Implementing Research Results: Highlighting State and National Practices

Requested by
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The Caltrans Division of Research and Innovation (DRI) receives and evaluates numerous research problem statements for funding every year. DRI conducts Preliminary Investigations on these problem statements to better scope and prioritize the proposed research in light of existing credible work on the topics nationally and internationally. Online and print sources for Preliminary Investigations include the National Cooperative Highway Research Program (NCHRP) and other Transportation Research Board (TRB) programs, the American Association of State Highway and Transportation Officials (AASHTO), the research and practices of other transportation agencies, and related academic and industry research. The views and conclusions in cited works, while generally peer reviewed or published by authoritative sources, may not be accepted without qualification by all experts in the field.

Executive Summary

Background

Caltrans' Division of Research and Innovation is holding a peer exchange, *Characteristics of Organizations and Skill Sets of Individuals Successful at Accelerating Adoption of Innovation*, March 16-18, 2011. To prepare for the discussions that will unfold during the peer exchange, Caltrans would like to present participants with highlights of state and national practices in implementing the results of transportation research.

To provide this overview, this Preliminary Investigation compiles practices and citations that address the following: adopting successful implementation practices, overcoming hurdles to implementation, structuring a research program to support implementation, developing the staff responsible for implementation and fostering a culture of innovation.

Summary of Findings

We reviewed peer exchange reports, conference papers and other publications, and web-based information about state department of transportation (DOT) research programs and national transportation committees and programs to gather information about implementation practices at the state and national levels.

We present our findings in five topic areas, summarized below:

- Introduction to Implementation.
- Recurring Themes in Implementation.
- Selected Implementation Program Highlights.
- National Efforts to Encourage Innovation.
- Related Publications.

Introduction to Implementation

- We begin the discussion with definitions of implementation that range from the general approach taken by the Louisiana Transportation Research Center (LTRC) (adoption of research results to provide new and innovative practice) to the more specific description included in Ohio DOT's draft research manual (the incorporation of research findings into a new or revised ODOT policy, procedure, specification, standard drawing or work method).
- We close this section by identifying some of the challenges cited by research managers in structuring a successful implementation program, including:
    - Quantifying the outcomes of implementation.
    - Preparing effective communication.
    - Allowing for a lack of time and resources.
    - Tracking the implementation process.

Recurring Themes in Implementation

An examination of recent peer exchange reports and other publications related to implementation yielded recurring themes, including:

- **Encouraging management support.** Agencies are structuring implementation programs that involve top-level management while continuing to gather input and ensure buy-in from the field.
- **Staffing for implementation.** We contrast implementation processes that rely on members of technical panels to see the implementation process through to completion with programs that designate staff positions with a specific responsibility for implementation. More unique are those programs designed to focus solely on implementation.
- **Considering implementation throughout the research process.** Most agencies view implementation as a process that begins at the outset of research and concludes well after the research project wraps up. We provide examples of forms and processes used by agencies to document preliminary implementation plans at the project proposal stage and monitor progress during the research cycle.
- **Communicating research results.** Agencies recognize that communication is an important tool in fostering and supporting implementation, and an effective communication plan for implementation begins early. In this section, we highlight examples of communication plans; technology briefs; newsletters; and other outreach efforts such as webinars, workshops, field trips and staff meetings.
- **Ongoing monitoring of implementation.** A variety of tools are used to track projects and monitor implementation, including web-based management systems, Excel databases, online dashboards, performance measures, forms and periodic reports.
- **Encouraging innovation.** Agencies are encouraging innovation with staff recognition, incentives and dedicated staff to assist with deployment.

Selected Implementation Program Highlights

We examined in greater detail the implementation programs of five states—Louisiana, Minnesota, Ohio, Pennsylvania and Washington:

- **Louisiana Transportation Research Center**. LTRC is finalizing its web-based Research Project Management System that tracks all aspects of research and implementation.

- **Minnesota DOT.** Users of the Mn/DOT Implementation Funding Project-Builder web site submit implementation ideas for discussion and voting by the community. Mn/DOT has set aside $1.15 million in 2011 for implementing completed research.
- **Ohio DOT.** Ohio DOT's November 2010 draft research manual is awaiting Federal Highway Administration (FHWA) approval. Among the implementation processes detailed in the draft manual is direction for completing the Implementation Progress Report, which tracks progress based on the schedule in the implementation plan.
- **Pennsylvania DOT.** In 2004, PennDOT's Research and Innovation Implementation Program was developed to provide an implementation infrastructure to fast-track innovations. An Implementation System Manager works in concert with a consultant team to "identify and implement innovations, facilitate practical uses for these innovations, and communicate and implement research results."
- **Washington State DOT.** Implementation expectations are included in research proposals and managed throughout the project. Each research project is assigned a Principal Investigator, Technical Monitor and Research Manager. An Executive Monthly Report summarizes completed research projects and includes an implementation summary.

National Efforts to Encourage Innovation

- TRB's committees on Technology Transfer and Conduct of Research can offer support and resources to agencies seeking to enhance implementation practices.
- National programs encourage transformative research, fund promising but unproven innovations, and accelerate and expand the deployment of transportation-related innovations. These programs include:
    - FHWA's Every Day Counts, Exploratory Advanced Research Program, and Highways for LIFE.
    - TRB's Innovations Deserving Exploratory Analysis and Strategic Highway Research Program 2.
    - AASHTO's Technology Implementation Group.

Related Publications

In this section we highlight publications that address the implementation practices of state research programs. Many of these publications provided source material for the Recurring Themes in Implementation section of this Preliminary Investigation:

- Two NCHRP reports examine effective practices in technology transfer and communicating the value of research. Success in these areas can contribute to a successful implementation program.
- Final reports from peer exchanges held in 10 states—Alabama, Alaska, Florida, Iowa, Michigan, Minnesota, Missouri, New Jersey, Virginia and Washington—provide insight into current and planned implementation practices, challenges encountered and lessons learned as transportation research managers from around the country share their experiences.
- Results of a survey on implementation completed by members of AASHTO's Research Advisory Committee are presented.
- TRB publications describe the factors that create an environment conducive to conducting transformative research, provide strategies that might be used to foster implementation, and discuss implementation programs and the advancement of innovation in California, Minnesota and Pennsylvania.

- Florida DOT's research program manual and Tracker, a Missouri DOT publication that documents the agency's performance measurement system, including measures related to innovation in research, are discussed.

Gaps in Findings

Our research indicates that the implementation process in state DOTs is evolving, with research managers continuing to identify effective practices—sometimes already in use in other programs—and modifying them to fit local needs. Some of the implementation practices identified in this Preliminary Investigation may have changed since publication of the documents reviewed to prepare this overview.

The summary nature of this Preliminary Investigation means that there are likely other effective implementation practices in use by state DOTs that are not highlighted here. A more extensive state-by-state survey or analysis might yield more detail about the processes, practices and forms described in this overview, and also provide information about implementation practices applied in other research programs not referenced in this Preliminary Investigation.

Next Steps

This overview is intended to provide a compilation of approaches and experiences for discussion at the upcoming Caltrans peer exchange. Discussions among the Caltrans peer exchange participants are expected to generate information that will enhance Caltrans' current efforts aimed at refining implementation processes and accelerating innovation.

Introduction to Implementation

Effectively translating research results into practice is a challenge that must be met by researchers and managers in business and industry, the medical profession and virtually any field for which research is conducted. New innovations that arise out of research can save lives and increase efficiencies, sometimes bringing about profound changes in the way we live our lives. But seeing the results of research come to fruition cannot be assumed. For some organizations and disciplines, making changes in everyday practice can take years, or changes in practice may never be identified because the results of critical research never make it beyond the publication of a final research report. Too often, implementation can be more of an afterthought of the research process rather than an essential outcome.

Defining the Issue

For transportation agencies, putting new knowledge into practice is no less challenging. To understand and resolve these challenges, we begin with a simple question: What is implementation? Participants at a December 2010 peer exchange hosted by Michigan DOT offered these definitions:

- Results that are used, adopted or standardized.
- Research that results in knowledge to aid management decisions, a manual change, a policy development or change, technological application or a new process.
- Results that save time or money, improve efficiency or become another tool in the agency's toolbox.

Implementation is also defined in state DOT research manuals:

- The use of research results in a production mode, and [implementation] may occur in a variety of ways and to varying degrees. For example, implementation may be limited by the nature of the application, partial by the scope and nature of the rollout, or systematic as through specifications modifications (Florida DOT).
- Adoption of research results to provide new and innovative practice (LTRC).
- The incorporation of research findings into a new or revised ODOT policy, procedure, specification, standard drawing or work method (Ohio DOT).
- Adoption of a product for use, including technology transfer activities that promote adoption, such as:
    - **Information dissemination:** which includes the development and distribution of brochures, manuals, articles, reports, videos and other materials which provide product descriptions and instructions to enable and promote use.
    - **Training:** which includes training course development and conduct necessary to enable and promote use.
    - **Demonstration:** which is the placing of a product into TxDOT's operational environment to demonstrate its use, which includes:
        - **Deployment:** which is the initial procurement and dissemination of a product to users.
        - **Implementation Field Testing:** which is the demonstration or verification of product performance in TxDOT's operational environment (Texas DOT).

Identifying the Challenges

Participants in recent state DOT research program peer exchanges note that not all projects result in implementable research, and that some projects are worthwhile solely for the knowledge they create. Instead of labeling these projects as "basic research" or "not implementable," research managers might consider another label—advanced technology research.

Promoting the value of research that does not result in implementable results is just one of the challenges identified by recent peer exchange participants. Other common challenges include:

- Quantifying the outcomes of research implementation.
- Preparing effective communication.
- Acknowledging agency resistance to change.
- Allowing for a lack of time and resources.
- Defining expected implementation products before research results are known.
- Tracking the implementation process.

Recurring Themes in Implementation

As we examined recent peer exchange reports and other publications related to implementation, we began to see recurring themes in how research programs are structured and the processes and practices adopted by research managers to address challenges—both those identified above and others.

Below we provide examples from state DOT research programs in six topic areas that illustrate the range of approaches used to develop an effective implementation program that encourages and accelerates innovation. Citations for some of the publications we examined to prepare this summary appear below; additional citations appear in the Related Publications section of this Preliminary Investigation.

- Encouraging Management Support.
- Staffing for Implementing.
- Considering Implementation throughout the Research Process.
- Communicating Research Results.
- Ongoing Monitoring of Implementation.
- Encouraging Innovation.

Encouraging Management Support

Participants at a recent peer exchange noted that research programs often fall into one of two categories: executive-driven or grassroots. The challenge for these programs becomes how to encourage research and involve top-level management without losing input and buy-in from the field. Examples of management involvement in research programs include:

- **Louisiana Transportation Research Center.** LTRC requires proposal approval by a member of the Louisiana Department of Transportation and Development's (DOTD's) upper-level management. Should an upper-level manager choose not to implement successful research, this decision must be addressed in writing to the DOTD secretary.

- **Michigan DOT.** The agency's Research Executive Committee, which includes the Chief Operations Officer, Chief Administrative Officer, director of the research program, bureau directors and a regional representative, actively participates in the research process, approving implementation plans and overseeing the implementation of research results.

- **Minnesota DOT.** Research Services created the Transportation Research Innovation Group to provide guidance and direction for Mn/DOT's research. This group of Mn/DOT upper-level managers from the Mn/DOT districts and specialty offices reviews innovation and implementation proposals.

- **Montana DOT.** Montana DOT's Research Review Committee, composed of Montana DOT's executive staff, a district representative, representatives from FHWA and the state's research institute, and the agency's research manager, reviews progress and implementation recommendations made by the technical panels.

- **Pennsylvania DOT.** Management support led to the development in 2004 of PennDOT's Research and Innovation Implementation Program, which expanded the agency's capacity to serve customers throughout PennDOT and beyond and advanced implementation to address more than simply the findings from completed research.

- **South Dakota DOT.** The agency's Research Review Board—with a membership that includes the agency director, city and county staff, and academics—guides the research program, meeting five times a year.

- **Washington State DOT.** The Research Executive Committee, whose membership includes the assistant secretary, agency directors and regional administrators, reviews key research findings and evaluates and finalizes recommendations for implementation of research results. Implementation is then facilitated by Research Advisory Committees.

Staffing for Implementation

Staffing solely dedicated to overseeing a research program's implementation activities appears to be relatively rare. In many agencies, responsibility for implementation rests with a member of the committee or panel charged with direct oversight of the specific research project generating the results to be implemented. More unique among state DOTs are cases in which a position description allocates a certain percentage of time to implementation, or a specific program that uses in-house staff or consultants to focus solely on implementation. Below we highlight an example of each scenario:

- **LTRC.** The LTRC Technology Transfer Manager tracks the implementation status of projects and provides biannual status reports. LTRC project managers are responsible for following through with implementation of research results in cooperation with the LTRC Technology Transfer Manager. At LTRC, all Technology Transfer Engineer Administrators/Managers spend 50 percent of their time on implementation. This is written into their position descriptions, evaluation expectations and performance measures.

- **Michigan DOT.** The Implementation Coordinator (IC) facilitates research to meet needs and communicates intended uses of research results. The IC is recommended by the Focus Area Manager and receives support from the Research Manager (a staff person in the research program). The IC works with the Research Advisory Panel to develop an implementation plan.

- **Pennsylvania DOT.** PennDOT's Research and Innovation Implementation Program assigns the role of Implementation System Manager to one of its Research Division staff members (a time commitment of approximately 50 percent); a consultant team provides assistance in evaluating innovations and preparing communication materials. PennDOT notes the importance of involving the right staff with the appropriate mix of technical and procedural expertise, broad involvement of staff out in the field and the need for champions at all levels of the organization.

Considering Implementation throughout the Research Process

Participants of recent peer exchanges that took up the matter of implementation frequently commented on the significance of addressing implementation early and throughout the research process. For many agencies, this means including a discussion of implementation in research problem statements or proposals, and using forms, documents and meetings to track progress both during the research process and after a research project concludes. Implementation as a process—not simply an end result—is a common theme not only in peer exchange discussions, but is also evident in a review of research program manuals.

Implementation as a Key Factor in Project Selection

- **Maryland State Highway Administration.** While a formal implementation plan is not required for problem statements submitted to Maryland State Highway Administration, submitters are asked how research results will be implemented and what funding is available for implementation. The likelihood that the project's results can or will be implemented is one of the factors used in project selection.

Implementation in Problem Statements or Project Proposals

- **Arizona DOT.** The agency asks researchers to describe how research results will be implemented or deployed on the Research Problem Statement form. Related resource:

  Research Problem Statement Form, Research Program Manual, Arizona Department of Transportation, June 15, 2009.
  http://www.azdot.gov/TPD/ATRC/Publications/Miscellaneous/ATRC_Ops_Manual_2009.pdf
  See Appendix D on page 61 of the PDF.

- **Illinois DOT.** An Implementation Planning Worksheet is provided to Technical Review Panel chairs at the beginning of each project to encourage an examination of possible outcomes and the steps required to implement them. The worksheet addresses intended outcomes, strategies used to facilitate implementation, communication channels and target audiences for the research results, and the activities required to implement results.

- **LTRC.** Researchers are advised to include the following in research proposals with regard to implementation (see page 23 of the PDF below):

  > An assessment by the researcher of the areas of potential application of anticipated research findings. The form in which the findings might be reported (mathematical model or formula, test procedure, specification, design procedure, etc.) should be described. The specific area of practice that would be changed by the findings and those organizations or groups that might benefit from the new technology should be identified. The responsibility for and means of technology transfer relative to the study should be proposed when possible.

  Related resource:

  Research Manual, Louisiana Transportation Research Center, 2003.
  http://www.ltrc.lsu.edu/pdf/research_man03.pdf
  See 7. Assessing and Implementing Research on page 61 of the PDF.

- **Michigan DOT.** Research proposals include an initial implementation plan that describes how research results will be used, provides a cost/benefit analysis of implementing the results,

discusses barriers to implementation and possible solutions, and offers methods of implementation (training, specifications, demonstration project, revised standards).

- **Texas DOT.** Initial planning for implementation of research results begins with the development of the Research Problem Statement, which identifies the office primarily responsible for implementing the expected results and products of the research project, and defines the products desired as outcomes of the research project, including the format for delivery of the products. More focused planning takes place as projects near completion or deliver significant interim results. Related resource:

  Research Manual, Texas Department of Transportation, December 2009.
  http://onlinemanuals.txdot.gov/txdotmanuals/rtt/rtt.pdf
  Chapter 4, Implementation Program Development, begins on page 38 of the PDF.

Addressing Implementation throughout the Research Cycle

Ongoing monitoring of implementation potential and progress is often mentioned by peer exchange participants as critical to the success of an implementation program. Three approaches to this continuing review are highlighted below.

- **Florida DOT** uses deployment plans that document—before the research begins—how the results of research will be used by identifying the activities and actions necessary to optimize the use of research results. Plans may include some or all of the following components: implementation, performance indicators, technology transfer, training and marketing. Stakeholders are identified at the outset of research, and appropriate communication and coordination occurs to optimize implementation and assure effective use of research products.

  Annual reports are prepared to summarize the implementation status of projects. The agency's quality assurance program tracks and documents implementation of results, measuring results against the planned implementation documented in the deployment plan.

- **LTRC** evaluates each research project at various stages to determine whether the results or findings have potential that merits implementation. The Research Assessment and Implementation Report is completed by the Technology Transfer Engineer Administrator/Manager in conjunction with the LTRC Engineer Manager following the receipt of final reports or when a significant breakthrough or development results from the study.

  Annually, a research implementation status report summarizes the implementation status of the most important projects for executive staff in the department. This report is presented at a half-day meeting that is attended by the secretary of the department. Related resource:

  Research Assessment and Implementation Report, Form 1902, Louisiana Transportation Research Center, November 2009.
  www.ltrc.lsu.edu/pdf/form1902.doc
  This document describes implementation recommendations, potential impact, target audience, strategies and tactics, timeline, implementation responsibilities and how the implementation effort will be evaluated.

- **Ohio DOT** considers implementation throughout the research cycle:
  - Every proposal must include a preliminary implementation plan.
  - An assessment of implementation potential occurs at every project startup meeting.
  - Research review sessions conducted during the course of research include an implementation assessment portion.
  - Quarterly reports include a section to describe implementation to date.

- Periodic research review sessions update sponsors and other interested parties on the status of a research project.
- An annual summary reports implementation progress at the end of each fiscal year.

Communicating Research Results

Most—if not all—agencies include communication in their collection of tools to foster and support implementation. Below we highlight examples of communication plans, technology briefs, newsletters and other outreach efforts that engage participants beyond traditional print and electronic media.

- **LTRC.** Project Capsules begin sharing the potential for implementation as soon as projects are approved. Developed by the Technology Transfer Engineer Administrator/Manager for every project, these two-page documents describe the problem to be addressed by the research, objectives of the research, methodologies used and the implementation potential of the project. Related resource:

  Project Capsules, Louisiana Transportation Research Center.
  http://www.ltrc.lsu.edu/pubs_projectcapsules.html
  Find links to Project Capsules dating back to 2008. The most recent Project Capsules appear at the bottom of the page.

- **Missouri DOT.** A communication plan is created for every project as part of the scope of the project. The plan is completed by an in-house project administrator or the principal investigator. Embedded in the work plan process, the plan identifies communication messages, timing, target audiences and potential controversies.

- **Ohio DOT.** Research results presentations are conducted at the conclusion of each research project. Emphasis is placed on results, conclusions and recommendations, and implementation. The discussion of implementation includes the steps needed to implement, a suggested time frame, potential risks and obstacles, estimated costs and potential users.

- Many agencies develop brief summaries of completed research to disseminate research results and encourage broader implementation.

Agency	Publication
Arizona DOT	**Research Notes** http://www.azdot.gov/TPD/ATRC/Publications/research_notes/index.asp
Caltrans	**Research Project Summaries** http://www.dot.ca.gov/newtech/researchreports/two-page_summaries.htm **Innovation Team Briefs** http://www.dot.ca.gov/research/index.htm
Connecticut DOT	**Research Highlights** http://www.ct.gov/dot/cwp/view.asp?a=1387&q=259640

Agency	Publication
LTRC	**Technical Summaries** http://www.ltrc.lsu.edu/pubs_techsummaries.html
Michigan DOT	**Research Spotlights** http://www.michigan.gov/mdot/0,1607,7-151-9623_10724_48681_51213_51738---,00.html
Minnesota DOT	**Technical Summaries** http://www.dot.state.mn.us/research/2010-technical-summaries.html
Missouri DOT	**Advancements/Staff Summaries** http://www.modot.mo.gov/services/OR/byDate.htm
New Hampshire DOT	**Posters** http://www.nh.gov/dot/org/projectdevelopment/materials/research/projects/index.htm
Oregon DOT	**Research Notes** http://egov.oregon.gov/ODOT/TD/TP_RES/Researchnotes.shtml
Pennsylvania DOT	**Innovation Information** http://www.vancerenz.com/researchimplementation/IIB.asp
Washington State DOT	**Research Notes** http://www.wsdot.wa.gov/Research/Working/Notes.htm
Wisconsin DOT	**Research Briefs** http://on.dot.wi.gov/wisdotresearch/compresprojs.htm

- Periodic newsletters are another way agencies inform stakeholders of implementation activities.

Agency	Publication
Alaska DOT	**Technology for Alaskan Transportation** http://www.dot.state.ak.us/stwddes/research/assets/pdf/10v35n2.pdf
Arizona DOT	**Newsletter** http://www.azdot.gov/TPD/ATRC/Publications/newsletters/index.asp
Illinois DOT	**Illinois Interchange** http://www.dot.state.il.us/blr/iinews.html
Iowa DOT	**Research News** http://www.iowadot.gov/research/researchnews.aspx
LTRC	**Technology Today** http://www.ltrc.lsu.edu/pubs_technology_today.html
Michigan DOT	**Office of Research and Best Practices Newsletter** http://www.michigan.gov/mdot/0,1607,7-151-9622_11044_25626---,00.html

Agency	Publication
Center for Transportation Studies (Minnesota)	**Various Newsletters** http://www.cts.umn.edu/Publications/Newsletters.html
Missouri DOT	**Fast Forward** http://www.modot.mo.gov/services/OR/byDate.htm
New Hampshire DOT	**Focus on Research** http://www.nh.gov/dot/org/projectdevelopment/materials/research/newsletter.htm
Ohio DOT	**Moving Forward** http://www.dot.state.oh.us/Divisions/TransSysDev/Research/Pages/Newsletters.aspx
Pennsylvania DOT	**PennDOT Innovations** http://www.vancerenz.com/researchimplementation/default.asp?Show=Newsletters
Transportation Engineering and Road Research Alliance (TERRA)	**TERRA E-News** http://www.terraroadalliance.org/publications/enews/2010/02/
Utah DOT	**Research Newsletter** http://www.udot.utah.gov/main/f?p=100:pg:0:::1:T,V:1399
Wisconsin DOT	**Research & Library E-News** http://on.dot.wi.gov/wisdotresearch/news.htm **Wisconsin Highway Research Program E-News** http://www.whrpnews.org/

Outreach Activities

Webinars, workshops, field trips and staff meetings are just a few of the ways agencies are moving their communication efforts beyond traditional print and electronic media.

- **Caltrans.** The Research Connection is a video conference series designed to bring together researchers and practitioners to exchange information and transfer knowledge. Related resource:

  Research Connection, Caltrans Division of Research and Innovation.
  http://www.dot.ca.gov/researchconn/
  Check back at this site for information about the 2011 series.

- **LTRC.** A quarterly seminar series focuses on one research result/technology being implemented. The seminar series, which moves to different locations around the state, is open to the public and industry representatives often attend. Related resource:

  Past Conferences and Workshops, Louisiana Transportation Research Center.
  http://www.ltrc.lsu.edu/conferences.html
  Find entries here for previous seminars, including links to presentation materials.

- **Minnesota DOT.** Offered via teleconference/webinar, the Research & Innovation Presentation Series (RIPS) was initiated to inform Mn/DOT staff and stakeholders about leading-edge or high-visibility research and department initiatives. Sessions are typically offered on a quarterly basis. Related resource:

  Research & Innovation Presentation Series, Research Services Section, Minnesota Department of Transportation.
  http://www.dot.state.mn.us/research/2010-RIPS.html
  This site provides background information and links to RIPS webinars held in 2010 on high-profile research projects.

- **Minnesota, Center for Transportation Studies.** An annual research conference features research results and real-world projects happening throughout the state. Related resource:

  CTS Transportation Research Conference, Center for Transportation Studies, University of Minnesota.
  http://www.cts.umn.edu/Events/ResearchConf/
  The conference acts as a forum for researchers and practitioners from Minnesota and the Upper Midwest to share their research findings in a variety of transportation-related areas.

- **TERRA.** The annual Innovation Series has a technical focus on road engineering and construction that addresses research results, trends that improve productivity, innovative partnering and contracting models, and hot topics that may lead to new research related to TERRA priorities. Related resource:

  Innovation Series, TERRA.
  http://www.terraroadalliance.org/events/index.html
  Find information about upcoming events at this site. Links to previous events provide access to presentations and other resources related to the event.

- **Utah DOT.** Scan tours with industry and project managers support broader implementation of successful practices, tools and technologies. Utah DOT sends staff to sites where a new technology has already been implemented to learn and gain confidence in supporting broader implementation.

Ongoing Monitoring of Implementation

Agencies use a variety of tools to track projects and monitor implementation, including databases, forms and periodic reports.

- **Illinois DOT.** An Implementation Tracking Database in the form of an Excel spreadsheet identifies internal and external stakeholders and tracks deliverables throughout the process. An online dashboard for tracking projects managed by the Illinois Center for Transportation (ICT) is connected to web-based quarterly reports. Related resource:

  ICT Projects, Illinois Center for Transportation.
  http://ict.illinois.edu/IDOTprojects.asp
  Click on a project to see a summary, objective, expected outcome and project status.

- **Kansas DOT.** Research Implementation Plans (RIPs) are prepared by the Project Monitor with assistance from the principal investigator and Kansas DOT Technology Transfer Section staff at the time a final report is published. RIPs also document those projects without any implementation potential. Topics addressed in the RIPs include implementation potential strategies for implementation, task schedule for implementation and an implementation cost estimate. Updated annually until implementation is completed, the plans provide a schedule and

documents milestones as they are completed. Triennial benefits and costs are listed with both a projected and actual benefit/cost ratio.

- **LTRC.** LTRC's web-based Research Project Management System tracks all aspects of research and implementation. Five categories are used to track project status over a five-year period. (see page 16 of this Preliminary Investigation for more information about this new LTRC tool.)

- **Missouri DOT.** A periodic publication, Tracker, documents Missouri DOT's performance measurement system that assesses how well the department meets customer expectations. See page 33 of this Preliminary Investigation for more information about Tracker.

- **Washington State DOT.** WSDOT has tested a Research Performance Measures database now under development by WSDOT and Caltrans, but is not actively using it. The database has limited tracking functions. See http://www.pooledfund.org/projectdetails.asp?id=407&status=4 for more information about the Transportation Research Program Management Database pooled fund project.

Encouraging Innovation

Agencies can encourage innovation with recognition, incentives and dedicated staff to assist with deployment.

- **Caltrans.** The Deployment Support Branch "works with project managers in the implementation of transportation research and innovation including products and services that improve the efficiency, safety and security of the transportation system and that support the Department's strategic goals." The program encourages researchers to include deployment planning throughout the five stages of research (concept, laboratory prototype, controlled field demonstration, first application (contract) field pilot, and specification and standards with full corporate deployment). Related resource:

  Deployment Support Branch, Division of Research and Innovation, Caltrans.
  http://www.dot.ca.gov/research/deployment_support/index.htm
  Find information here about deployed projects, future deployment and commercialized products.

- **Missouri DOT.** Launched statewide in 2006, the Solutions at Work program identifies, measures, documents and communicates best practices within the organization. Missouri DOT's Organizational Results staff work with division and district managers to evaluate and document implemented best practices. A searchable online database stores best practices and shares them through the agency's intranet. Regular recognition events are held to honor successful work groups.

- **Texas DOT.** An apparently discontinued Texas DOT program made annual selections of the "Top Research Innovations and Findings" based upon their estimated benefit to Texas DOT and the state of Texas. Such benefits might include number of lives saved, increased efficiency, monetary savings or other factors. Related resource:

  Top Research Innovations and Findings, Texas Department of Transportation, 2005.
  http://www.utexas.edu/research/ctr/research/highlights/inno2005_bike.pdf
  This excerpt from a larger report, no longer available on the public web site, describes a bicycle-related project that received the 2005 award.

- **Virginia DOT.** During its October 2010 peer exchange, the Virginia Transportation Research Council (VTRC) reported that a legislatively mandated review of VTRC noted that implementation is lagging, and VTRC was advised to establish an incentive program.

Selected Implementation Program Highlights

Below we provide brief summaries of the implementation programs of five states—Louisiana, Minnesota, Ohio, Pennsylvania and Washington. Information for these summaries is gathered from the documents cited below and in the Related Publications section of this Preliminary Investigation.

Louisiana Transportation Research Center	
Program Overview	The LTRC is a cooperative research, technology transfer and training center administered jointly by the Louisiana Department of Transportation and Development (DOTD) and Louisiana State University. From page 53 (page 62 of the PDF) of LTRC's Research Manual: It is the primary goal of LTRC to develop and manage a research program which emphasizes implementable products. The two criteria used in selection and ranking of research problem statements are (1) importance of the problem to the Louisiana Transportation Community and (2) implementation potential, on an equal ranking basis. Research study proposals are required to contain clearly identified products.
Responsibility for Implementation	• An implementation plan is developed at the beginning of each project. • The Engineer Administrator/Manager and the Technology Transfer Engineer Manager have joint responsibility for ensuring that study findings with potential for application are implemented. • The Technology Transfer Engineer Manager tracks the implementation status of projects and provides biannual status reports. • Technology Transfer Engineer Administrators/Managers spend 50 percent of their time on implementation. This is written into their position descriptions, evaluation expectations and performance measures. • Each project proposal must be recommended for approval by an implementation sponsor at the DOTD upper-management level before the project may begin. The implementation sponsor is the lead decision maker with regard to implementation. • LTRC project managers are responsible for following through with implementation of research results in cooperation with the Technology Transfer Engineer Manager.
Communication Vehicles	**Project Capsules** http://www.ltrc.lsu.edu/pubs_projectcapsules.html Two-page summaries published when a study begins that include an assessment of implementation potential. **Technical Summaries** http://www.ltrc.lsu.edu/pubs_techsummaries.html Two-page project summaries that disseminate the results of completed research.

Louisiana Transportation Research Center (continued)	
Communication Vehicles	**Research Implementation Updates** http://www.ltrc.lsu.edu/pubs_riu.html Four-page documents that describe research results and assess implementation feasibility. **Quarterly newsletter (Technology Today)** http://www.ltrc.lsu.edu/pubs_technology_today.html
Monitoring Practices	LTRC is finalizing its **Research Project Management System** that tracks all aspects of research and implementation. From page 2 of LTRC's 2009-2010 Annual Report: This web based management system automates every process used in the administration of the research program, including modules for our research project solicitation process, work program development, biannual reporting, and implementation reporting along with access to project files and other management reports. The financial side will be included when DOTD initiates the state's Enterprise Resource Program. Additional modules will be added as necessary. Hundreds of man-hours are saved through this management system. LTRC uses the following **categories for recording project status** to track a project over a five-year period: • Project in progress. • Implementation recommended. • Implementation complete. • Project not implemented (unsuccessful project). • No implementation results expected (basic research).
Forms/Documents	**Research Manual**, Louisiana Transportation Research Center, 2003. http://www.ltrc.lsu.edu/pdf/research_man03.pdf See page 61 of the PDF for 7. Assessing and Implementing Research. **Research Assessment and Implementation Report**, Form 1902, Louisiana Transportation Research Center, November 2009. www.ltrc.lsu.edu/pdf/form1902.doc This document describes implementation recommendations, potential impact, target audience, strategies and tactics, a timeline, implementation responsibilities, and how the implementation effort will be evaluated. **Research Implementation Status Report**, Louisiana Transportation Research Center. Prepared annually for executive staff, this document summarizes the implementation status of LTRC's most significant projects. **2009-2010 Annual Report**, Louisiana Transportation Research Center, 2010. http://www.ltrc.lsu.edu/pdf/2010/09_10ar.pdf See page 18 of the PDF for a discussion of LTRC's seminar series.

Minnesota Department of Transportation	
Program Overview	Mn/DOT uses a dynamic research process that integrates implementation planning into research project development and management. • Research problem statements include a conceptual implementation plan that outlines the potential use of the expected research products and the individual responsible for implementation. • When projects are funded, conceptual implementation plans are updated to preliminary implementation plans that include information about the type and anticipated delivery date of the expected final research product. • Preliminary implementation plans are continuously adjusted as research progresses, and interim results are available for performance assessment. Implementation-related activities or groups include: • Users of the **Mn/DOT Implementation Funding Project-Builder web site** (http://mndot-research.ideascale.com/a/panel.do) submit implementation ideas that are linked to completed research. The community discusses and votes for ideas, and the best ideas rise to the top. Mn/DOT has set aside $1.15 million in 2011 for implementing completed research. • The **Research Implementation Committee (RIC)** is a subgroup of the Local Road Research Board, which is operated by county and city engineers, Mn/DOT staff and a representative from the University of Minnesota's Center for Transportation Studies. Mn/DOT's Research Services Section administers the LRRB program and research projects. The goal of the RIC is to make information available and transfer research results into practical application. • The **Implementation Funding Program (IMP)** is a subgroup of Mn/DOT's State Research Program. The goal of the IMP is to apply research results in measurable ways that will lead to further implementation and improve the performance of Mn/DOT's investments.
Responsibility for Implementation	Mn/DOT's 2009 Annual Report describes staff roles in managing implementation: • During the project and roadmap planning processes, staff members determine measures required for successful implementation and ensure that these are built into research contracts. • When a research contract ends, Research Services evaluates the results to determine the most appropriate actions to take given the progress of the research. Steps may include additional work to further develop usable end-user products such as specifications or manuals, demonstrations, training and technology transfer activities to inform potential users of research findings and enable them to make the best use of developed resources. • Administrative liaisons for implementation contracts identify the impacts of research investments and measure the performance of individual projects and Mn/DOT's research program as a whole.

Minnesota Department of Transportation (continued)	
Communication Vehicles	**Technical Summaries** http://www.dot.state.mn.us/research/2010-technical-summaries.html Two-page reports that summarize research projects. **2010 Research & Innovation Presentation Series** http://www.dot.state.mn.us/research/2010-RIPS.html These sessions, which are recorded for future access, feature research staff discussing project results and implementation efforts.
Monitoring Practices	University of Minnesota's Center for Transportation Studies uses performance measures to track implementation of research results (new technologies, policies, procedures, design practices). Data sources for the tracking include annual surveys completed by university researchers, quarterly status reports, Mn/DOT project closeout memos, anecdotal information and follow-up inquiries.
Forms/Documents	**2009 Annual Report,** Research Services Section, Minnesota Department of Transportation, 2009. http://www.dot.state.mn.us/research/annual-reports/2009/MnDOT-Research-Services-2009-Annual-Report.pdf See page 124 of the PDF for a summary of completed research reports and implementation products.

Ohio Department of Transportation	
Note: The summary below is based on Ohio DOT's November 2010 draft research manual that is awaiting FHWA approval.	
Program Overview	Ohio DOT's research program is managed by the Innovation, Research and Implementation Section (IRIS), which is part of the Office of Innovation, Partnerships and Energy. From Chapter 6, Implementation, of Ohio DOT's draft research manual: A major goal of research is to provide results that can be successfully implemented. This starts with the drafting of problem statements, which will emphasize the goals of the research and indicate success criteria for judging the outcome. Proposals are required to address the potential application of anticipated research results. Final reports include recommendations for implementation as well as drafts of policy statements, specifications, standard drawings, test procedures, and so forth needed for implementation as appropriate.
Responsibility for Implementation	• Every proposal is required to include a preliminary implementation plan; an assessment of implementation potential occurs at every project startup meeting and every project review session. • The goal is to have an implementation plan for every project regardless of project findings.

Ohio Department of Transportation (continued)	
Responsibility for Implementation	• Shortly after a project's closeout meeting, IRIS provides the project's subject matter experts (SMEs) with a draft implementation plan based on the discussions that occurred during the closeout meeting. The SMEs will be responsible for reviewing, modifying and finalizing the implementation plan. • Responsibility for tracking implementation activities lies with the sponsoring office administrator(s) and the SMEs. A research staff member periodically follows up to track implementation progress.
Communication Vehicles	**Research Results Presentations** These presentations are conducted at the conclusion of each research project. Emphasis is placed on results, conclusions and recommendations, and implementation. The implementation discussion includes: • Steps needed to implement. • Suggested time frame. • Expected benefits. • Potential risks and obstacles. • Strategies for overcoming potential risks and obstacles. • Potential users and other organizations that may be affected. • Estimated costs. **Newsletter (Moving Forward)** http://www.dot.state.oh.us/Divisions/TransSysDev/Research/Pages/Newsletters.aspx
Monitoring Practices	**Research Implementation Progress Report**, Ohio Department of Transportation, November 2010. http://www.dot.state.oh.us/Divisions/TransSysDev/Research/researchmanual/Documents/Draft/AppC.pdf (see page 40) IRIS coordinates submission of this report during the first scheduled follow-up on the implementation plan with the SME, and initiates review and updates to the report based on the schedule in the implementation plan. If a time frame for reporting on implementation progress is not defined in the implementation plan, IRIS contacts the SME to submit quarterly updates. **Research review sessions** are typically held during April and October to update sponsors and other interested parties on the status of a research project. At least one formal review is conducted for each year a project is active. IRIS prepares an **annual summary** of implementation progress at the end of each fiscal year. An **historical report of research project implementation activity** is reviewed and updated every three years. Projects are included in the report once an implementation plan is developed. A summary of significant findings is provided after each update.

Ohio Department of Transportation (continued)	
Forms/Documents	**Chapter 6, Implementation**, Research, Development and Technology Transfer Manual of Procedures, Ohio Department of Transportation, November 2010. http://www.dot.state.oh.us/Divisions/TransSysDev/Research/researchmanual/Documents/Draft/Chap6.pdf This chapter of the draft manual describes the processes used to track implementation. Links to all chapters of the draft manual are available at http://www.dot.state.oh.us/Divisions/TransSysDev/Research/researchmanual/Pages/DraftResearchManual.aspx. **Subject Matter Expert Forms** http://www.dot.state.oh.us/Divisions/TransSysDev/Research/Pages/TechForms.aspx Find links here to forms used by SMEs, including: • Implementation Assessment Form. • Implementation Plan. • Implementation Progress Report.

Pennsylvania Department of Transportation	
Program Overview	*From the PennDOT web site:* PennDOT's Research and Innovation Implementation Program seeks to identify and implement innovations, facilitate practical uses for these innovations, and communicate and implement research results throughout the Commonwealth. The program is carried out through several formal methods of implementation. Tools and processes have been developed to electronically submit innovations, assess their readiness for deployment, and track progress through the system. PennDOT's fast-tracking of innovations begins with the Implementation System Manager (ISM) scanning the organization and soliciting input for innovations that could benefit the department. These recommendations could be in the form of research results, innovations from districts and counties, and innovations and successful technologies from external sources.
Responsibility for Implementation	A Research Division staff member is designated as the ISM and devotes approximately 50 percent of his/her time to the implementation program. Using the Checklist for Winning Innovations—a decision tool to assess readiness for deployment—the ISM works with a consultant team to evaluate innovations. PennDOT management is brought in to work with the ISM and the consultant team to select innovations for implementation. Evaluators ask four important implementation questions: • What will the innovation contribute? • What materials should be developed to implement this innovation? • With whom is this information being shared? • What is required to institutionalize this innovation?

Pennsylvania Department of Transportation (continued)	
Responsibility for Implementation	For a specific project, staging activities may include selecting locations, enlisting users and other participants, and marshalling resources. Dissemination and deployment are a group effort and can involve the ISM, consultant team, district and county personnel, sponsor organization, project champion, PennDOT management and users/customers.
Communication Vehicles	**Newsletter (PennDOT Innovations)** http://www.vancerenz.com/researchimplementation/default.asp?Show=Newsletters This newsletter provides updates on the Research and Innovation Implementation Program. **Transfer Packages** http://www.vancerenz.com/researchimplementation/default.asp?Show=Transfer Packages Available for download, these packages include information and materials to support statewide deployment of 12 innovations. Among the materials that can be downloaded are training presentations, executive summaries, final reports and FAQs. **Innovation Information** http://www.vancerenz.com/researchimplementation/IIB.asp These brief bulletins, which provide an introduction to each innovation, are included in the Transfer Packages.
Monitoring Practices	Projects are tracked with milestones and deliverables; activity coordination; and reporting on progress, problems and problem resolution. Project evaluation considers research design, criterion measurements, data analysis and interpretation, cost/benefit analysis, learning points to guide future implementation and capture of best practices.

Washington State Department of Transportation	
Program Overview	From page 38 of the WSDOT Research Procedures Manual: > The objective of the WSDOT research program is to produce findings that significantly enhance the operations of the Department. In many cases, research reports include specific recommendations for altering the procedures or methods of a functional area. In other cases, the findings contribute to the body of knowledge that serves as the basis for daily operational decisions, planning decisions and/or the prioritizing of future research options. In any case, the research process is not complete until the implementation of applicable results has been accomplished. The Research Executive Committee evaluates and finalizes recommendations for implementation of research findings. Four Research Advisory Committees (RACs) provide input to the research program, including discussing the recommendations of Technical Monitors for implementation and making recommendations on funding for implementation. As WSDOT's Research Procedures Manual describes it, the RACs are responsible for "starting the implementation process by describing the desired outcomes and benefits expected of the recommended research." Each research project is assigned a Principal Investigator, Technical Monitor and Research Manager. Implementation expectations are included in the research proposal and managed throughout the project.
Responsibility for Implementation	Each **Research Manager** is responsible for working with the Principal Investigators and Technical Monitors to develop an Implementation Plan for State Program Research projects in their subject area. As a representative of the functional area, the **Technical Monitor** is responsible for communicating intended uses of research results and helping to manage the research to meet those needs. Specific tasks may include: • Providing a list to the Research Manager, before the scope is finalized, of WSDOT offices and regions that will be users of research findings or affected by changes as a result of research findings. • Establishing and maintaining communication with representatives of user and customer groups to ensure research products achieve the most comprehensive outcome possible for the resources provided. The Technical Monitor develops the implementation plan and is encouraged to consider implementation-related issues when developing the research proposal. Implementation plans document how the findings will be fully implemented in the department, which could include further research, field tests, training programs, manual revisions, specification changes, policy recommendations, or the purchase of equipment and software. While not responsible for implementing research results, **Principal Investigators** are encouraged to understand how research results are intended to be used at the completion of the project.

Washington State Department of Transportation (continued)	
Communication Vehicles	An **Executive Monthly Report** summarizes completed research projects, new starts and key project progress, and includes an implementation summary. At the conclusion of selected research projects, a **workshop or presentation** may be conducted to explain the research and discuss the findings. **Research Notes** http://www.wsdot.wa.gov/Research/Working/Notes.htm These two- to four-page summaries communicate results of research projects in a manner accessible to a broad audience. **Research Implementation Plans** http://www.wsdot.wa.gov/Research/Results/Default.htm Find links to Implementation Plans, reviewed by the RACs, in four categories (project delivery, operations, multimodal, and information and finance). The plans identify results achieved through the research and items/actions needed to implement results. Periodically, WSDOT's **Gray Notebook** reports on transportation research. See page 115 of GNB Edition 34, published June 30, 2009, and available at http://www.wsdot.wa.gov/NR/rdonlyres/1DCF9725-14D1-4341-A091-43E7A73A4298/0/GrayNotebookJun09.pdf for a special report on WSDOT's Research Program.
Communication Vehicles	Implementation of each research project is addressed in the Washington State Transportation Research Center (TRAC) **Biennial Report**. (See http://depts.washington.edu/trac/otherpubs/index.html for links to recent reports.)
Monitoring Practices	Research Managers collect research implementation reports from Technical Monitors upon completion of research projects in their respective emphasis areas. One Research Manager is designated as Research Implementation Manager and compiles, edits and documents research implementation activities into a report that is completed biennially. WSDOT has tested the Research Performance Measures database now under development by WSDOT and Caltrans, but is not actively using it. The database has limited tracking functions. See http://www.pooledfund.org/projectdetails.asp?id=407&status=4 for a summary of this pooled fund effort.
Forms/Documents	**WSDOT Research Procedures Manual**, Washington State Department of Transportation, June 2010. http://www.wsdot.wa.gov/NR/rdonlyres/DDEFB8F8-DD23-4548-9468-75B13C2E63D6/0/ResearchProceduresManualJune2010FINAL83010.pdf See pages 38-40 of the PDF for Section Four, Implementation Management. This section "identifies the specific project requirements, from proposal development to final reporting, that promote implementation of relevant findings upon completion of the research project."

National Efforts to Encourage Innovation

Below we highlight avenues for support and implementation of innovation at the national level. National committees that address technology transfer and the conduct of research can offer support and resources to agencies seeking to enhance implementation practices. A variety of national programs is also available to encourage transformative research, fund promising but unproven innovations, and accelerate and expand the deployment of transportation-related innovations.

National Committees

Committee on Technology Transfer, TRB.
http://trbt2.pbworks.com/w/page/8359023/FrontPage
This committee is concerned with information exchange and research on the processes and methods for technology transfer, and assisting other TRB committees in their role as an agent for technology transfer. The committee's blog, available at http://technology-transfer.blogspot.com/, provides "tools, techniques, technologies and tips for transferring ideas to practices."

Committee on Conduct of Research, TRB.
http://sites.google.com/site/conductofresearchcommittee/
Included in this committee's charge is the promotion of improved coordination between those sponsoring and conducting research and those responsible for implementing research products. A group discussion is available at http://groups.google.com/group/trb-cor.

National Programs

Every Day Counts, FHWA.
http://www.fhwa.dot.gov/everydaycounts/
Every Day Counts (EDC) is designed to identify and deploy innovation aimed at shortening project delivery, enhancing the safety of our roadways and protecting the environment. Among the technologies and innovations in the first round of initiatives are:

- Adaptive signal control.
- Geosynthetic reinforced soil.
- Prefabricated bridge elements and systems.
- The asphalt Safety Edge.
- Warm mix asphalt.

An EDC brochure available at http://www.fhwa.dot.gov/everydaycounts/pdfs/EDC_Brochure(6-25-2010).pdf notes:

> Every Day Counts is not about inventing the next "big thing." It's about taking effective, proven and market-ready technologies and getting them into widespread use. By advancing 21st century solutions, we can improve safety, reduce congestion and keep America moving and competitive.

Exploratory Advanced Research Program, FHWA.
www.fhwa.dot.gov/advancedresearch
Established in connection with the Safe, Accountable, Flexible, Efficient Transportation Equity Act–A Legacy for Users (SAFETEA-LU), the Exploratory Advanced Research Program (EAR) program addresses the need to conduct longer term—and higher risk—research with the potential for

transformational improvements in the transportation system. In scanning for potential projects, FHWA identifies research topics that:

- Involve discoveries in science of new technology that have the potential to lead to revolutionary change.
- Address significant current or anticipated issues in highway transportation.
- Can engage researcher and facilities with the capacity to solve complex problems that cut across or push the frontiers of traditional disciplines.
- Would not move forward without FHWA funding.

Highways for LIFE, FHWA.
http://www.fhwa.dot.gov/hfl/
From the web site: The purpose of Highways for LIFE (HfL) is to advance **L**onger-lasting highway infrastructure using **I**nnovations to accomplish the **F**ast construction of **E**fficient and safe highways and bridges. The three goals of HfL are to:

- Improve safety during and after construction.
- Reduce congestion caused by construction.
- Improve the quality of the highway infrastructure.

HfL's outreach efforts include:

- **The Vanguard Technology initiative.** Designed to greatly accelerate the widespread adoption of high-payoff innovations to benefit road users, the Vanguard Technology process uses dedicated teams, proven marketing approaches and designated funding. Organizations wishing to deploy their own innovations can use HfL's Guide to Creating an Effective Marketing Plan, available at http://www.fhwa.dot.gov/hfl/091013/index.cfm. HfL is using the Vanguard Technology initiative to promote five innovations: road safety audits, prefabricated bridge elements and systems, precast concrete pavement systems, techniques for making work zones work better and the Safety Edge. Read more about these innovations at http://www.fhwa.dot.gov/hfl/technology/vanguard.cfm.
- **Monthly web conferences (NHI Innovations).** Developed in partnership with the National Highway Institute, NHI Innovations are 90-minute web conferences that focus on a particular innovation with a panel of recognized experts from the highway community. See http://www.nhi.fhwa.dot.gov/about/innovationseries.aspx for seminar registration and conference recordings.
- **Training course.** Using both classroom and web-based training, *Leap Not Creep, Accelerating Innovation Implementation* (FHWA-NHI-134073) is a two-day course, designed in partnership with the National Highway Institute, that provides participants with the tools to implement innovations quickly and integrate innovative processes into an agency's standard practice. After completion of the course, participants will be able to develop a deployment plan for implementing an innovation, determine the resources required to mainstream the innovation into standard practice and identify strategies for overcoming barriers to implementing an innovation. See http://www.nhi.fhwa.dot.gov/training/course_detail.aspx?num=FHWA-NHI-134073&topicnum=134 for course details.

Innovations Deserving Exploratory Analysis, TRB.
www.trb.org/IDEAProgram/Public/IDEAProgram.aspx
The four Innovations Deserving Exploratory Analysis (IDEA) programs, which provide startup funding for promising—but unproven—innovations in surface transportation systems, include:

- **NCHRP-IDEA**. Nurtures new concepts for technologies, methods and processes for application to highway systems in broad technical areas such as highway design and construction, materials, operations and maintenance.
- **Reliability-IDEA**. Focuses on innovative approaches, technologies and products that will help to improve travel time reliability.
- **Transit-IDEA**. Focuses on products and results for transit practice in support of the Transit Cooperative Research Program.
- **Safety-IDEA**. Focuses on innovative technologies to improve transportation safety, with an emphasis on commercial motor vehicles.

Strategic Highway Research Program 2, TRB.
www.trb.org/StrategicHighwayResearchProgram2SHRP2/Blank2.aspx
Halfway through its original lifespan, Strategic Highway Research Program 2 (SHRP 2) is producing the first completed research projects in its four focus areas—safety, renewal, reliability and capacity. Full-scale implementation of SHRP 2 research results is expected to be led by FHWA, with direction and funding coming as part of the successor to SAFETEA-LU. Until the next federal highway legislation is adopted, Congress has provided SHRP 2 with additional funds and two additional years for preimplementation activities such as pilot tests and demonstration projects. Funds will also be invested in developing training curricula and tools and in accelerating existing outreach efforts.

Technology Implementation Group, AASHTO.
http://www.aashtotig.org/?siteid=57&pageid=708
The Technology Implementation Group (TIG) identifies potentially ready-to-implement technologies and provides leadership to promote and support rapid nationwide implementation of selected technologies. TIG's objective is "to share information with AASHTO member agencies, local agencies, and their industry partners to improve the Nation's transportation system."

Annually, TIG selects a valuable but largely unrecognized innovation that has been adopted by at least one agency. The innovation must be market-ready and available for use by other agencies. Focus technologies for 2011 include:

- New bridge material design options.
- New pavement evaluation tools.
- Sequential barricade warning light system.

Related Publications

Below we highlight a variety of publications that relate to the implementation practices of state research programs, including NCHRP reports, peer exchange final reports, TRB Annual Meeting papers, research manuals, an AASHTO survey and journal articles. Many of these publications provided source material for the **Recurring Themes in Implementation** section of this Preliminary Investigation.

National Guidance

Communication Matters: Communicating the Value of Transportation Research Guidebook, *NCHRP Report 610*, 2009.
http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_610.pdf

This guidebook provides tips, a model process, case studies and examples of good communication methods that can be used to integrate communication throughout the research process. On page 8 of the PDF, the report makes the connection between effective communication and successful implementation:

> Properly packaging a research report alone will not ensure implementation or further research funding for follow-up studies. Effectively communicating both the results and return on investment of a single project or an entire program remains a major challenge for transportation research organizations at all levels. The time is long past when the value of the research will simply sell itself with no additional effort.

Transportation Technology Transfer: Successes, Challenges, and Needs, *NCHRP Report 355*, 2005.
http://www.trb.org/publications/nchrp/nchrp_syn_355.pdf
This report highlights successful practices, challenges encountered and the need to promote improvements in technology transfer—defined in the report as "the activity leading to the adoption of a new-to-the-user product or procedure by any user or group of users." Researchers examined both private and public sector technology transfer efforts, noting that no processes in place within state DOTs were yet recognized as best practices at the time of publication. Researchers associated the following factors with successful technology transfer:

- A champion is associated with the research and technology transfer effort.
- Pilots and demonstrations allow hands-on learning.
- Senior management support attracts attention, leads by example and gives guidance to the effort.
- Early involvement of the user allows early resolution of problems and prepares the user for fully embracing the innovation.
- A technology transfer or implementation plan identifies strategies and tactics.
- Qualified people are in lead roles.
- Progress is monitored and funding is available.
- There is an emphasis on marketing and communications.

Peer Exchange Final Reports

Alabama

2005 Peer Exchange Final Report, Research & Development, Alabama Department of Transportation, May 2005.
http://cms.transportation.org/sites/research/docs/ALDOT%202005%20Peer%20Exchange%20-%20Complete%20Final%20Report.pdf
Results from discussions associated with the peer exchange's Theme 5: Research Implementation Practices begin on page 10 of the PDF. Among the opportunities for improvement identified by participants:

- Start implementation planning as early as possible in the research project.
- Add a tracking feature to track implementation/final report as a performance measure.
- Require an implementation plan in the research proposal.
- Explore adopting a formal implementation procedure.
- Conduct follow-up interviews after research projects are completed to assess the success of the research's implementation.

The report included the general observation that "states do a better job of research implementation than they would immediately recognize, but there's no method in place to readily measure or track it."

Alaska

Peer Exchange Report, Research & Technology Transfer, Alaska Department of Transportation & Public Facilities, July/August 2006.
http://www.transportation.org/sites/research/docs/Alaska%20DOTPF%202006%20Peer%20Exchange%20Report.pdf

Implementation strategies were among the topics addressed in this peer exchange. Participants discussed the value of marketing completed research, how project selection criteria can limit implementation potential, and how the active involvement of technical staff throughout the research process could increase the likelihood of successful implementation. Page 6 of the PDF provides recommendations for moving research into practice, including:

- Designing and budgeting projects at the outset to result in products (such as specifications, drawings, standards and methods) that are fully ready to use in normal practice.
- Developing a formal process for technical committees to review research findings and recommend implementation steps.

Florida

Peer Exchange: Final Report, Florida Department of Transportation, October 2007.
http://research.transportation.org/Documents/FloridaDOT2007.pdf

Recommendations arising out of a post-symposium session with regard to performance measurement, implementation and technology transfer include:

- Remember that seeing the future and having a strategic plan are not the same thing; the two must be brought together and performance measures should be applied to ensure progress stays on course.
- Consider implementation as an integral part of the research process, not an add-on to research.
- Consider making a PowerPoint presentation of research results a required deliverable to facilitate technology transfer.
- Keep in mind what will be necessary to achieve a "pull" rather than a "push" of research results—what will decision makers need to use/promote the results? Identify the levels of buy-in necessary.

Iowa

Best Practices in Technology Transfer: Research Peer Exchange, Iowa Department of Transportation, August 2007.
http://www.iowadot.gov/research/pdf/2007%20Peer%20Exchange%20report.pdf

This peer exchange focused on best practices in technology transfer, a topic closely tied to implementation. As participants examined technology transfer, their observations with regard to implementation included the following:

- There is a need for more complete implementation plans and regular assessment.
- Implementation products must be in a usable form, such as draft specifications, policies, legislation, ordinances, interagency agreements, pilot projects and training.
- The key to implementation is comfort—people must be comfortable with the ideas—which can come with familiarity and trust of the office or individuals.
- In-person meetings—not just paper forms—are needed to create handoffs from research to implementation, identifying those responsible and the source of needed resources.

Michigan

ORBP Peer Exchange: Bridging the Gap: Implementing Research Results, Michigan Department of Transportation, February 2011.

The report will be available online soon at http://www.michigan.gov/mdot/0,1607,7-151-9623_10724_48681---,00.html

Topics addressed during this peer exchange included defining implementation, identifying components and structure of a successful implementation program, funding implementation activities, and measuring implementation impacts. Some of the effective practices noted by participants include:

- Rate projects on their implementation potential when selecting them for funding.
- Track implementation activities during the research phase and after the research project concludes.
- Plan for implementation funding by using a dedicated source for follow-up activities, building it into the research work plan or leaving some flexibility in your overall program budget.
- Make sure everyone who will be needed for implementation is involved in the research project panel. Use that panel to oversee both the research and the implementation activities.
- Include marketing and communications professionals on your implementation planning team.
- Conduct surveys of customers to get feedback on the implementation process.

Minnesota

Communicating the Value of Research Workshop and Peer Exchange, Minnesota Department of Transportation, November 2009.

http://www.dot.state.mn.us/research/documents/peer-exchange/2009/MnDOT-Peer-Exchange-Final-Report.pdf

This peer exchange with a communication focus gave participants an opportunity to identify lessons learned that also relate to implementation. From page 9 of the PDF:

- Start tracking the implementation process early and often. This allows for communicating early successes and saves time in demonstrating full benefits at the end of implementation.
- Engage a project review committee to provide implementation expertise.
- Market projects with quantifiable implementation benefits. Look at the three-year implementation history and consider projecting implementation savings.
- Develop an implementation strategy early, formalize it and track it.
- Recognize the DOT staff commitment needed to support research projects and implementation and the amount of time this takes from their other responsibilities.

Peer exchange presentations are available at http://www.dot.state.mn.us/research/documents/peer-exchange/2009/MN-2009-peer-exchange-presentations.pdf.

Missouri

Organizational Results Research Report: Peer Exchange Final Report, Missouri Department of Transportation, March 2007.

http://www.transportation.org/sites/research/docs/Peer%20Exchange%20Final%20Report%2003-07.pdf

Implementation is one of the four critical issues addressed in this peer exchange. Page 7 of the PDF describes strengths, weaknesses and opportunities for implementing research results throughout Missouri DOT. Strengths include:

- Research projects have a champion who can help facilitate implementation.
- Buy-in on research from top management helps facilitate implementation.
- Criteria for project selection include consideration of whether results are likely to be implementable.

New Jersey

Research Peer Exchange Report, New Jersey Department of Transportation, June 2006.
http://www.transportation.org/sites/research/docs/NJDOT2006.pdf
Pages 10 and 11 of the PDF provide participants' takeaways from the discussion of project implementation and technology transfer, including:

- Start at the beginning for implementation.
- Develop and maintain a research implementation database.
- After three to four years, ask the project champion to give the status of implementation and cost savings, and publish the benefits.
- Develop and use research project implementation status reports.

Virginia

Virginia's Transportation Research Peer Exchange, Final Report VTRC 11-R8, Virginia Transportation Research Council, October 2010.
http://www.virginiadot.org/vtrc/main/online_reports/pdf/11-r8.pdf
With an emphasis on the implementation of research results, recommendations for improving the implementation process begin on page 7 of the PDF, including:

- Implementation should be considered at the same time a research topic is proposed and should be reviewed at significant milestones during the conduct of the study.
- When proposed research topics are prioritized, greater weight should be placed on those projects for which the outcomes have a high potential for implementation.
- The prospects for implementation can be enhanced by gathering executive level support to assist operations staff in achieving implementation within their respective divisions.
- It is important to get the right message to the right people at the right time.
- A program to fund demonstration projects could assist with getting research recommendations implemented.

Washington

Research Office Peer Exchange: Summary Report, Washington Department of Transportation, May 2005.
http://research.transportation.org/Documents/WSDOTPeerExchangeReport2005withstateinfo.doc
This report includes research program descriptions provided by peer exchange participants from DOTs in Arizona, Idaho, Louisiana, Ohio, Texas and Washington, and the U.S. DOT Research and Innovative Technology Administration; see page 21 of the PDF for details. Included in each description is a section titled "Research Implementation Process."

Other Publications

General Research

"Opportunities and Challenges in Advancing Transformative Research: The Case of Transportation Research on Both Sides of the Atlantic," O. A. Elrahman, G. A. Giannopoulos, *TRB 90th Annual Meeting Compendium of Papers DVD*, Paper #11-0051, 2011.
http://amonline.trb.org/12jhd7/1
This conference paper examined the notion of transformative research—the high-risk research that makes a radical difference and introduces fundamental changes in existing processes and systems—and explored its application and implications in transportation. The authors note that the need to demonstrate the value

and return on research investments can limit the willingness of research organizations to accept the risk-taking required for transformative research.

The authors cite a recent study that suggested the following four elements are crucial for producing innovation:

- Structured, standardized processes that consistently generate and pursue innovative ideas.
- A talent and skill base that drives the "wheel of innovation."
- Fiscal government policies that encourage innovation.
- Supportive education policies that produce skilled workers and address workforce needs.

"General Theory on Translating Research into Policy and Practice," Everett. M. Rogers, *Transportation Research E-Circular No. E-C072*, January 2005.
http://onlinepubs.trb.org/onlinepubs/circulars/ec072.pdf
This paper draws on the diffusion-of-innovations model for strategies to achieve a higher degree of research utilization. The author notes that researchers are not rewarded for utilization of their findings and often lack the time, resources and expertise needed for the activities associated with implementing research results. Strategies that might be used to foster implementation include:

- Using champions to promote the innovations.
- Encouraging a high degree of community and practitioner participation in designing and conducting research.
- Capitalizing on peer networks to disseminate information about innovations.
- Focusing considerable efforts in the early stages to identify early adopters of a new process or technology. Once a critical mass is achieved, less effort is needed to achieve widespread adoption.

State-Related Publications

California

"Successful Research Strategies at Caltrans," Lawrence H. Orcutt, Greg Larson, *Journal of Public Works & Infrastructure*, Vol. 2, No. 3, March 2010: 215-230.
Citation at http://tris.trb.org/view.aspx?id=917723
In this journal article, the authors describe three research mechanisms used by Caltrans' Division of Research and Innovation—in-house research, partnering with academia and partnerships with the private sector—to move research forward to become future innovation.

"Overcoming Roadblocks Facing the Implementation of Innovations: Three Case Studies at Caltrans," Lawrence H. Orcutt, Mohamed Y. AlKadri, *TRB 88th Annual Meeting Compendium of Papers DVD*, Paper #09-3671, 2009.
http://www.dot.ca.gov/researchconn/past_speakers/MrLarryOrcutt/threecasestudies.pdf
This conference paper examined challenges faced by Caltrans in deploying innovations. Lessons learned and successful mitigation measures are presented for three innovations:

- Sensys, a compact, low-cost wireless traffic-sensing system that can replace less reliable, more expensive inductive loops.
- CA4PRS, software that simulates highway construction, predicting traffic delays associated with simulation scenarios, to optimize construction quality, costs and traffic impacts.
- Balsi Beam, a mobile frame designed to protect highway workers.

Roadblocks identified by the authors include:

- The complex and interjurisdictional nature of some projects.

- Multiple layers of decision making sometimes lacking logic.
- A public sector procurement process driven by competitive multiple low-bid processes that often infringes on intellectual property rights.
- Public agency resistance to change.
- Risk-aversive executives hesitant to implement new innovations.

The systems engineering process recommended to overcome these roadblocks includes customers in all phases of the process, ensuring that the final product meets customer needs. Other factors critical to successfully deploying innovations include:

- Improving communications at all levels and stages between researchers, developers, operators and decision makers.
- Utilizing innovation champions.
- Establishing criteria for evaluating new innovations.

"Barriers and Enablers of Innovation: A Pilot Survey of Transportation Professionals," Mohamed Y. AlKadri, Lawrence H. Orcutt, *TRB 88th Annual Meeting Compendium of Papers DVD*, Paper #09-2649, 2009.
http://www.dot.ca.gov/researchconn/past_speakers/MrLarryOrcutt/pilotsurveyoftransportprof.pdf
This study reports on a survey of 109 transportation professionals—primarily in California—that queried respondents about their experiences with innovation. Researchers sought to determine respondents' assessment of the significance of revolutionary (disruptive) and evolutionary (sustaining) innovation; how to rate common roadblocks to and enablers of innovation processes; how innovations in safety, performance, cost-effectiveness, quality and environmental protection should be prioritized; and methods to improve the process of innovation.

Actions recommended by respondents to improve the innovation process include:

- Establish clear direction and procedures for the innovation process.
- Improve communications.
- Secure executive sponsorship and management support.
- Empower employees and find champions for each innovation.
- Create incentives for innovators.
- Demonstrate the benefits of innovation.
- Manage risk and change.

Florida

Research Program Manual, Research Center, Florida Department of Transportation, December 2010.
http://www.dot.state.fl.us/research-center/Program_Information/Research%20Program%20Manual%2012-8-10.pdf
Chapter 5, Deployment, which begins on page 36 of the PDF, discusses in detail the components of deployment plans that document—before the research begins—how the results of research will be used by identifying the activities and actions necessary to optimize the use of research results. Included is a discussion of how an implementation plan is monitored, opportunities for conducting demonstration projects as part of the deployment of the research results, and how implementation plan activity will be reported.

Illinois

Implementation of Research Findings, Research Advisory Committee Survey, Illinois Department of Transportation, January 2010.
http://research.transportation.org/Documents/RAC%20Surveys%20of%20Practice/IDOT%20implementation_survey_summary_Feb4.pdf
In late 2009, Illinois DOT conducted a survey of members of AASHTO's Research Advisory Committee on the topic of implementation. This document provides the responses from 26 states to a survey that included the following questions:

- Does your agency have documented procedures related to the implementation of research findings?
- Is an implementation plan required at the beginning of a project?
- Are implementation activities identified, documented, and monitored at the end of a project? Do you hold a meeting at the end of a project where the findings are summarized and discussed and implementation tasks are identified?
- If an implementation champion is identified, what level of the organization is the champion typically from?
- Do you have staff members in your research division whose role is to monitor implementation of research findings?

Minnesota

"Dynamic Management Process for Innovative Research Products at a State Department of Transportation," Eil Kwon, Cory Johnson, Clark Moe, Susan Lodahl, *TRB 88th Annual Meeting Compendium of Papers DVD*, Paper #09-3311, 2009.
Citation at http://tris.trb.org/view.aspx?id=882213
This paper describes a dynamic research process that integrates implementation planning into research project development and management. Elements of the process include:

- Research problem statements include a conceptual implementation plan that outlines the potential use of the expected research products and the individual responsible for implementation.
- When a research project is selected for funding, the conceptual implementation plan is updated to a preliminary implementation plan that includes information about the type and anticipated delivery date of the expected final research product.
- The preliminary implementation plan is continuously adjusted as the research project progresses and interim results are available for performance assessment.

Factors considered in the development of an implementation plan include:

- Expected products, use, benefit (relative to existing methods) and cost.
- Implementation office/personnel resource requirements.
- Potential barriers for implementation, including compatibility with existing methods or tools.
- Administrative process changes needed for implementation.
- Implementation process to produce expected final products.
- Performance definition and measurement plan.
- Additional research needs to support for implementation.

Missouri

Chapter 8, Innovative Transportation Solutions, Tracker, Missouri Department of Transportation, January 2011.
http://www.modot.mo.gov/about/general_info/documents/Tracker_Jan11/Chapter8.pdf
Published periodically throughout the year, Tracker documents Missouri DOT's performance measurement system that assesses how well the department meets customer expectations. The Tracker tool is organized around 18 tangible results, with senior- and mid-level managers involved in monitoring approximately 100 individual measures. This chapter reports data for the following performance measures:

- External awards received.
- Innovative reports published.
- New product evaluations completed.
- Innovative technologies implemented in program delivery.
- Innovative solutions implemented for maintenance.
- Innovative revisions and dollars saved.

Pennsylvania

"Building PennDot's Research and Innovation Implementation System," Michael R. Bonini, Bonnie Fields, Robert Vance, Michael Renz, Barbara Thomas Harder, Mary Treisbach, Larry Bankert, *TRB 90th Annual Meeting Compendium of Papers DVD*, Paper #11-1833, 2011.
http://amonline.trb.org/12k9do/1
In 2004, PennDOT responded to the need to address implementation programmatically with the development of its Research and Innovation Implementation System. Nine key decisions and actions that created the system are detailed in this paper, including:

- Accept that a need exists.
- Be guided by department strategic objectives.
- Provide financial and technical resources.
- Develop a team.
- Engage the field.
- Identify champions at all levels.
- Communicate.
- Build a foundation for success.
- Measure results.

More than 80 innovations were implemented in the program's first five years. The authors note that at least that many innovations were reviewed for implementation potential and either rejected or postponed pending further review, highlighting the importance of careful screening of implementation candidates. Adaptability and responsiveness are considered key to the implementation program's future success.