Acknowledgements

This research was conducted with funding provided through the National Cooperative Highway Research Program (NCHRP) Project 20-44(21) - "Synthesis of State Peer Exchanges and RPPM". The NCHRP is supported by annual voluntary contributions from the state Departments of Transportation. The report was prepared by CTC & Associates LLC. The work was guided by a technical working group that included:

- Dr. Hafiz M. Munir - Minnesota Department of Transportation
- Ms. Susan Sillick - Montana Department of Transportation
- Dr. Joseph Crabtree - Kentucky Transportation Center

The project was managed by Mr. Sid Mohan, NCHRP Senior Program Officer.

Disclaimer

The opinions and conclusions expressed or implied are those of the research agency that performed the research and are not necessarily those of the Transportation Research Board or its sponsoring agencies. This report has not been reviewed or accepted by the Transportation Research Board Executive Committee or the Governing Board of the National Research Council.
## Table of Contents

### Overview and Synthesis
- Research Peer Exchange Reports ................................................................. 4
  - Citation Format .................................................................................. 5
- Organization of Findings ............................................................................ 5
- Considerations ............................................................................................ 6

### Synthesis of Findings
- Observations and Trends ............................................................................ 6
- Program Management .................................................................................. 7
- Roles and Staffing ....................................................................................... 7
- Project Management and Process ............................................................... 8
- Funding and Contracting ............................................................................. 8
- Tracking ....................................................................................................... 8
- Technology Transfer/Marketing .................................................................. 8
- Demonstrations, Pilots, Other Implementation Activities ........................... 9
- Other Noteworthy Approaches .................................................................. 9

### Detailed Findings ................................................................................. 10

#### 1. Program Management
  - Program-Level Philosophy ................................................................. 10
  - Strategies That Support Any Philosophy ............................................ 12
  - Implementation and the Value of Research ........................................ 13
  - Program-Level Challenges and Opportunities .................................... 15

#### 2. Roles and Staffing ........................................................................... 17
  - Research Staff ..................................................................................... 17
  - Project Panels and Champions ............................................................. 17
  - Other Stakeholders ............................................................................. 19

#### 3. Project Management and Process .................................................. 20
  - Project Selection .................................................................................. 20
  - Implementation Plans ........................................................................... 21
  - Ensuring Quality in Deliverables ......................................................... 23
  - Implementation Reports, Final Reports ................................................ 24
  - Implementation Time Frame ............................................................... 25
  - Role of Principal Investigator in Implementation ................................ 26
## 3.7. Implementing Other Agencies’ Research

---

## 3.8. Pooled Fund Participation

---

## 4. Funding and Contracting

---

## 5. Tracking

- 5.1. Reporting on Implementation

---

## 6. Technology Transfer/Marketing

- 6.1. Communication Strategies and Talking Points
- 6.2. Staff Outreach
- 6.3. Webinars
- 6.4. Videos
- 6.5. Research Briefs and Summaries
- 6.6. Posters
- 6.7. Conference Presentations
- 6.8. Newsletters (Internal, External)
- 6.9. Email Notifications
- 6.10. Annual Reports

---

## 7. Demonstrations, Pilots, Other Implementation Activities

---

### Appendix A. Listing of Peer Exchange Reports
Overview and Synthesis

Per federal regulations, each state department of transportation (DOT) must host a peer exchange at least once every five years. Peer exchanges bring together state DOTs and others involved in state DOT research to share best practices and innovations through an open exchange of ideas, knowledge, and brainstorming. During a two- to four-day meeting, staff and management from the host state and a group of invited peers from other states, federal agencies, and research partners exchange information on a few focused topics that are particularly relevant to the host state’s research program.

In conducting these research peer exchanges, state DOTs commonly select research implementation as a discussion topic. They seek to learn about best practices from among their peer agencies to help ensure that research results are implemented. Among the 93 reports housed in American Association of State Highway and Transportation Officials (AASHTO) Research Advisory Committee’s (RAC’s) peer exchange report database (https://research.transportation.org/peer-exchange-reports/) dating back to 1997, fully 60 address the topic of “Implementation/Deployment of Results/Technology Transfer” in whole or in part.

These peer exchange reports are lengthy and dense with information, and it takes users significant effort to identify and extract the most important findings and the actionable recommendations.

This project seeks to extract value from these underutilized resources through a detailed synthesis of studies on implementation-focused peer exchange reports (Task 1, this report) and a synthesis of implementation resources submitted to the Research Program and Project Management (RPPM) database (Task 2, conducted in parallel).

These will be complemented with follow-up work to further identify implementation best practices (Task 3) and with the development of guidance to effectively communicate future peer exchange findings (Task 4), all compiled in a final report (Task 5).

RESEARCH PEER EXCHANGE REPORTS

CTC & Associates conducted a detailed review of all peer exchange reports from the last 10 years (2010 to 2019) that feature implementation as a topic area. The topic area designation is made by the host state DOT at the time it submits the peer exchange report to AASHTO RAC’s peer exchange report database. As of the time of this report writing, 31 reports meet this criterion. In most cases, reports have more than one topic area; implementation is a central focus to some reports and a secondary focus for others.

The eight categories in the report database (https://research.transportation.org/peer-exchange-reports-topics/) are:

1. Research Project and Program Management
2. Alignment of the Research Function with Departmental Missions and Goals
3. Research Staffing Needs, Capacity Building, and Skill Sets
4. Research Collaboration and Partnerships
5. Optimizing the Value and Quality of Research
6. Implementation/Deployment of Results/Technology Transfer
7. Information and Knowledge Management
8. Research Performance Measures and Communicating the Value of Research Projects and Programs

Implementation is part of Category 6, “Implementation/Deployment of Results/Technology Transfer.”

In analyzing the peer exchange reports, we sought to identify practices, opportunities, and challenges related to research implementation identified by peer exchange host states and visiting out-of-state participants. In this report, those practices are grouped by category, including citations to their source. This synthesis also includes observations about trends and unique practices.

Citation Format

For ease of readability, the peer exchange reports are cited in this synthesis according to the peer exchange’s host state and the year the peer exchange was conducted. In the Detailed Findings chapter of this report, citations are presented in the following format:

\[(\text{presenting agency, as appropriate); (host state) (year), (page)}\]

Example: [AASHTO presentation; Montana 2017, page 4]

The citations used for the 31 reports are listed in chronological order in Appendix A: List of Reports.

ORGANIZATION OF FINDINGS

The findings are organized into seven top-level functional areas. These are the same areas used to organize the synthesis of findings from the Research Program and Project Management (RPPM) database (Task 2 of this project). A brief description of what each area covers is also provided.

1. Program Management — Ways a research program is organized to support implementation, and ways it interacts with other agency departments or organizations beyond the DOT to support implementation.

2. Roles and Staffing — Who is responsible for implementation work; this might include research staff, others at the DOTs, and consultants/investigators.

3. Project Management and Process — Steps established at all phases of research to support implementation.

4. Funding and Contracting — Formal channels for providing funds for implementation; established contract language to facilitate implementation.

5. Tracking — Established methods to track what research is being implemented and how successful those implementation efforts have been.

6. Technology Transfer/Marketing — How transfer of technology intersects implementation; how marketing successful research promotes implementation.

7. Demonstrations, Pilots, Other Implementation Activities — Noteworthy implementation examples in practice.
In each area, we present one or more strategies to facilitate, promote, or enhance implementation, followed by specific approaches drawn from the reports, including citations.

Beyond these seven areas, this synthesis includes an eighth section:

8. Other Noteworthy Approaches — Additional approaches that were noteworthy in terms of their sophistication level but were mentioned only occasionally across the 31 peer exchange reports.

CONSIDERATIONS

The following considerations should be taken into account with respect to the findings in this report:

- Some of the peer exchange reports are years old and may no longer represent current practice.
- Text from peer exchange reports has been edited for clarity in some cases. Readers should consult the cited reports directly for more details.
- The reference to the peer exchange host state in each citation (“Montana 2017” in the example above) does not necessarily imply that the state endorses the cited approach or strategy.

SYNTHESIS OF FINDINGS

Observations and Trends

A research program’s ability to produce implementable results is a critical measure of its effectiveness. Generally, though, results are implemented not by research staff, but by an agency’s functional areas: bridges, pavements, safety, operations. The 31 peer exchange reports we reviewed examine a research program’s role in bridging the gap between results and implementation.

In these reports, which spanned a decade, we observed a trend toward greater involvement by research programs in facilitating implementation in functional areas. At more than one peer exchange, attendees noted that the historical approach to implementation—described as taking completed research and passing implementation responsibility to the functional areas—was ineffective and was no longer an accepted practice. In the last decade, research programs have increasingly formalized their processes for planning for implementation during project selection; requiring project tasks and deliverables that support implementation; coordinating implementation efforts with functional areas; and tracking implementation activities after a project is completed.

Despite the challenges inherent in this effort, research programs have made great strides in implementing process changes in the last decade. Not uncommonly, strategies, processes, or tools that states described as their own were the same practices or tools that they had noted as takeaways at an earlier peer exchange. As a whole, the nation’s research programs are more sophisticated—sometimes considerably so—in their approach to implementation than they were a decade ago.

Below is a high-level summary of implementation-related strategies and approaches that were discussed at peer exchanges in the last decade. The strategies are grouped according to the seven categories listed above, with a focus on approaches that had some consensus of support among attendees. They are followed by a final category, Other Noteworthy Approaches—emerging practices of interest that were mentioned only occasionally across the 31 peer exchange reports.
Findings reinforced by a significant number of citations and states are tagged here as **KEY FINDINGS**. These are candidate topics to be addressed in more detail in follow-up tasks for NCHRP Project 20-44(21).

Full detailed citations referencing specific resources, agencies, and citation links are presented in the next chapter, “Detailed Findings.”

**Program Management**

- **KEY FINDING**: Institutionalize the central role that implementation plays in research. Have a program-level research philosophy that “begins with the end in mind” as projects are selected for funding and project tasks are outlined.

- **KEY FINDING**: Get buy-in from agency leaders.

- **KEY FINDING**: Formalize and document the implementation process (roles, steps, options).

- Use successful implementation efforts to demonstrate the value of the research program and build staff and management support.
  - Some agencies take this further, using implemented results in benefit-cost analyses and return-on-investment calculations or linking implementation to operational performance measures. Others caution that this approach can create issues and may not capture all benefits.

- Identify barriers to implementation and opportunities to address them. Common challenges include resistance to change, lack of dedicated implementation resources and funds, and difficulty in accurately anticipating implementation needs and costs before research has begun.

**Roles and Staffing**

- Define the roles and responsibilities of research staff in implementation.
  - In the last decade, designating a research staff member as a dedicated implementation coordinator or implementation manager has become a common approach. However, institutionalizing a focus on implementation may be more important than using any one specific staffing structure.

- **KEY FINDING**: Define the roles and responsibilities of project panels, project champions, and functional area staff who will be implementing the research. Throughout the research effort, engage the practitioners who will ultimately implement the research.

- Keep the project panel together after the project has ended to track and facilitate implementation activities.

- Involve other groups within the agency who may be affected by implementation activities, such as information technology (IT). As appropriate, include external stakeholders as well, such as by gathering industry feedback on new specifications and products. Early involvement promotes buy-in and future implementation.
Project Management and Process

- **KEY FINDING:** Consider implementation throughout the research process, beginning with project selection. Evaluate proposed projects for implementation potential.

- **KEY FINDING:** Develop an implementation plan for each research project. Develop the plan early and revise it as the project progresses. Consider using an implementation planning worksheet or template as a guide.

- Require high-quality deliverables that facilitate implementation. In addition to the final report, consider requiring companion deliverables that promote implementation, such as manuals or training materials.

- As the project concludes, outline implementation recommendations in the final report or in a separate implementation report.

- Begin implementation activities in a timely manner. The appropriate time frame will vary depending on the project; be open to implementing known results even before the project concludes.

- Implement relevant research results from other agencies, including research discussed at the Transportation Research Board (TRB) Annual Meeting and other conferences. Establishing reporting tools from conference attendees and internal technology transfer channels can facilitate such implementation.

Funding and Contracting

- Allocate dedicated funding for implementation projects. Depending on the scope, implementation activities may be funded as discrete projects or included as tasks in the original research project contract.

- Consider alternative funding sources for implementation activities.

Tracking

- **KEY FINDING:** Track implementation for all completed research projects. Use a database or other tool to document implementation activities.

- Conduct surveys or interviews of project stakeholders to assess implementation status.

- Report periodically on implementation progress. Share results with agency staff through regular communications, dashboards, conferences, or other methods.

Technology Transfer/Marketing

- **KEY FINDING:** Communicate research results and showcase implementation successes.

- Present research results directly to relevant DOT staff and local agencies.

- Consider a variety of approaches to make staff aware of research results. Options include webinars, videos, research briefs and summaries, conference presentations and posters,
newsletters, email notifications, and annual reports. Tailor your message and format to each targeted audience.

Demonstrations, Pilots, Other Implementation Activities

- Define and document a framework of deployment steps or options.
- As appropriate, translate findings from the final report into a user-friendly format. Develop specifications, manuals, or training materials; consider holding technology transfer meetings with DOT staff.
- Learn from other agencies’ successful and unsuccessful implementation efforts.
- If appropriate, begin deployment with a demonstration project or pilot project.

Other Noteworthy Approaches

In addition to the strategies outlined above, we identified a few other approaches that were noteworthy in terms of their sophistication level but were mentioned only occasionally across the 31 peer exchange reports. These included:

- **Accelerated/concurrent implementation**, or “[taking] advantage of early implementation opportunities and accomplish[ing] them concurrently with the research phases of other implementation activities” [Indiana 2013, page 1]. This was identified as a primary focus of Indiana DOT’s 2013 peer exchange; early implementation was also mentioned as a positive approach at Georgia DOT’s 2015 peer exchange [Georgia 2015, page 6].

- **Considering implementation/deployment steps through the lens of change management.** This approach was mentioned at Caltrans’ 2011 peer exchange [California 2011, page 15].

- **Highlighting the connection between innovation and research implementation.** Aligning research and innovation was discussed at a few peer exchanges, including Wisconsin’s 2018 peer exchange [Wisconsin 2018, pages 1-2].
Detailed Findings

1. PROGRAM MANAGEMENT

1.1. Program-Level Philosophy

**Strategy:** Define what implementation means to your agency.

Approaches:

- **Agencies’ definitions of research implementation** include:
  - Widespread adoption or systematic use. [Montana 2017, page 109]
  - Deployment, demonstrations, and pilot projects. [Montana 2017, page 109]
  - Specification changes. [Utah DOT; Georgia 2015, page 4]
  - Verification of existing practice. [Montana 2017, pages 3 and 109]
  - Technology transfer⁴. [Montana 2017, page 109]

- For Maine DOT, **successful implementation** is defined:
  - **Generally:** As implementation adopted by the agency (e.g., bridge project postings; calibration of Highway Safety Manual for rural intersections).
  - **Programmatically:** As the implementation of one to two projects within a one-year period.
    - Using this definition, roughly half of core Maine DOT research projects are implemented. [Georgia 2015, page 3]

- Over time, an implemented process becomes a normal way of doing business, typically after deployment in multiple locations. [Virginia DOT comment; Georgia 2015, page 3]

**Notes:**

- Keep in mind that knowing not to use or do something has value. [AASHTO presentation; Ohio’s Research Initiative for Locals (ORIL) 2017, page 7] Validating and confirming current practice likewise has value [Montana 2017, page 13]

**Strategy:** Have a program-level research philosophy that prioritizes implementation.

Approaches:

- **Institutionalize research** into daily business. [Wisconsin 2018, pages 1-2]

- Focus the research program on **tangibly implementable products**. [Georgia DOT approach; Georgia 2015, page 6]

---

⁴ Some agencies equate implementation with technology transfer; others do not. This report treats these as distinct concepts.
**Make incremental changes** that can be sustained. [Wisconsin 2018, pages 1-2]

- Implementation can be a **need-driven process** or **institutionalized at a program level**. (“Need-driven” means an implementation project is proposed by a practitioner who is solving a problem, using results from completed research.) [Montana 2017, pages 5 and 113]
  - A need for one district might not be a universal need—an innovation or pilot in one region may find resistance elsewhere in the state. **Research staff can help expand implementation by playing the role of salesperson**, marketing one area’s successes with a deployment to other areas.
  - Implementation may start as needs-based and then evolve into an institutionalized practice. Also, having an institutionalized process can be helpful, even if it isn’t used every time, because it gives a path forward.
  - Utah’s exercise of asking people in the DOT functional areas to list their primary concerns is an interesting approach to understanding needs across an agency and knowing what kinds of research results to watch for. [Montana 2017, pages 13 and 115]

**Notes:**
- In Montana’s experience, implementation is more successful when it is needs-driven and less successful when it is driven by a programmatic desire to “push out” the results of single completed research projects. [Montana 2017, page 113]
- In Ohio, research that comes from districts leads naturally to implementation; central office-led projects are less frequently applied. [Montana 2017, page 15]

- **Align research and innovation.** Opportunities for implementing research may be missed if the research program does not have strong connections with innovation experts. [Wisconsin 2018, pages 1-2]
  - Enhance connections between research staff and innovation experts.
  - Promote a people-driven culture of innovation.
  - In 2016, Illinois DOT launched a gainsharing pilot program to identify opportunities to improve operational efficiency and enhance the quality of services it delivers. The gainsharing program **financially rewards employees who bring forward tangible cost-saving ideas** the department can implement. (See page 30 of IDOT’s [2016 Annual Report](https://example.com).) The IDOT Bureau of Research would like to investigate **methods in which the research program can be incorporated** into the process. [Illinois 2017, page 18]

- Many research solutions require new ways to do business. Consider research implementation/deployment as a **change management process**. There may be tools available from the change management process that are applicable. [California 2011, page 15]

- **Treat research as risk management.** [Wisconsin 2018, pages 4 and 9]
  - Target efforts toward improving areas of greatest risk.
  - Research risks losing value the longer it takes to communicate it to implementers; reducing that time reduces risk.
Risk-averse agencies may be more receptive to research if branded as risk mitigation.

Notes:
- To lead your implementation effort, you must be in tune with the culture of your organization. [California 2011, page 15]

1.2. Strategies That Support Any Philosophy

Strategy: Get buy-in from agency leadership.

Approaches:
- Before a project begins, get commitment to implementation from high-level leadership (as appropriate). [Montana 2017, page 112]
- Involve research staff in providing updates to agency staff as a project progresses, especially when the research is expected to lead to a change that will affect the entire agency. [TRB approach, Montana 2017, page 112]
- Market implementation successes to upper managers through targeted outreach. (See Section 6, Technology Transfer/Marketing, for examples of this approach.)
- Put implementation on division heads’ performance evaluations. [Mississippi 2015, page 11]

Notes:
- For leadership engagement in particular, program implementation support may be more important than specific project support. There may be politics and multiple agencies involved. Good communication with leaders and the entire agency is vital. [Montana 2017, pages 4 and 112]
- For a mass deployment, staff needs to hear from leadership that the change is important, that the research was implemented, and that this is the way the agency is going to do things. [Ohio DOT comment, Montana 2017, page 112]

Strategy: Formalize the implementation process.

Approaches:
- Clearly define implementation roles early in project proposal development. [Georgia 2015, page 8]
  - (See Section 2, Roles and Staffing, for related strategies.)
  - Step 2: Implementation action plan developed as project nears completion.
    - Project manager (PM), research manager (RM), and implementation coordinator (IC) concur that research results are ready for implementation.
Recommend implementation level.

- Could be implemented at division, Transportation Service Center (TSC), region, or office level.
- Trial project/test sections.
- Regionwide or statewide use.

- Establish a work plan with tasks and deliverables (reports, guides, specifications, training materials, etc.).
- Develop budget and funding sources.
- Determine if principal investigator (PI) involvement is needed.
- With approval signatures from PM, RM, and IC, the IC obtains approval from the following:
  - Bureau, division, office, TSC, and/or region depending on the jurisdiction of implementation.
  - Engineer of research, who will forward to deputy director.
  - The Research Executive Committee provides final implementation approval.
- With final approval, implementation of results in the field or a pilot study can begin.

- **Define and document a framework of deployment steps or options.** *(See Section 7, Demonstrations, Pilots, Other Implementation Activities, for examples of this approach.)*

**Strategy:** Recognize that not every project will be implemented.

**Approaches:**

- Communicate to stakeholders that not every project will be implemented. Causes can include:
  - Changes in circumstances or priorities.
  - Due to the nature of the research, there are no results to implement. [Montana 2017, page 4]

- Aggregate reasons for not implementing the results of certain research projects, including lessons learned. [Mississippi 2015, pages 9 and 14]

**Notes:**

- If a customer doesn’t “bite,” it’s OK for a research office to let go of a possible implementation. [Montana 2017, page 5]
- Studying examples where implementation was not successful can be valuable if it provides insights into barriers and how to overcome them. [Montana 2017, page 6]
- The successful implementation of one project every five years may be enough to justify the cost of the entire ORIL program. [AASHTO presentation; ORIL 2017, page 7]

### 1.3. Implementation and the Value of Research

**Notes:**
As noted below, peer exchange attendees differed in their assessments of whether implementation should be linked to performance measures or used to quantify the value of research.

**Strategy:** Use successful research implementations to demonstrate the value of the research program.

- (See Section 6, Technology Transfer/Marketing, for examples.)

**Strategy:** Use implemented results to calculate and quantify the benefits of research.

**Approaches:**

- Use a benefit-cost analysis to evaluate the success of the implementation process. [South Carolina 2018, page 14]

- Assess the value of the implemented research at the end of the research project by conducting a performance analysis on the organizational change/improvement. [Oregon 2014, page 5]

- The calculation of benefits needs to be based on known data, such as bid prices, miles of roadways, expected life, and miles of repairs from a recent year. The validity of the calculations may be questioned if the metrics used are not clear and reliable. [MnROAD 2014, page ii]

- Agency methods to calculate benefits are not standardized and probably cannot be. They do have to be based on realistic values and accepted data and pass a common reality check. [MnROAD 2014, page ii]

- Separate out projects that will not have implementation plans and label them as such from the beginning. These are projects where the product will be knowledge, or information to be gained, policy research, or research where the product will be training. Exclude these projects from benefit-cost ratio calculations. [Kansas 2013, pages 4-5]

**Notes:**

- Use department technical experts to perform analyses and document their assumptions. [Montana 2017, page 124]

- A politician’s cycle for return on investment is not realistic. For example, it took the automobile industry 15 years to fully implement airbags. [AASHTO presentation; ORIL 2017, page 7]

- “There is not much value in attempting to determine a return-on-investment for individual research projects. In general, the criteria for quantifying value are ambiguous and argumentative. There is, however, immense value in evaluating the overall program. It is suggested that a program-level evaluation occur every five years to show what the program has done, highlight success and show a programmatic savings/contribution.” [AASHTO presentation; ORIL 2017, page 7]

- Not all benefits of research can be calculated in terms of cost savings. Projects results may be useful for reinforcing the effectiveness of current practices, avoiding harmful practices or approaches, or establishing new products or approaches that are extremely beneficial but cannot be easily assigned dollar values. Research can help agencies better
understand the tools and techniques they have available to extend pavement life (both in terms of what works and what does not). [MnROAD 2014, page ii]

**Strategy:** Use research implementation as an operational performance measure.

**Approaches:**

- In Missouri, performance measures have been used for 12 years in a centralized way and project implementation was one of the statewide performance measures at one time. Several years ago, the number of statewide performance measures were reduced and this measure was removed. Each division and district have their own performance measures, but research project implementation is not one of them. [Mississippi 2015, page 11]

- **Performance measures** discussed at peer exchanges include:
  
  - Percent of projects where recommendations are implemented or adopted within two years of the final research report. [New Mexico DOT performance measure; New Mexico 2013, page 35]
  - Percent of projects deemed successful by the department. [New Mexico 2013, page 35]
  - Percent of projects with implementation plan complete. [New Mexico 2013, page 35]
  - Number of products (specifications, policies, training, etc.) produced and shared. [Illinois DOT performance measure; Iowa 2013, page 11]

**Notes:**

- The research group should not be indebted to performance measures regarding implementation, since research does not have the authority to implement research results in functional areas. [New Mexico 2013, page 36]

1.4. **Program-Level Challenges and Opportunities**

**Challenges and barriers to implementation:**

- **The status quo.** [Virginia DOT presentation; Georgia 2015, page 3]

- **Resistance to change.** Agency management or staff in charge of implementing research findings may not buy into research or changes to current practices. [Wisconsin 2018, page 6]
  
  - Opportunity: Seek buy-in from staff and management. [Wisconsin 2018, page 7]
    
    - Target “late adopters” to innovation with strategies to encourage earlier adoption (see the buy-in bell curve in Appendix E of Wisconsin 2018, page 172).

- **Not enough staff** to properly oversee the conduct of research or track implementation and outcomes. [Wisconsin 2018, page 7]
  
  - If implementation and outcomes are not tracked, return on investment cannot be calculated.

- A project could be too **politically sensitive or expensive** to implement. [Illinois DOT presentation; Georgia 2015, page 4]
• Difficulty in accurately anticipating implementation costs at the beginning of a research project. [Michigan 2010, page 8]
  o Opportunities: [Michigan 2010, pages 9-10]
    ▪ Plan for implementation funding by using a dedicated source for follow-up activities, building it into the research work plan, or by leaving some flexibility in the overall program budget.
    ▪ Require a benefit-cost analysis from every PI when the research is completed, even if it’s a best guess at what benefit the implementation will yield.
    ▪ Consider pooled fund studies with other states to implement research results of common interest.

• Defining expected implementation products or plans before the research results are known. [Michigan 2010, page 7]
  o Opportunity: Consider adding implementation products or related activities to a project after it is already under way and the need becomes apparent. [Michigan 2010, page 9]

• Determining who has the authority and responsibility for implementation. [Michigan 2010, page 8]

• Lacking dedicated resources for managing implementation activities and seeing them through, within the research program or among technical experts within the agency. [Michigan 2010, page 8]
  o Opportunities: [Michigan 2010, page 9]
    ▪ The research program needs to make implementation simple for its department stakeholders. Provide whatever support in time and money is possible to make sure it happens. Hire out the work if you don’t have the staff in house.
    ▪ Don’t fund research projects unless they have strong project champions. A project won’t be successful, and the results are hard to implement if the customer isn’t willing to be involved.
    ▪ 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.
    ▪ Have senior managers share the risk of pursuing research in order to drive innovation in the department. If senior managers assume that risk with you, they’ll support you when the project is a big win or when it doesn’t meet expectations.
2. ROLES AND STAFFING

2.1. Research Staff

*Strategy:* Assign implementation responsibilities to research staff.

Approaches:

- **Designate a research staff position focused on implementation.**
  - Titles will differ across agencies (implementation coordinator, manager, engineer, specialist, etc.). [Montana 2017, page 6]
  - Responsibilities include promoting, facilitating, and tracking research implementation. [Kentucky 2011, page 4]
  - Engaging people across the agency is a key part of the job. Duties may include a combination of program-level tasks and project-specific implementation efforts. [Montana 2017, page 112]

  **Notes:**
  - Having an implementation coordinator who is well connected within an agency is a key job requirement; an in-house hire makes sense. [Montana 2017, page 6]

- **Involve project managers and other research staff in implementation.**
  - In Arkansas, the research team has a formal implementation committee. [Arkansas 2012, page 4]
  - Research project managers can help implement research results. [Utah 2016, page 28]
  - Convey that ownership of the project belongs to the technical staff (end users), not the research group. Express that the panel needs to review all project deliverables and ensure that they are meeting their needs. [Montana DOT approach; Montana 2017, page 111]

2.2. Project Panels and Champions

*Strategy:* Clearly define and document the roles and responsibilities of each member of the project team.

Approaches:

- **Develop written guidance** on responsibilities of sponsors, project managers, and technical advisory committee members for project oversight and implementation. [ID-NV-SD-WY 2015, page 19]
  - Include guidance on what panel members should be looking for in their reviews. [NCHRP; Ohio 2015, page 14]
  - Build in a close-out checklist for the technical panel. [New Mexico 2013, page 37]
**Strategy:** Give the project champion a central role in implementation.

Approaches:

- **Engage champions (subject matter experts) early in the project** for successful implementation later. [Georgia DOT; Georgia 2015, page 6]

  *Notes from peer exchange discussion:*
  - Implementation manager should have in-depth knowledge of Maine DOT mechanics, know direct points of contact, and establish relationships with key project team members.
  - One of the biggest implementation hurdles is not having a strong champion.

- **Find ways to increase the motivation and effectiveness** of implementation champions. Consider incentives or recognition. [NCHRP; Ohio 2015, page 14]

- At Maine DOT, research projects are initiated by establishing an **internal champion (implementation manager)** while maintaining focus on the final presentation to stakeholders. [Georgia 2015, page 3]

- In Montana, research projects have a **champion** (can be anyone in the department) and a **sponsor responsible for implementation (division and/or division administrator or higher)**. [Mississippi 2015, page 12]

  *Notes on selecting a champion:*
  - Identify champions through constant dialogue and showing field staff that the research program can be of value; many innovations come from district offices. [Montana 2017, page 4]
  - For a specific project, the research project manager may be better positioned than the implementation coordinator to identify a champion. [Montana 2017, page 4]
  - The staff member who wrote the project idea should be involved in the beginning and throughout. They know the project and are invested in it. [Ohio comment; Montana 2017, pages 4 and 110]

- Utah DOT relies on **project champions as implementers**. [Montana 2017, pages 4 and 111]

  **Strategy:** Assign implementation responsibilities to the project panel.

Approaches:

- South Carolina DOT has a **Steering and Implementation Committee** for each project with clearly defined roles and expectations. Multiple stakeholders are included in each committee. [South Carolina 2018, pages 4-5]

  *Notes:*
  - Having “implementation” in the steering committee’s name emphasizes implementation for the duration of the project and “makes a clear statement of the
importance of implementation and the responsibility of the committee.” [South Carolina 2018, pages 5 and 16]

- For research projects that have a high potential for cross-cutting implementation, consider utilizing technical advisory committees made up of experts that will be impacted by the implementation. [Oregon 2014, page 8]

- **Have an implementation team** so that if the champion leaves, the project will still move forward. [TRB comment; Montana 2017, page 111]

- **Keep the technical advisory committee together after the project has ended** to track implementation. [Mississippi 2015, page 17]

**Strategy:** Include subject matter experts and staff from regions or districts on project panels.

**Approaches:**

- Within the technical advisory committee, choose staff who are invested so that if the champion leaves, there are others to whom the project is important. [Utah DOT; Montana 2017, page 110]

- Manage technical leadership changes during project if project focus shifts. [Georgia DOT; Georgia 2015, page 6]

- Engage young engineers as members of project technical panels or ad hoc to research. [Georgia DOT; Georgia 2015, page 6]

**Strategy:** Engage the practitioners who will ultimately implement the research.

**Approaches:**

- Staff responsible for implementation should be involved as early as possible in a research project. [Montana 2017, page 4]

- The project champion should be closely tied to project initiation and implementation. A key part of the process is to go to the field and work with the people there to develop specific ways to put research recommendations into practice. The process combines research methodology with the embedded commitment of resources to implement research-based solutions. Research neutrality is critical. [VA-WV 2014, page 18]

### 2.3. Other Stakeholders

**Strategy:** Involve other groups within the agency who may be affected by implementation activities.

**Approaches:**

- Engage information technology in the research preparation and implementation process, especially if an IT component is a part of the research. [Oregon 2014, page 8]

- Facilitate coordination between researchers and implementers and asset management teams. [Wisconsin 2018, page 7]
• Georgia DOT has set a goal to foster connections between research and its New Products Evaluation group. [Georgia 2015, page 8]

**Strategy**: As appropriate, include external stakeholders in the implementation process.

**Approaches**: 

• Consider including outside parties as part of a project review committee or implementation review committee, since this can foster important stakeholder buy-in. [Montana 2017, page 4]
  

• Incorporate industry review and feedback on new specifications and products to ensure they are viable. [MnROAD 2014, page iii]

### 3. PROJECT MANAGEMENT AND PROCESS

#### 3.1. Project Selection

**Strategy**: Address implementation during project selection.

**Approaches**: 

• Evaluate proposed projects for implementation potential.
  
  o Florida DOT’s Call for Research Proposals process includes ranking of “implementability” and potential benefits. [Illinois 2017, page 43]
  
  o Illinois DOT focuses on implementation when considering research needs and outputs, evaluating problem statements, and scoping new projects. [Utah 2016, page 8]

  ▪ In Illinois, implementation discussions start early. Illinois DOT’s Technical Advisory Groups (TAGs) identify research needs that can be implemented to assist the agency. When reviewing research proposals, TAGs discuss the ability or likelihood of research implementation. If a project does not have a high likelihood of implementation, it is typically not selected for funding consideration. [Georgia 2015, page 4]

  o At Mississippi DOT, technical experts are required to rate proposals, and implementation potential is one of the criteria. [Mississippi 2015, page 4]

  ▪ In Mississippi, project champions must state if a project has implementation potential and specify what benefits he/she expects from a study before MDOT will fund the study. [Mississippi 2015, page 6]

  o At Utah DOT, research projects are prioritized based on importance and likelihood of implementation. [Georgia 2015, page 4]

• Encourage incremental changes that do not require lengthy, costly projects. [Wisconsin 2018, page 7]
Innovations can be expedited when the value is apparent and implementation is easy/low-cost.

Notes from peer exchange discussions:
- Considering implementation from the beginning is key to a high rate of implementation. [Montana comment; Mississippi 2015, page 13]
- Challenge: Front-end screening helps to some degree but cannot anticipate all problems. Sometimes useful results do not happen. [Mississippi 2015, page 6]

• Fund implementation activities as separate projects.
  - Evaluate and fund implementation projects in an annual process. [Utah 2016, page 28]
  - (See Section 4, Funding and Contracting, for more detail on this approach.)

Notes:
- Funding implementation as a separate project provides a clear line of demarcation and avoids the appearance of scope creep. [Montana 2017, page 111]

Strategy: Address implementation in the research contract.
Approaches:

• Include implementation as a task or deliverable within traditional research projects.
  - Require researchers to provide implementation support as one of the research contract tasks. SHRP2 was noted as a model of this. [Montana 2017, page 6]
  - At Montana DOT, implementation products are included in the contract. [Mississippi 2015, page 13]
    - As a research project ends, if the needed implementation activities are more extensive than expected, the implementation becomes a separate project. [Montana 2017, page 111]

• Encourage or mandate deliverables that ease implementation. [Wisconsin 2018, page 7]
  - A research project’s primary deliverable could be a specification, product, and/or report; it doesn’t necessarily have to be a formal report. [Missouri 2011, page 4]
  - In New Jersey, implementation is addressed from the beginning, starting with the RFP deliverables to an implementation product in the final report package. [Montana 2017, page 110]

3.2. Implementation Plans

Strategy: Develop an implementation plan for each research project.
Approaches:

• Require an implementation plan at the problem statement stage.
At Alabama DOT, implementation plans are included within research proposals. This emphasizes the importance of implementation from the beginning of a project. [AL-AR-KY 2019, page 13]

In Georgia, project development procedures require that an implementation plan be included in each research proposal. [Georgia 2015, page 5]

Make sure selected projects have implementation plans with time frames developed and incorporated into work plans and schedules. [MnROAD 2014, page iii]

- Develop an implementation plan as the project progresses.
  - In Illinois, the implementation plan is acknowledged within the initial phase of each research project. [Georgia 2015, page 4]
  - In Kentucky, a preliminary implementation assessment is prepared at the beginning of the project, concurrently with the project’s work plan. The PI and Study Advisory Committee chair work together to determine:
    - How each project will be implemented.
    - The anticipated impacts of that implementation.
    - The potential challenges to implementation.

  During the project, the assessment is developed into a more extensive implementation plan, due before the final report is published. [AL-AR-KY 2019; page 14]

Participants’ notes on Kentucky’s approach:
  - Having a preliminary implementation assessment due at the beginning of the project emphasizes the importance of implementation from the projects’ starts. [AL-AR-KY 2019; page 14]
  - The assessment breaks down different types of implementation to more accurately define the degree to which each project can be implemented. [AL-AR-KY 2019; page 15]

- Complete an implementation plan as the project ends.
  - Have a post-project implementation meeting with the technical advisory committee and researcher. Then, require the researcher to submit a report and formal implementation plan. [Mississippi 2015, page 11]
  - In Mississippi, an implementation plan is now required for each project from the researcher (modeled after NCHRP). [Mississippi 2015, page 17]
  - South Carolina DOT requires the project steering committee chair to complete an Implementation Statement at the end of the project detailing the implementation plan. [South Carolina 2018, page 5]
  - In South Dakota, researchers have the latitude to provide any implementation recommendation that they consider appropriate. [Mississippi 2015, page 16]
  - In South Dakota, projects are evaluated to determine if a formal implementation plan is required. [Mississippi 2015, page 16]

- Distribute the implementation plan to the project sponsors. [New Mexico 2013, page 37]
• Use an implementation planning form for every research or implementation project.
  
  o Illinois DOT uses an Implementation Planning Worksheet (IPW), a living document that is updated regularly. The worksheet includes expected benefits. [Utah 2016, page 8; also mentioned in Montana 2017, page 5]

    ▪ The IPW is the initial document where implementation performance measures are defined. [Georgia 2015, page 4]
    ▪ The IPW is reviewed to ensure that all stakeholders involved are held accountable for their role within the implementation process. [Georgia 2015, page 4]

**Notes on Illinois’ worksheet:**

➢ The worksheet can be useful but possibly a burden or too formal in its existing form for some agencies. [Montana 2017, page 5]
➢ Multiple participants were excited about this tool.

• In South Dakota, an implementation plan template is in place for projects that require a formal implementation plan. [Mississippi 2015, page 16]

  ▪ The template includes version history, implementation plan approval, a research summary, an implementation plan, an evaluation, and key terms. [Mississippi 2015, page 16]

### 3.3. Ensuring Quality in Deliverables

**Strategy:** Require high-quality research products that facilitate implementation.

**Approaches:**

• Include as part of the RFP how the researcher will ensure quality. [Mississippi 2015, page 11]

• Have task reports submitted throughout the project, so issues can be detected sooner. [Mississippi 2015, page 11]

• **Tie deliverables (report chapters) to payment.** [Arizona DOT; Ohio 2015, page 8]

• Require a midproject presentation. [Maryland SHA; Mississippi 2015, page 9]

**Strategy:** Require final reports that are highly usable and accessible in terms of clarity, readability, length, and distillation of key results.

**Approaches:**

• **Aim to produce “field-ready” reports** that support implementation. [CTC & Associates; Ohio 2015, page 12]

• **Limit the length** of research reports. [Utah DOT; Ohio 2015, page 10]

  o Consider what should go in the report and what should appear in the appendices. [Ohio 2015, page 15]
• **Develop report writing requirements** and guidance for researchers. This guidance should address:
  
  o Intended audience and purpose of the report.
  o Desired sections of the report (including an executive summary and expected use of appendices).
  o Style guidance (see style manuals used by TRB and other state DOTs for examples).
  o Writing guidance (to emphasize the importance of readability/flow, clarity, and concise writing).
  o Formatting guidance/template (to reinforce the DOT brand and ensure consistency). [Ohio 2015, page 21]

• Require universities to hire **technical editors** for research reports. [Georgia DOT; Georgia 2015, page 8]

• Identify and require **companion deliverables** (in addition to the final report) that encourage implementation. Consider a range of communication products aimed at senior managers, middle managers, and practitioners—all of whom have a role in putting results into practice. [Ohio 2015, page 22]

### 3.4. Implementation Reports, Final Reports

**Strategy:** Outline implementation recommendations or plans in the final report or in a separate implementation report.

**Approaches:**

• **Address implementation as a section within the final report.**
  
  o Final reports from projects are expected to include a business plan or section addressing technology transfer and implementation of the findings, but not a completed plan for implementation. [Iowa Highway Research Board strategy; ORIL 2017, page 4]
  
  o At Maryland State Highway Administration (SHA), researchers are asked to provide implementation recommendations. Maryland SHA evaluates the implementation potential and decides if the project should be implemented. [Mississippi 2015, page 8]

**Notes:**

➢ When determining the structure of research reports, be cautious of trying to accomplish too many items with one report. Traditionally, research reports detail everything that was done during the study. This is good for other researchers who are interested in doing additional work on the subject matter. However, the needs of the sponsoring agencies and practitioners are different. Sponsoring agencies had an issue that they wanted evaluated while practitioners want directions for solving the problem. While it is good to have this technical documentation, many state DOTs are moving toward managing programs as opposed to performing engineering duties. Awareness of this
trend should be considered when determining how to document research. [AASHTO presentation; ORIL 2017, page 7]

- **Require a separate implementation report as a final project deliverable.**
  - In Virginia, once each project has been completed, a full implementation report is published to move toward standard agency practice. [Georgia 2015, page 2]
  - In Montana, the researchers and panel meet to discuss the researcher’s implementation recommendations and determine the agency’s response. This all gets put into an implementation report from the consultant. Research staff put this information into the agency’s implementation report template. All implementation reports have to be approved by the high-level sponsor, who is ultimately responsible for implementation. [Montana 2017, page 118]

3.5. **Implementation Time Frame**

**Strategy:** *Once research results are known, begin implementation activities in a timely manner.*

**Approaches:**

- After the research is completed, Illinois DOT “closes the deal” by acting while the information is fresh and on people’s minds. This includes supporting project champions, finding money and resources, and helping with technology transfer, marketing, communications, and training. Implementation funding is typically state funds. Then six to 12 months after implementation has begun, they interview the practitioners, stakeholders, and champions to assess benefits of the research and ongoing implementation. [Utah 2016, page 8]

- Be open to implementing known results even during the project. [Georgia DOT, Georgia 2015, page 6]
  - As appropriate, consider accelerated/concurrent implementation, which takes advantage of early implementation opportunities and accomplishes them concurrently with the research phases or other implementation activities. Its primary goal is to accelerate application of research results to practice. [Indiana 2013, page 6]

- Select a time frame that can be tied to a performance measure regarding whether projects have been implemented. Survey stakeholders to see what implementation activities have occurred during this time. Three to five years was suggested, but this will vary across agencies. [Montana 2017, page 114]

**Notes:**

- The appropriate time frame for implementation can vary significantly depending on the type of research and type of implementation. [Montana 2017, page 5]
- Not all research is implemented immediately; it takes time to make a cultural shift. [Iowa 2011, page 20]
- Research has a shelf life; any time lost communicating it with the right people costs the agency time/money. [Wisconsin 2018, page 8]
3.6. Role of Principal Investigator in Implementation

**Strategy:** Consider where a project’s PI best fits into the implementation process.

**Approaches:**

- **Have the researcher develop implementation recommendations** for each project. [Missouri DOT approach; Mississippi 2015, page 11]

  **Notes from peer exchange discussions:**
  
  - Recommendations on how to implement results are more appropriate coming from the agency rather than the researcher; they might come from research staff, a technical advisory panel, or a champion in a functional area. Researchers may make recommendations, but it’s the agency that owns the results and needs to derive benefit. It is likewise the agency’s role, rather than the researcher’s, to develop the implementation plan. [Montana 2017, page 3]

- **Explore ways to utilize PIs with implementation after the completion of the project** where appropriate. [South Carolina 2018, page 5]
  
  - PIs working with Alabama DOT research will sometimes stay involved in the implementation of projects once projects are complete, as they are often able to develop future work related to the project. [AL-AR-KY 2019, page 13]

  **Notes:**
  
  - It may be helpful not to have the original researcher lead implementation. The focus of implementation can be significantly different than the original research. [Montana 2017, page 3]
  
  - Challenge: Those performing and overseeing the research are not adequately incentivized to see it through to implementation. [Wisconsin 2018, page 4]

3.7. Implementing Other Agencies’ Research

**Strategy:** Implement relevant research results from other agencies.

**Approaches:**

- **Implement research results from NCHRP Research Reports, Synthesis Reports, and other publications.**
  
  - Use dedicated implementation funding through NCHRP Project 20-44 to help implement NCHRP research results. [Montana 2017, page 5]
    
    - NCHRP Project 20-44, “Accelerating the Application of NCHRP Research Results,” is a funding source managed by TRB for implementation. It primarily funds brochures, workshops, travel for attendees, etc. [Georgia 2015, page 5]
  
  - Consider adopting successful implementation strategies shared in the NCHRP “Paths to Practice” case studies. [Montana 2017, page 20]
- Illinois DOT tracks TRB publications and webinars in a spreadsheet and automatically sends them to appropriate staff. [Georgia 2015, page 4]

- Include discussions of NCHRP research at spring and summer research meetings. [Georgia 2015, page 7]

- Mississippi DOT is working to quantify implementation of NCHRP projects. [Mississippi 2015, page 17]

- **Implement research discussed at the TRB Annual Meeting and other conferences.**
  
  - Utah DOT tracks what employees have learned and implemented from the TRB Annual Meeting. After the meeting, the Utah DOT attendees meet every other month as a group to discuss what they learned and what they are doing with it. The process is changing as they want to mentor younger employees about national membership. [Montana 2017, page 11]
    - In Utah, TRB annual meeting attendees have to implement two ideas after the meeting. [Georgia 2015, page 4]
  
  - Minnesota DOT requires each traveler to the TRB Annual Meeting or other national conferences to submit a trip report to highlight what they learned and what they plan to do with the knowledge. [Utah 2016, page 11]

**Notes:**

- Both active and passive activities (distributing research reports from other states, TRB E-Newsletter, etc.) are important. [Montana 2017, page 100]

- Reviewing other agencies’ research results is a large undertaking, but the benefit-cost ratio is high. [Georgia 2015, page 8]

- When trying to foster implementation of research from other states or elsewhere, it can be challenging to get the right information into the right hands at a DOT due to information overload; emails often go unread, and results could be marketed to other agencies better. [Montana 2017, page 5]
  
  - An implementation coordinator can play a role in getting research results (or two-page briefs, webinars, etc.) to the right people.
  
  - Typically, other states’ research is just a starting point to start the conversation and get people thinking about how it would be adapted for their own state.
  
  - Implementing other research efforts administered outside of your state may warrant further review to see what works for your state when considering weather conditions, funding for larger DOT divisions, and the like. [Montana 2017, page 19]
3.8. Pooled Fund Participation

**Strategy:** Find implementation opportunities from pooled fund participation.

**Approaches:**

- Consider pooled fund studies with other states to implement research results of common interest. [Michigan 2010, page 10]

- Mississippi DOT is looking into pooled funds back to 2005 to see which ones the agency has implemented. [Mississippi 2015, page 17]

- Montana DOT is evaluating how pooled fund contributions are benefiting the agency. [Mississippi 2015, page 14]

4. FUNDING AND CONTRACTING

**Strategy:** Fund implementation activities as discrete projects, separate from the original research contract.

**Approach:**

- The Iowa Highway Research Board utilizes an agreement with the Institute for Transportation (InTrans) at Iowa State University to assist in implementation and technology transfer efforts. [ORIL 2017, page 4]

  **Notes:**
  
  - Previous projects are a good reference for determining resources needed for implementation, but with an understanding that every project is different. This determination is difficult for many agencies. [Montana 2017, page 5]
  
  - Implementation is commonly funded separately from a research project, especially if the implementation can’t be defined up front. Also, committing funds before knowing whether implementation is feasible and desirable may tie up funds unnecessarily. Some agencies always fund implementation as a separate project. [Montana 2017, page 4]

**Strategy:** Fund implementation activities as tasks within the original research project.

**Approaches:**

- In Montana, implementation products are included in the research project budget. This means the research team must have people on the team who can develop any products that are expected to result from the research. [Montana 2017, page 108]

- In Ohio, implementation is included in a research project budget to the extent that the deliverables can be identified and defined up front. For district projects, at six months into a project the district staff look at what’s being developed to see if it would be feasible. If not, they end the project. If the research is implementable, then there is a Phase Two of the project. [Montana 2017, page 108]
• In Texas, implementation is not included as part of the research project budget, since they don’t yet know if the results of the project will be valuable. If it were included, it would tie up funds. [Montana 2017, page 108]

**Notes:**

➤ Some states feel that including implementation support (such as training) in the original research project contract makes implementation success more likely. [Montana 2017, page 119]

**Strategy:** Allocate dedicated funding for implementation projects.

**Approaches:**

• In Maryland, funds are set aside in the work program for the implementation of research products. [Mississippi 2015, page 8]

• The Minnesota Local Road Research Board allocates funding for implementation in its budget. These funds are overseen by the Research Implementation Committee (RIC). From these funds, the RIC contracts with a consultant to provide assistance in implementation of research findings. This contract is for three to four years and typically initiates five to eight implementations each year. [ORIL 2017, page 5]

• Minnesota DOT directs $1 million to implementation each year. [Utah 2016, page 4]

• In 2013, Texas DOT had an annual research budget of $21.5 million and an annual implementation budget of $3.5 million. [New Mexico 2013, page 21]

• Virginia DOT has a $13 million annual budget for research projects (mostly state funds) plus a $10 million annual budget solely for implementation (all state funds). [Georgia 2015, page 2]
  
  o In Virginia, 50 or more funded implementation projects are currently underway. Once each project has been completed, a full implementation report is published to move toward standard agency practice. [Georgia 2015, page 2]

**Strategy:** Investigate whether funding for implementation is available from functional areas.

**Approaches:**

• In Texas, if the research office cannot fund a project proposed by a functional area, area staff sometimes conduct their own targeted research activity and implement the results independently. [Montana 2017, pages 4 and 109]

• At the 2017 Montana peer exchange, attendees discussed whether a research implementation pay item could be jointly funded by the research office and a functional area. [Montana 2017, page 109]

**Notes:**

➤ Getting funding from a DOT functional area to pay for implementation of relevant research is not common, though in-kind support (like traffic control) is common. [Montana 2017, pages 4 and 109]
**Strategy:** Consider alternative funding sources for implementation activities.

Approaches:

- Consider an experimental features program as a mechanism to facilitate implementation of new materials, technologies, and processes. [Missouri 2011, page 3]
- Consider pooled fund studies with other states to implement research results of common interest. [Michigan 2010, page 10]

### 5. TRACKING

**Strategy:** Track implementation activities for all completed research projects.

Approaches:

- **Keep the technical advisory committee together after the project has ended** to track implementation. [Mississippi 2015, page 17]
  - (See Section 2, Roles and Staffing, for more examples of how staff can be involved in tracking.)
- **Seek and communicate feedback from research stakeholders** regarding research project successes (i.e., measure how their needs have been met). [VT-NH-ME 2010, page 7]
  - Follow-up on the success of the implementation is crucial: Did it work the way we thought it would? [Michigan 2010, page 12]
  - Consider a formal customer satisfaction survey (in addition to each project exit survey). [Mississippi 2015, page 14]
- Consider tracking what can’t be implemented and lessons learned (in addition to what can be implemented). [Mississippi 2015, page 14]
- For projects with barriers to implementation, **check later to see if barriers got removed.** [Mississippi 2015, page 17]
- The Kentucky Transportation Cabinet has funded an effort at the Kentucky Transportation Center begun in 2017 to review every research project completed over the past five years in order to document the implementation or nonimplementation of each, to classify the types of implementation, and to assign a value to each implementation where applicable. The effort will also help Kentucky identify processes to start tracking this information on an ongoing rather than periodic basis. [AL-AR-KY 2019, page 14]

**Notes:**

- **Successful implementation tracking requires buy-in from participants** on its value, because such tracking does require effort. Before requiring staff to begin tracking, build the business case and present it to show the long-term value. Sell it as “this is a good thing.” Selling it is critical. [Montana 2017, pages 5 and 117]
➢ Be careful of asking staff to **capture too much information**. This can lead to poor-quality information, which can be worse than having none. [Montana 2017, page 117]

➢ It can be hard to identify (and therefore track) research deployment **beyond initial deployment**. [Montana 2017, page 5]

**Strategy:** *Use tools to document and track implementation.*

Approaches:

- **Use a dedicated database or tool** for tracking implementation. Examples include:
  - Florida DOT tracks implementation in a SharePoint database. [Illinois 2017; screen shots of database on pages 46-47]
  - In Illinois, project details are placed in an **implementation planning database** that tracks project progress. [Georgia 2015, page 4]

- Incorporate implementation tracking into the **research project database**. [Utah 2016, page 28] Examples include:
  - Minnesota’s ARTS system, an Oracle-based system that was developed in-house, which includes a tab for tracking implementation activities. [Montana 2017, pages 116-117]
  - Ohio’s ARMS system was developed in-house using .NET technology. [Montana 2017, page 116]

- Develop a **post-project checklist**. [Mississippi 2015, page 17]

**Notes:**

➢ **Issues with tracking systems** include dependence on contractors, learning curve to use systems, need to create and update documentation, interface with DOTs’ other systems, IT support, and development and maintenance costs. [Montana 2017, page 5]

**Strategy:** *Select a time frame for tracking implementation efforts.*

Approaches:

- Explore tracking **early implementation**. [South Carolina 2018, page 14]

- Wyoming DOT tracks implementation at **nine months** and **three years** following project completion. [ID-NV-SD-WY 2015, page 17]

- In Arkansas, the research team tracks projects for **three years** after completion of the project. [Arkansas 2012, page 4]

  *(See the next strategy below for more examples of states’ time frames.)*

**Strategy:** *Conduct surveys or interviews of project stakeholders to assess implementation status.*

Approaches:
• In **panel exit surveys**, ask members to describe activities they are undertaking to implement the results of their project. [NCHRP; Ohio 2015, page 14]

• Conduct **retrospective surveys** to track implementation. Possible time frames: annually, every five years. [Montana 2017, page 5]

• About six to 12 months after research is done and implementation has begun, Illinois DOT **interviews stakeholders and champions** on implementation progress. [Utah 2016, page 8]

• Utah DOT conducts **evaluations** every three years to track implementation. [Georgia 2015, page 4]

• **Revisit the implementation report with the project subcommittee** (6 months after project ends) to ensure implementation is on track. [Arkansas 2012, page 4]

• Conduct a **pre- and post-condition survey of the research topic** if implemented (potentially a six- to 12-month follow-up). [South Carolina 2014, page 12]

• Consider **alternative methods** to gather feedback from users regarding implementation on projects. [Arkansas 2012, page 4]

• Some states do **surveys of the implementation of “old” research projects**. [Montana 2017, page 15]

**Notes:**

➢ It can be difficult to conduct periodic (such as five-year) retrospective surveys to track implementation. **Annual or ongoing efforts** are more work but ultimately may be more effective. [Montana 2017, page 5]

5.1. Reporting on Implementation

**Strategy:** **Report periodically on implementation progress.**

**Approaches:**

• It is important to share the tracking results beyond research to the rest of the agency. This can be done through **regular communications, dashboards, conferences, or other methods**. [Montana 2017, page 6]

  o Make implementation tracking worthwhile by **communicating successes at various meetings and conferences** for the department. [Montana 2017, page 20]

  o The responsibility for **final reporting of implementation data** can be shared between the DOT research office, the functional area/champion, and the researcher; this varies from state to state, and can depend on whether this is written into the contract. [Montana 2017, pages 6 and 117]

  o The tracking process should include **periodic implementation status reports**. [Kentucky 2011, page 5]
• Texas DOT’s tools for managing implementation projects include an interactive online Research Project Map. [Utah 2016, page 13]

Notes:
➢ Multiple participants were excited about this tool.

6. TECHNOLOGY TRANSFER/MARKETING

6.1. Communication Strategies and Talking Points

Strategy: Communicate research results and showcase implementation successes.

Approaches:

• Utilizing professional web and communications staff to share and promote research findings is one of the most effective ways to assist with implementation. [MnROAD 2014, page i]

• Communication is critical for the acceptance/implementation of projects and the survival of programs. Making efforts to not only share the findings from research, but to communicate the importance of those findings is key. Be aware that not everyone will like the results. [AASHTO presentation; ORIL 2017, page 7]

Notes:
➢ Several DOTs pointed out that technology transfer and implementation go hand-in-hand to be effective. Effective technology transfer is often derived from quality content created during implementation. It is important to understand how implementation feeds into technology transfer, and how marketing and promoting the research program can enhance this effort. [Illinois 2017, page 19] Conversely, technology transfer leads into implementation as well. [Montana 2017, page 3]

➢ Minnesota DOT suggests that research departments be timely with publicizing research. For example, if something happens in the news, the department can send out information about relevant research underway or projects that have already been implemented. [Illinois 2017, page 20]

• “What have we implemented today?” will become a communication effort that places implementation in the vision of Utah DOT’s research program. [Georgia 2015, page 8]
  o Question can only be answered if research has actually been implemented or applied.
  o Question also provides the best justification for research.
  o The agency plans to incorporate this message into research project selection and management processes to maintain proper perspective on ultimate goal of research.
  o Afterward, implemented research will be summarized and communicated throughout Utah DOT to transfer technology and market the agency’s research services.
6.2. Staff Outreach

**Strategy:** *Present research results directly to relevant DOT staff and local agencies.*

**Approaches:**

- Maryland DOT invites the PI to present within the division, so the research effort can be *heard by all the impacted staff.* [South Carolina 2018, page 15]

- Consider conducting *presentations on implementation to upper management* as appropriate. [South Carolina 2014, page 10]

- In Utah, project managers coordinate *post-project implementation presentations.* Interested parties may observe project results and ask questions. Upon completion of the presentation, *professional development hour (PDH) credits* are given to participants as applicable. [Georgia 2015, page 2]

- At Georgia DOT, a *post-project presentation is directed to end users.* [Georgia 2015, page 6]
  - Expand post-project presentations to other offices interested in project findings. [Georgia 2015, page 8]

- A *concise, fast-paced presentation series to showcase different aspects of the research program,* sometimes referred to as “Pecha Kucha” or “Fast and Furious,” was discussed among peer exchange participants. Each presenter has seven minutes for the actual presentation, and seven minutes for questions. Each session has two presentations. This presentation style is used to encourage researchers to focus on clear messaging, storytelling, and presentation skills in an informal setting. Presenters gain practice giving presentations, participate in idea sharing, increase the use of technology, network, foster collaboration between researchers, and improve communication for broad audiences. There is a three-step process for this presentation style: [Illinois 2017, page 19]

  1) **Preparation.** A steering committee works with presenters to prepare and offer presentation tips such as providing additional background information on the topic, explaining why the topic matters, and telling a story.

  2) **The event.** This presentation style is casual and fun, but all aspects have been prepared and rehearsed ahead of time. Agencies can determine how often the series should occur, but typically once a month during the lunch hour. Conference calls, video, and WebEx are used for remote attendees.

  3) **Follow up.** The steering committee is typically highly responsive to attendee and presenter feedback via regular surveys.

**Strategy:** *Hold a research showcase or conference.*

**Approaches:**

- In 2016, New Jersey DOT implemented an *annual research showcase to recognize innovative research projects.* Staff can submit their own ideas or nominate others. Projects are evaluated
and selected for awards. In the future, the agency plans to tie this in with the State Transportation Innovation Council incentive program. [Illinois 2017, page 19]

- Utah DOT hosts an **annual research conference** in which participating universities, consultants, and DOT professionals **present their projects** in specific subject areas and in-depth discussions are held in workshops. [Georgia 2015, page 2]

- Organize either a stand-alone **research poster session** or a poster session in conjunction with the agency’s research peer exchange. [Georgia 2015, page 7]
  - Revisit **education/workforce development benefits of research** without undue emphasis on them, keeping the main focus on implementable research for the DOT. [Georgia 2015, page 7]

- Include **transportation industry/local governments** as part of research outreach efforts. [Georgia 2015, page 8]

**Notes:**
- Take every opportunity to tout and aggressively market the program. Get the research products out there so people know what you are doing. Sharing information through emails is good, but **it is important to physically get in front of people and get their attention**. After some time has passed, follow up to see who is using the products and capture their experiences and any benefits. [AASHTO presentation; ORIL 2017, page 8]
- The best people to “sell” the [ORIL] program are the locals (counties). **Peer-to-peer conversations will generate more interest and potential buy-in.** Utilize testimonials from locals who have used a research product. **Those individuals become advocates** for the program. Start with [ORIL’s] board members and expand from there. [AASHTO presentation; ORIL 2017, page 8]

### 6.3. Webinars

**Strategy:** Use webinars to provide detail on implementation-ready research.

**Approach:**

- Illinois DOT recently carried out a Safety Project Outreach **webinar series to showcase implementation projects**. The **series** included three presentations: Pavement Markings, Right Turn Skew, and Flashing Yellow Arrows. Over 450 attendees from 60 Illinois **cities and local jurisdictions**, as well as registrants from Arkansas, Missouri, and Iowa, have participated. A total of 452 PDH certificates were issued. [Illinois 2017, page 4]

### 6.4. Videos

**Strategy:** Use short videos to promote research results.

**Approaches:**

- Use **YouTube video clips** to highlight research projects and implementation efforts. [Minnesota DOT strategy; Utah 2016, page 10]
• Work with DOT communications personnel to develop short videos promoting research findings on YouTube and other online venues. [South Carolina 2018, page 5]

• Minnesota Local Road Research Board hosts its own YouTube channel. This has become a main method for outreach. [ORIL 2017, page 5]

6.5. Research Briefs and Summaries

Strategy: Prepare brief summaries of completed research.

Approaches:

• Prepare a one-page project summary for agency leadership.
  o Develop a one-page market summary for management to encourage implementation. [South Carolina 2018, page 14]
  o Create handouts on project/program implementation for the agency executive committee. [Georgia 2015, page 7]

Notes:
  ➢ One-page summaries may be a good promotional tool for senior/executive leadership to highlight the program. However, for practitioners, be careful that they realize additional information is available elsewhere. Potential misuse of the results could occur if one-pagers are relied on for all pertinent information. [AASHTO presentation; ORIL 2017, page 7]

• Prepare two- to four-page research briefs for a wider audience.
  o Michigan DOT is putting together success stories on pooled funds that describe how they’ve been beneficial to the state and what has been implemented. [MnROAD 2014, page 13]
  o Minnesota DOT both contracts out and develops two-page technical summaries in-house to effectively communicate to a general audience. [MnROAD 2014, page 13]
  o Have researchers prepare three- to four-page summary text that DOT staff then puts into a template. [Mississippi 2015, page 12]

Notes:
  ➢ There is a tendency to go toward shorter summaries (two-page briefs rather than eight-page executive summaries) to best communicate results for implementation. It can be useful for an investigator to draft these documents, but ultimately these summaries must reflect the needs of the agency: “How does this research help us?” Videos can be effective as well. These communication tools can be built into the research contract, but this is only done by some DOTs. [Montana 2017, page 6]
  ➢ Online formats are often preferred. Two-page summaries should be adapted for easy viewing online or on smartphones. [MnROAD 2014, page 13]
6.6. Posters

**Strategy:** Use conference posters to showcase completed research.

**Approaches:**

- Require inclusion of *posters and brochures* as project deliverables. [Kansas DOT; South Carolina 2018, page 15]

- Develop additional technology transfer processes (project deliverables) such as *posters for use as marketing materials within headquarters and region offices* and at committee meetings, and with human resources for workforce development. [South Carolina 2018, page 21]

6.7. Conference Presentations

**Strategy:** Present research findings at state, regional, or national conferences.

**Approaches:**

- Florida DOT promoted research efforts within the agency by *making presentations at scheduled district and state meetings*. These large meetings provided large, diverse audiences from around the state that were able to learn how the research program benefits the DOT and the state of Florida. [Illinois 2017, page 19]

- Minnesota Local Road Research Board hosts booths at various state conferences organized by American Public Works Association, Local Technical Assistance Program (LTAP) and others. *Preloaded flash drives containing research findings are handed out* at these events. Numerous presentations are also given at these local conferences and before TRB subcommittees. Efforts are made to keep conference presentations interactive by utilizing trivia games and other audience participation activities. [Minnesota Local Road Research Board; ORIL 2017, page 5]

6.8. Newsletters (Internal, External)

**Strategy:** Prepare articles about completed research for inclusion in internal or external newsletters.

**Approaches:**

- Minnesota Local Road Research Board publishes a newsletter in February and August providing updates on the program and individual projects. In addition, articles are submitted for other publications such as DOT and LTAP newsletters, and national publications. [ORIL 2017, page 5]

- Consider submitting selected projects for publication in *The Connector*, South Carolina DOT’s quarterly newsletter. [South Carolina 2018, page 29]

- Utah DOT publishes a quarterly newsletter to highlight salient research at the agency. [Georgia 2015, page 4]

6.9. Email Notifications

**Strategy:** Use listservs and email notifications to notify stakeholders of completed research.

**Approach:**
• Minnesota Local Road Research Board distributes email notifications through a listserv to let people know projects are completed and reports are available. [ORIL 2017, page 5]

6.10. Annual Reports

**Strategy:** Showcase successful implementations in the research program’s annual report.

**Approaches:**

• Include an implementation summary in the annual report. [Montana 2017, page 14]

• In the annual report, include a look back at projects completed five years earlier to see how effective the implementation was. [Oregon 2014, page 5]

• To share information about its projects, the Minnesota Local Road Research Board uses fact sheets and an annual “At-A-Glance” report that summarizes all reports for a given year. [ORIL 2017, page 5]

7. DEMONSTRATIONS, PILOTS, OTHER IMPLEMENTATION ACTIVITIES

**Strategy:** Define and document a framework of deployment steps or options.

**Approaches:**

• In a 2012 presentation, TRB staff described SHRP2 activities to convert research results into usable products. Activities included development of:
  
  o Guidebooks
  o Training programs
  o Model specifications and/or standards
  o Web tools
  o Webinars and workshops
  o Pilot tests of products (new technologies, IT and processes) [SHRP2 presentation; Utah 2012, page 64]

• SHRP2 product-level implementation plans addressed the following: [Utah 2012, page 67]
  
  o Implementation goals and objectives
  o Target audiences
  o Barriers to implementation
  o Implementation strategies and tactics
  o Change management issues
  o Roles and responsibilities for FHWA, AASHTO, and others
  o Governance structure (e.g., advisory committee)
  o Hosting of web tools; IT requirements
- Updating of content
- User support
- Training
- Marketing/communications
- Budget
- Evaluation

**Strategy:** *Translate findings from the final report into a user-friendly format.*

**Approaches:**

- **Challenge:** Consistently implementing the changes in the field and developing needed standards and guidelines. Staff resources are needed to support this transition, and *research results may need to be refined for simplicity* in field/operational applications. [Michigan 2010, page 12]
  - Opportunities: [Michigan 2010, page 12]
    - Hold tech transfer meetings with DOT staff to pare down the findings for them.
    - Identify a DOT implementation coordinator for each project who will work through all details to get a final product ready for use.

- **Develop training.**
  - Mississippi DOT now requires a two-page technical brief for every final report. Depending on the project, a presentation, webinar, or training may be required. [Mississippi 2015, page 5]

- **Provide training through webinars.** (See Section 6.3, Webinars, for an example.)

- **Related case studies:**
  - Minnesota DOT dedicated funding for an implementation project for field testing the calibration of salt spreaders (to measure how sand and salt are dispensed on the roadway). Implementation dollars were used to purchase calibration scales from the Iowa Research Program. The original research was done through the Clear Roads Pooled Fund Program and it was then customized for MnDOT. The department then deployed the technology for local agencies by developing a training course for MnDOT maintenance staff, creating a controller calibration guide, and implementing training through the LTAP. [California 2011, page 8]

  - Ohio recently deployed pre- and post-construction strategies for preventing the “bump at the end of the bridge.” The research was successfully deployed because the DOT’s pavements, materials, construction, geotechnical, structures, and production divisions were involved in the process from the outset. Throughout the process, there was interdisciplinary communication and strong project management. The project resulted in a paradigm shift from “smoothness” to the connection of the pavement and the bridge and an increased emphasis on safety. To deploy the technology, the department developed a comprehensive specification, and training for bridge and pavement contractors. [California 2011, page 6]
Utah recently started using a Self Propelled Modular Transport (SPMT) system to reconstruct bridges. This system utilizes a computer-operated, multi-axle platform that pivots 360 degrees to lift, carry, and set large and heavy loads at walking speed. The use of this system drastically reduces road closures associated with bridge replacements and saves millions of dollars. The state DOT was very successful in communicating the benefits of the system to put it in agency use and to inform the public. However, the state did experience an internal problem with staff support that will represent a lesson learned for the department going forward. [California 2011, page 7]

**Strategy:** Begin deployment with a demonstration project or pilot project.

**Approaches:**

- Iowa Highway Research Board began to emphasize efforts on implementation of research findings within the last four years. Recent efforts have been focused on demonstration projects, which have been shown to be effective. [ORIL 2017, page 3]

- **Related case studies:**
  - Washington State DOT used a solar, fiber optic lighting system to replicate natural lighting under some of its overwater structures in an attempt to alleviate damage to fish habitats caused by overwater structures. Although the research was well-done, it was aborted during the pilot phase because researchers realized that the equipment used wasn’t designed for outdoor applications or for seawater. The time invested in the project was worthwhile and instructive because the risks were low (the research was relatively inexpensive), collaboration high, and if it had succeeded, it would have been easily implemented and very beneficial. [California 2011, page 6]

  - In the SHRP2 program, the four Technical Coordination Committees identified actions to move the research products nearing completion to the next step of readiness for implementation. The Oversight Committee then selected and approved a slate of activities to refine and strengthen research results and move them forward to practice. Activities were selected to identify knowledge gaps and other barriers to implementation, conduct pilot tests, construct demonstration projects, and undertake additional similar efforts to advance research results to produce the tools and products that are most useful to transportation practitioners. [California 2011, page 6]

**Strategy:** Learn from other agencies’ successful and unsuccessful implementation efforts.

**Related case studies:**

- Connecticut has developed several low-cost technologies that improve roadway safety and performance. The department implemented the Longitudinal Notched Wedge Joint, which improved the performance of hot mix asphalt longitudinal joints. The research successfully transferred into practice because its use had a proven safety benefit (it kept longitudinal joints together), it was fast to implement, and it had limited risks. This project indicates that implementation doesn’t need to be difficult or expensive. [California 2011, page 8]

- Two examples of implementation efforts at Illinois DOT: Implementation of the Construction Scheduling Expert System project, produced with the intent of transferring historical and
institutional knowledge, was less successful. One year after training and a user manual were provided to the districts, no one was using the system and there was no IT support from the PI. A more successful implementation example was the Flashing Yellow Arrows for Protected/Permissive Left Turn Control project. Research demonstrated that left-hand turn related crashes were reduced significantly, and changes were made to the design manual. **Implementation was successful for this project due to effective technology transfer through a series of webinars, supported with implementation funding, as well as dedicated project champions and excellent communication.** [Utah 2016, pages 8-9]

- Louisiana deployed high-strength concrete in bridge construction, which potentially permits either reduction of girders or longer girders with a reduction in foundation elements. In addition, the high-strength concrete is denser, providing corrosion resistance of reinforcing steel and therefore enhancing lifespan. The technology uses one less girder/span in each direction, which in a recent application on the Twin Span Bridge resulted in a return on investment of $17.1 million. Other benefits include lower foundation costs and a longer lifespan. This technology is now specified for all bridges in a marine environment. The research for this technology was initiated at a TRB committee meeting that resulted in four research projects that cost $1.3 million over a sustained 10-year period. **This project indicates that it is worthwhile for agencies to stick with long-term research that supports a vision.** [California 2011, page 8]

- One Oklahoma DOT implementation success is the Road Runner 3 Traffic Counting and Classification System. **Success in this implementation is aided by an active project panel** and is proven by the accuracy of the data, saved man-hours by the organization, and fewer hours spent correcting errors. An example of an implementation failure at the agency is an anti-icing system on bridges. **The design and materials were poor, there was no maintenance, and there was a lack of communication and coordination** with the structures division. [Utah 2016, page 11]

- A peer exchange attendee described his experiences implementing research results as part of FHWA’s Every Day Counts innovation deployment initiative. **This project was a success because it was an initiative from FHWA Administrator Victor Mendez**—the directive came straight from the top of the organization, so **funding and high-level support were secured.** The initiative also included **proven new technologies,** and the agency partnered with AASHTO to hold innovation summits across the country, which **educated transportation staff on the benefits of the technologies and how to use them.** [California 2011, page 7]