater flexibility in managing the Federal workforce would enhance the efficiency, responsiveness, and effectiveness of future research. Human resources policies may be able to evolve, within future legislative and regulatory authorities, to provide this flexibility. In any case, the Federal workforce alone does not suffice to meet future challenges. TFHRC continues to monitor, and adjust as needed, the composition and allocation of its onsite contractor workforce to adapt its output to the Nation's evolving needs for highway research. This evolution also governs the configuration of the center's visiting staff from academia, other government agencies, and industry. Performance management promotes and enables high achievement of the combined workforce.

Objective 3.1: Develop and Sustain Flexible Organizational and Human Capital Structures

A flexible organizational and human capital structure would enable TFHRC to develop and manage a maximally responsive, agile workforce. Other Federal research enterprises may provide good examples of practices in human capital management (e.g., simplified job classification) that could serve as models to evolve these organizational and human capital structures for TFHRC. Organizational changes should also be instituted as appropriate and feasible to enhance the performance of TFHRC and respond to FHWA requirements.

Illustrative Pathways

- Identify and consider organizational structures that support flexibility to meet changing needs/demands.
- Enhance human capital structure, in coordination with human resources leadership.

Objective 3.2: Define Future Requirements and Establish Proper Expertise Levels for Core Discipline/Knowledge Areas

Developing the appropriate workforce requires understanding the substantive needs well in advance because changes in workforce do not occur quickly. In accordance with the objectives of Goal 1, examination of future research challenges identifies the knowledge, skills, and capabilities needed to meet those challenges. Desired workforce characteristics for the future are compared with the existing workforce to enable effective workforce planning. This planning for subject matter expertise occurs regardless of the administrative structure, flexibilities, and limitations of TFHRC. Workforce planning proceeds in continuous coordination with infrastructure planning—and is guided by the same corporate processes for identifying and meeting future research needs—because both human and physical resources must coalesce to serve the same ends and require time to mature.

Illustrative Pathways

- Develop future workforce vision for TFHRC by determining the knowledge, skills, and abilities (KSA) needed in the future.
- Assess current state relative to the future vision and create a research workforce/support expertise plan, taking into account trends and plans for similar disciplines throughout FHWA.

Objective 3.3: Conduct Workforce Planning and Management to Meet Future Expertise Demands

TFHRC conducts workforce planning to help achieve, on a timely basis, the skills that are identified as needed under Objective 3.2 above. As research priorities evolve, TFHRC management will attain the necessary workforce through adaptation of the Federal staff, in addition to using non-Federal and visiting researchers. Formal partnerships play an important role in providing growth in new research areas. Management of the workforce ensures that it does not become stagnant or unresponsive to future challenges. A flexible workforce consisting of Federal and non-Federal workers provides alternatives and options to refresh and shape the skillsets and experience of the research workforce.

Illustrative Pathways

- Achieve desired Federal workforce capabilities.
- Achieve desired onsite contractor workforce capabilities.
- Augment the onsite workforce with visiting researchers and partnerships, and encourage careers in highway research

Objective 3.4: Communicate and Coordinate Within TFHRC and With Other Units of FHWA

To capitalize on TFHRC's many potentials, proactive internal communication—both within TFHRC and within FHWA—is mandatory. Internal communication merits special emphasis because it enables each employee to see how his or her projects contribute to the larger goals of TFHRC and FHWA, and because it encourages and facilitates creative collaboration among projects and personnel.

GOAL 4: FIRST-RATE RESEARCH INFRASTRUCTURE IS DEVELOPED AND SUSTAINED THROUGH LONG-RANGE PLANNING AND ADEQUATE CAPITAL INVESTMENT

As the only Federal laboratory focused on highway transportation, TFHRC develops, maintains, and operates first-rate research facilities and equipment. Doing so requires strategic investment in research infrastructure to ensure that resources are optimized and that current and future research needs are met. Partnerships that leverage the infrastructure resources of other research enterprises in government, academia, or industry (see Objective 2.3, Strategic Partnerships, for more information), including small business, are essential elements, while critical infrastructure is maintained in-house. Critical infrastructure for TFHRC includes those physical assets that are:

- Necessary and fundamental to the core FHWA research program.
- Required to solve emerging challenges over the next 10 to 20 years.
- Essential for technical support of national interests related to the highway system.
- Unavailable from external sources.

To complement our reliance on external research facilities, we publicize our infrastructure resources and allow other researchers appropriate access. Doing so leverages the Federal

investment in our research infrastructure, helps sustain and enhance our abilities, fosters partnerships in research, and advances the economy by fostering small business success.

Objective 4.1: Assess Needs and Strategically Pursue Research Infrastructure

TFHRC anticipates future research needs by actively engaging the broader highway research community and maintaining awareness of emerging topics in other research domains.

Much like human capital, research facilities and equipment are neither easily nor quickly developed, so anticipating needs to provide sufficient lead time is critical. Because of the time and investment involved, decisions to develop and maintain in-house infrastructure must be deliberate and supported by trends in research directions. Developing human capital in core focus areas supports investments in research infrastructure. Researchers and managers at TFHRC consider how a potential partner's research facility satisfies some portion of TFHRC's needs and pursue appropriate methods to access and rely on those research facilities. FHWA must strategically provide first-rate research infrastructure and ensure that physical resources are optimized to meet future research needs.

Illustrative Pathways

- Assess the requirements for research infrastructure.
- Develop plans to acquire or access needed research infrastructure.

Objective 4.2: Establish Essential Research Infrastructure

TFHRC adapts or upgrades existing in-house research infrastructure that is determined to be necessary to retain within the FHWA. With the support of the FHWA R&T Leadership Team, TFHRC explores and develops new research facilities and equipment to address emerging areas.

Illustrative Pathways

- Plan and budget for research infrastructure.
- Develop and adapt research infrastructure.
- Operate, maintain, and continuously update a first-rate research facility that provides for evolving capabilities that meet the identified needs of FHWA's R&T Program.

GOAL 5: RESEARCH ACTIVITIES AND OUTCOMES ARE APPROPRIATELY ADVANCED THROUGH EFFECTIVE ALIGNMENT OF RESOURCES, DISSEMINATION OF KNOWLEDGE, AND TECHNOLOGY TRANSITION

TFHRC plans and conducts R&T development to improve the state of the practice, consistently focusing on technology transition and on its prerequisite: effective communication. TFHRC engages transition partners early in the research process to facilitate knowledge transfer and technology transition, ensuring that products and results continue to advance. Depending on the maturity of the research results or technology, advancement can require further research or development and/or implementation, which can include demonstrations, pilot projects, and full-scale deployments. Research and implementation partners agree on development milestones necessary for successful transition.

Communication must take place throughout the innovation or development life cycle to create and sustain mutually agreed expectations. As part of that communication, TFHRC maintains—and shares with its prospective partners—comprehensive and current knowledge of the evolving resources and mechanisms that can advance each stage of the research, development, and implementation cycle. Examples of potentially applicable mechanisms include, but are not limited to, the Transportation Pooled Fund Program, the Small Business Innovation Research Program, the Strategic Highway Research Program, and the coordination of cooperative research programs managed by the TRB. These programs would be useful in assisting TFHRC's efforts to foster externally developed innovations and technologies.

Technology Transition

Technology transition generally refers to transitioning technology from the laboratory to a program. From a highway research perspective, technology transition is the incorporation of technology into operating transportation systems to achieve (a) increased performance in terms of safety, capacity, speed, energy efficiency, and emissions reductions, and/or (b) reduced cost for developing, producing, acquiring, installing, designing, constructing, and maintaining operating system components throughout their life cycles.

Timing. Timeliness is extremely important to technology transitions because public safety and expenditures are involved. Technology transitions can occur during the development of highway system components, or even after certain types of components have been in the field for a number of years

Participants. Technology transitions can occur between government organizations, such as when a government research facility transitions a technology to a government transportation department for installation in an operating facility. Industry can transition technology to government, and vice versa.

Methods. Technology transitions occur through application of the following:

- Leveraging the best technology available from both government and commercial sources.
- Transitioning the technology rapidly into new highway system components with advantages focused on safety, performance, energy, environmental, and cost.
- Refreshing the technology, as appropriate, to maintain and further upgrade system safety, performance, external impacts, and economy.[7]

Objective 5.1: Engage Actual and Potential Stakeholders to Improve Awareness of FHWA Research Priorities, Directions, and Technology Roadmaps and to Facilitate Implementation of Results

The national and international highway research arena is diverse and requires continual communication to establish working partnerships for setting agendas; conduct of research; and transfer of knowledge, technology, and innovation. The R&T agenda of FHWA is transparent to actual and potential stakeholders and partners—within USDOT, at all levels of government within and outside the United States, and in the private sector and academia—and encourages dialogue on FHWA's national challenges, goals, and strategies.

Illustrative Pathways

- Develop and implement strategic communications plans for R&D.
- Engage external partners early, where feasible, to plan technology transition and implementation.
- Support agency initiatives, including targeted outreach, to accelerate technology transition and implementation.

Objective 5.2: Collaborate Within FHWA, and With Other Appropriate USDOT Agencies; States; Other Governmental Jurisdictions, Including Local Governments; Industry; Academia; and National and International Organizations, to Ensure Successful Innovation and Technology Transition in Accordance With Agency Technology Roadmaps

TFHRC coordinates R&T programs across FHWA, with other appropriate USDOT agencies, States, other governmental jurisdictions at all levels, industry, academia, and national and international highway research organizations, to identify areas for collaboration to address transportation challenges. The research capabilities of TFHRC provide the knowledge for FHWA to add value to the state of the art and eventually influence the state of the practice. TFHRC engages with appropriate offices and organizations to develop a technology and innovation transition plan and to accelerate implementation of that plan. Transition paths vary depending on the nature and maturity of a particular research product or technology.

Illustrative Pathways

- Develop flexible and seamless process for coordination of R&D across FHWA.
- Engage technology transition partners within the agency early to plan transition according to technology and innovation roadmaps.
- Develop and sustain a process to enhance TFHRC's existing partnership with the Office of Federal Lands Highway (FLH) and other FHWA units to demonstrate and pilot research products.
- Cultivate linkages with other USDOT R&D efforts.
- Establish clear and continual communications for coordination and collaboration to facilitate technology transition with national and international partners

Objective 5.3: Foster Development and Implementation of Targeted Externally Developed Innovations and Technologies

Through consultation with FHWA's partners and stakeholders, TFHRC maintains awareness of R&D activities nationally and internationally to identify technologies being developed elsewhere that show great promise. Depending on the type of technology and its maturity, TFHRC may engage in a partnership to develop the technology further or may advocate for its demonstration or implementation.

Illustrative Pathways

- Maintain awareness of emerging innovations of national interest.
- Develop a process to assess the need for FHWA involvement to advance emerging innovations.
- Refine and validate research products when appropriate.

GOAL 6: TFHRC PROVIDES NATIONAL LEADERSHIP TO HIGHWAY AND INTERMODAL TRANSPORTATION RESEARCH

FHWA fulfills its strategic goal of national leadership by developing and advocating solutions to national transportation needs. TFHRC fulfills a corresponding national leadership role in highway research and technology development. In addition to chairing the FHWA R&T Leadership Team, TFHRC actively participates in leading cooperative research programs with partners including Research and Innovative Technology Administration, TRB, and the States. In support of this national leadership role, TFHRC strategically manages its Federal and non-Federal workforce as well as its research infrastructure.

Objective 6.1: Advocate a Research Vision for the Nation's Highway Research Programs

Based on the strategies described in this Strategic Plan for TFHRC and the underlying FHWA Strategic Plan, TFHRC advocates and implements a research vision that guides the national research agenda in highway transportation. As the champion for research in FHWA, TFHRC participates in relevant interagency committees and initiatives, such as the National Nanotechnology Initiative, and conducts joint research programs with other agencies in the broader research community. TFHRC engages in the leadership of national and international cooperative research programs, and leads the FHWA's Small Business Innovation Research program. To improve alignment of complementary research, TFHRC promotes research plans and priorities to university transportation centers and other academic researchers. TFHRC also catalyzes joint research projects under the Transportation Pooled Fund Program.

Illustrative Pathways

- Articulate the transportation impacts of broader research.
- Engage in interagency and international research initiatives and collaborate with other agencies and organizations.
- Pursue alignment of cooperative and complementary research programs with a national research agenda.
- Engage small businesses.

Objective 6.2: Lead the FHWA R&D Program

TFHRC leads the planning, programming, budgeting, and execution of the internal and external research that it manages in support of FHWA's strategic objectives, and coordinates the FHWA research program across the agency and the Department.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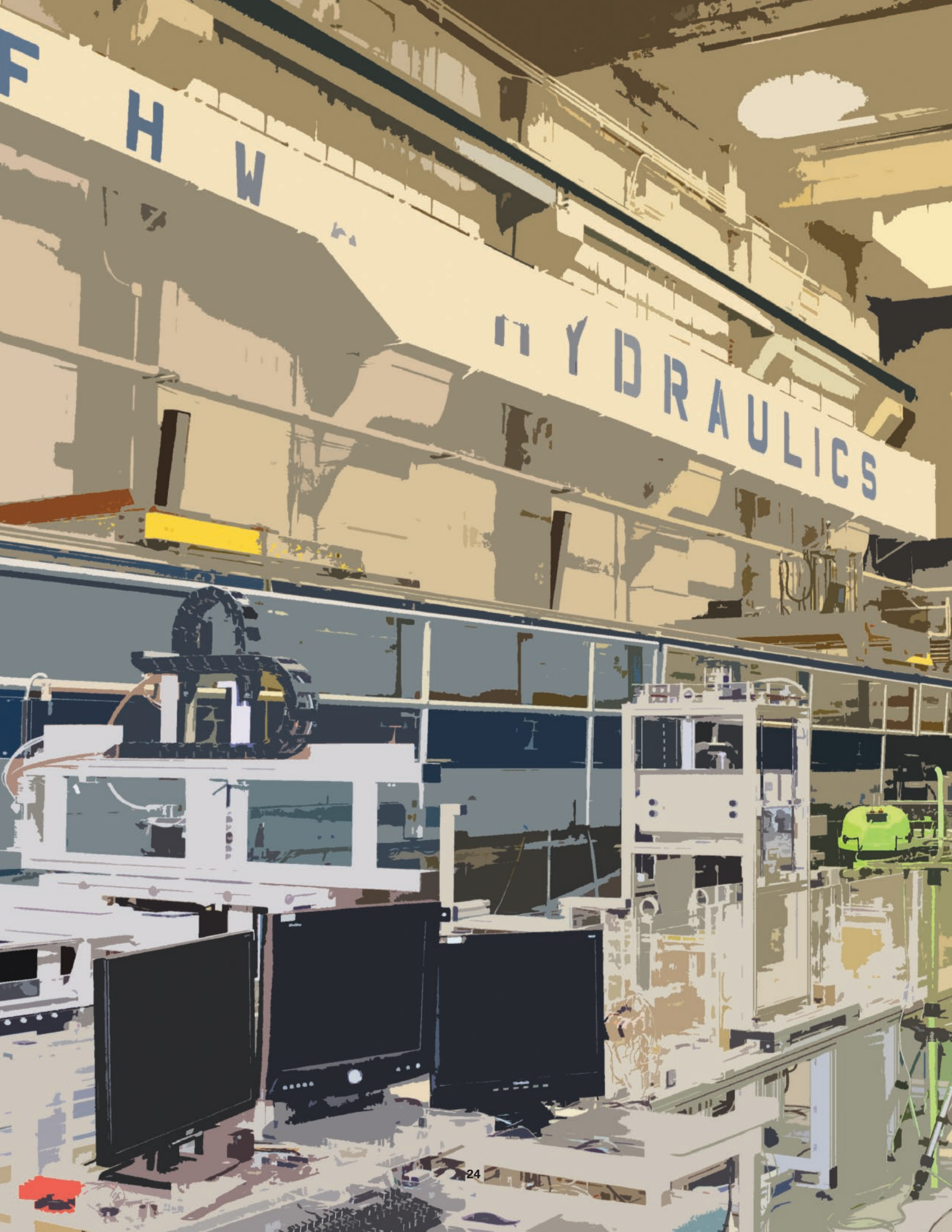
MOVING FORWARD

Implementation of the TFHRC Strategic Plan, already well underway, will enable TFHRC to strengthen its national leadership of highway and intermodal transportation research. By putting in place mechanisms to assure that the center's programs identify and undertake the right research, TFHRC will establish a continuing basis for effecting the following:

- Forging productive partnerships with all levels of the public sector, private industry, academia, and the international research community that will leverage and amplify the Federal investment in highway research.
- Systematically planning TFHRC's research capabilities, in terms of both human and infrastructure resources.
- Quickly transitioning innovation from the laboratory to the Nation's transportation network, where the benefits of the research will accrue.

There is great potential for added safety, efficiency, economy, mobility, and quality of life in the U.S. highway network. Only research of the caliber, breadth, and depth that have characterized TFHRC since its inception can fully unlock that potential. This Strategic Plan presents the principles and strategies that will enable TFHRC to achieve its vision, accomplish its mission, and—ultimately—realize a safer, longer-lasting, and more productive highway network for America.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APPENDIX: FHWA'S RESEARCH PORTFOLIO IN BRIEF

FHWA's R&T portfolio comprises five topical areas and three crosscutting programs that together support the full range of FHWA's mission and functions and bolster the far-reaching national highway enterprise, as shown in table 2. Research under the direction of TFHRC is described in detail at TFHRC Research and Development Programs Web page.[8] The entire FHWA research agenda is detailed at the FHWA Research and Technology Agenda Web page.[9]

Assisted by staff throughout FHWA and partner entities, the R&T Leadership Team assures continuous and comprehensive interaction and productive collaboration among these research components. For example, the Leadership Team encourages joint projects addressing crosscutting issues and creative initiatives that do not fall neatly into existing categories.

Table 2. Research components.

	Research Component
Topical Areas	Infrastructure
	Operations
	Safety
	Planning, Environment, and Realty
	Policy
Crosscutting Programs	Exploratory Advanced Research
	Innovative Program Delivery
	Federal Lands

The following sections briefly describe the eight components of FHWA's R&T portfolio and provide references to additional sources of information.

INFRASTRUCTURE

The FHWA Infrastructure R&D Program provides technologies and solutions to advance practices in highway infrastructure engineering. Detailed information on the programs of the Office of Infrastructure R&D can be found on the FHWA Infrastructure R&D Web page.[10]

R&D activities address pavements, bridges, tunnels, and other structures, the materials from which our highway infrastructure is constructed, inspection techniques for assessing its condition and long-term performance, and measures to protect the infrastructure from natural and man-made extreme events including blast, fire, earthquakes, and floods.

The FHWA's Infrastructure R&D Program develops products that could eventually become national guidelines, tools, or specifications, and that support achievement of the following FHWA Infrastructure R&T purposes:

- Reduce the number of fatalities attributable to infrastructure design characteristics and work zones.
- Improve the safety and security of highway infrastructure.
- Improve the management of infrastructure assets and advance the implementation of a performance-based program for the National Highway System.
- Improve the ability of transportation agencies to deliver projects that meet expectations for timeliness, quality, and cost.
- Reduce user delays attributable to infrastructure system performance, maintenance, rehabilitation, and construction.
- Improve highway conditions and performance through enhanced design and construction practices, increased use of long-lasting materials, and maintenance innovations.
- Reduce the life-cycle environmental impacts of highway infrastructure (i.e., design, construction, operation, preservation, and maintenance).

The focus areas pursued to achieve these purposes include Long-Term Infrastructure Performance, Durable Infrastructure Systems, Accelerated Highway Construction, Environmentally Sensitive Highway Infrastructure, Performance-Based Specifications, and Comprehensive and Integrated Infrastructure Asset Management.

OPERATIONS

The FHWA Operations R&D Program addresses the full range of technologies, strategies, and opportunities to move people, vehicles, and freight more efficiently, effectively, and safely. Detailed information on the programs of the Office of Operations R&D can be found on the FHWA Operations R&D Web page.[11]

Investments are made to achieve three strategic aims:

- Manage congestion by improving reliability and operating the system at peak performance.
- Build a strong foundation for proactive operations.
- Improve reliability through efficient movement of freight.

Three focus areas of Operations R&D support achieving the preceding aims:

- Transportation Enabling Technologies pertains to methods and equipment that sense and measure traffic characteristics; capture, organize, and manage large amounts of real-time "big data" generated by mobile devices; measure vehicle position and trajectory; assist in navigation; perform precision lane-level mapping; control traffic movement via traffic signals and changeable message signs; and wirelessly communicate information among vehicles and the infrastructure and across the entire communications spectrum, including 3G, 4G, Long Term Evolution (LTE), and dedicated short-range communications at the 5.9 gigahertz band.[12]
- Operations Concepts and Analysis involves the development and use of new modeling, simulations, and visualizations to test connected vehicle strategies and automation technologies in their conceptual stages while avoiding costly and possibly unsafe testing on "live roadways."
- Transportation Operations Applications takes promising concepts from simulations to the real world to smooth traffic flow. This area employs hardware and software tools and strategies to develop and test innovative transportation applications on test tracks and public roads. Applications include those susceptible to implementation in the near term (e.g., road weather and work zone management) and the long term (e.g., vehicle platooning and creation of eco-friendly electronic glide paths through signalized intersections).[11]

SAFETY

FHWA's Safety R&D Program addresses three major focus areas:

- Human factors research, which fosters understanding of how road users perceive, process, and respond to the roadway environment, thus improving highway safety through better roadway design.
- Roadway research, which helps keep vehicles on the roadway and minimizes the consequences of leaving the roadway.
- Safety management, which supports improved safety resource allocation decisions through the collection of consistent, high-quality data, the development of analytical tools to transform data into actionable information, and the formal evaluation of the effectiveness of potential safety improvements.

Additional information on the programs of the Office of Safety R&D is available on the Safety R&D Program Web page.[13]

PLANNING, ENVIRONMENT, AND REALTY

The Office of Planning, Environment, and Realty's research primarily addresses topics associated with comprehensive intermodal and multi-modal transportation planning, enhancement of community and social benefits of highway transportation, and improvements to the quality of the natural environment by reducing highway-related pollution and by protecting and enhancing ecosystems. In addition, research on the fair and prudent acquisition and management of real property is undertaken.

Additional information on FHWA's planning, environmental, and realty research is available on the Office of Planning, Environment, and Realty's Research and Financial Services Web page.[14]

POLICY RESEARCH

FHWA's policy research initiatives support the following objectives:

- Evaluate impacts of a broad range of policy options, and analyze current and emerging issues that will affect surface transportation programs.
- Promote the efficient, systematic, and comprehensive collection and utilization of national transportation data to improve highway management and investment decisions.
- Research intergovernmental issues between States, cities, and Tribal governments that impact transportation policy decisions, budgetary processes, and legislative recommendations.
- Promote the exchange of highway technology and program innovations between the United States and foreign countries and organizations.

Additional information on policy research is available on the FHWA's Office of Policy and Governmental Affairs Web page.[15]

EXPLORATORY ADVANCED RESEARCH

FHWA manages the Exploratory Advanced Research Program across a spectrum of issues that are critical to the transportation industry. This research encompasses four comprehensive focus areas:

- Predicting societal and complex natural systems.
- Creating next-generation solutions to build, maintain, and manage future highways.
- Developing next-generation solutions for system operations and reducing congestion.
- Creating next-generation pedestrian, bicycle, and driver safety.

Additional information can be found on the Exploratory Advanced Research Program Web page.[16]

INNOVATIVE PROGRAM DELIVERY

The FHWA's Office of Innovative Program Delivery executes a comprehensive research program. It seeks to place its activities within a broader, national agenda by engaging a wide spectrum of stakeholders to define the goals for the research program and develop multi-year roadmaps. Research focuses on (1) refining and developing new innovative strategies for project finance, revenue generation, and procurement; (2) developing and delivering tools for evaluating the applicability of the innovative strategies; and (3) addressing public policy, operational, and legislative issues associated with the strategies.

Additional information can be found on the Office of Innovative Program Delivery Web page.[17]

FEDERAL LANDS HIGHWAY TECHNOLOGY PROGRAMS

The Office of Federal Lands Highway, in close collaboration with the Office of Research, Development, and Technology and other partnering entities, advances highway technology through two related programs:

- The Federal Lands Highway Technology Program evaluates new highway technology that will improve the quality and efficiency of the Federal Lands Highway Program and its delivery systems within the highway community. The program provides solutions that are sensitive to agency needs, improve agency efficiency, and improve the quality of transportation projects. This is accomplished through engaging partners and customers to play an active role in the program. The program enables technology transfer between Federal land management agencies, tribal governments, FHWA Resource Centers, FHWA's Office of RD&T, and the transportation industry. Goals of the program include developing, evaluating, and implementing new highway technologies; field testing and demonstrating new technologies; providing engineering assistance; and sharing and documenting results with the transportation community.[18]
- The Coordinated Federal Lands Highway Technology Implementation Program is a cooperative technology deployment and sharing program between FHWA's Office of Federal Lands Highway and Federal land management agencies. It provides a forum for identifying, studying, documenting, and transferring new technology to the transportation community.[19]

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LIST OF ACRONYMS AND ABBREVIATIONS

CTIP ..... Coordinated Technology Implementation Program

FHWA ..... Federal Highway Administration

FLC ..... Federal Laboratory Consortium

LTE ..... Long-Term Evolution

MAP-21 ..... Moving Ahead for Progress in the 21st Century Act

NCHRP ..... National Cooperative Highway Research Program

R&D ..... Research and Development

R&T ..... Research and Technology

RD&T ..... Research, Development, and Technology

RTCC ..... Research and Technology Coordinating Committee

TFHRC ..... Turner-Fairbank Highway Research Center

TPF ..... Transportation Pooled Fund

TRB ..... Transportation Research Board

USDOT ..... United States Department of Transportation

UTC ..... University Transportation Center

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