Tracking Implementation Results in State Transportation Agencies

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16. Abstract

This report gathers the results of an e-mail survey and follow-up interviews on research results implementation tracking at state transportation agencies. The majority of the 26 participants identified his or her agency as either focused entirely on funding research studies that lead to implementation, or as agencies that fund a variety of research project types and focus on implementation for select projects only. Half of the participants reported using an implementation tracking system, and of those participants, most reported his or her tracking system to be underused or outdated. Other notable findings included that most participants reported that only about 20 percent of the studies funded through his or her agency's research division is policy-specific research; most participants reported that the best research results champions are from the management level and possess both technical and communication expertise; and motivation and time were the two largest roadblocks to successful research results implementation championship. Results are presented and discussed within the context of transportation research results implementation literature, and recommendations are provided for each core category of interview responses. Two implementation planning initiatives were undertaken at the Illinois Department of Transportation following the completion of the study and are detailed in this report.

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TRACKING IMPLEMENTATION RESULTS IN STATE TRANSPORTATION AGENCIES

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The researcher would like to acknowledge the numerous state transportation department employees who participated in this study's surveys and phone interviews. Each provided this researcher with a significant amount of their time in order to help the researcher better understand transportation implementation practices in state government throughout the United States.

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DISCLAIMER

The contents of this report reflect the views of the author, who is responsible for the facts and accuracy of the data presented herein. The content does not necessarily reflect the official views or policies of the Illinois Department of Transportation. This report does not constitute a standard, specification, or regulation.

EXECUTIVE SUMMARY

Mr. Charles H. Duell, the Commissioner of the United States Patent Office in 1899, has been attributed with the saying “Everything that can be invented has been invented” (Duell, 2012). In times of shrinking budgets and reduced headcounts, research is often viewed as an unnecessary expense. The stance taken by Mr. Duell can become a drumbeat to addressing budget realities. One way research divisions at state transportation agencies can justify their existence is by implementing their research results and documenting their value. Following a survey of state transportation departments throughout the United States, 25 respondents participated in follow-up interviews on the topic of implementation. The interviews were conducted by phone and were later analyzed using the constant-comparative qualitative data analysis method. Discussions focused on topics such as research implementation champions, policy research implementation, and barriers to implementation.

This study found that within the 25 states interviewed, most respondents self-identified their programs as research divisions that approached implementation as the entire basis for his or her research division or alternately as research divisions that focused on implementation for select projects only. Half of all respondents reported using a formal implementation tracking system, while most other respondents reported time limitations and staff size as the key factors preventing implementation tracking at his or her research division. When discussing research implementation champions, the majority of respondents reported having the most success with champions located at the management level who possessed both technical expertise and communication skills. Motivation and time were also key factors in effective research results championing. These factors were also identified as key barriers to the implementation of research results at interviewees’ transportation departments.

Along with a literature review on implementation practices in the public sector and at the policy level, this report provides recommendations in each discussion category that state transportation departments can use to increase implementation activities. These recommendations are intended to be used to increase the percentage of implementation at a state transportation agency and increase the overall effectiveness of a research program. Potential further research topics are provided for each core category.

Last, as a result of the research conducted for this paper, two major implementation planning initiatives were launched at the Illinois Department of Transportation in September, 2010. These are the creation and launch of the Implementation Planning Worksheet, a two-page electronic implementation planning form; and the Implementation Planning Database, a spreadsheet for tracking implementation at the macro- and micro-levels at the department. These initiatives are discussed and detailed in the final chapter.

CHAPTER 1: BACKGROUND AND LITERATURE REVIEW

In the 2000s and today, state transportation agencies have faced increasing pressure to justify their budget allocations for several reasons. These include a major recession, national and state-level budget crises, and movements to increase efficiency in federal and state government (Rogers, 2005). When faced with these circumstances and a national call to increase efficiency, many organizations have looked to their research and planning offices to make the quickest and deepest cutbacks in spending and manpower. To protect themselves, research offices have worked to justify their spending and resource allocations by demonstrating their value to their parent transportation agency. For many of these state transportation agencies, the most beneficial function a research office can provide to its parent agency is to coordinate beneficial research and successfully implement the results.

The purpose of this report is to assist any state transportation research office in increasing its implementation activities and demonstrating usefulness to its parent agency. This report provides more than a dozen recommendations for increasing implementation activities. It does so using 1) the results of a survey posted to the AASHTO Research Advisory Committee (RAC) listserv, 2) phone interviews with 25 state transportation research offices, and 3) a review of scholarly and government literature on implementation. Specifically, this report provides recommendations relating to the following implementation topics:

- Selecting and maintaining an implementation tracking system.
- Choosing effective research results implementation "champions."
- Implementing policy-related research results.
- Understanding and addressing common implementation barriers.
- Increasing communication and technology transfer activities internally and externally.

1.1: Preview of Chapters

- *Chapter One: Background and Literature Review* – This chapter details the background and purpose of the study. A literature review conducted for this study focused on topics relating to implementation, diffusion of innovation, implementation champions, policy research, and research results communication. More than 20 scholarly and government reports were consulted, with the majority of the reports pertaining specifically to state transportation agencies.
- *Chapter Two: Methods* – This chapter describes the development and application of the two main research instruments used in this study. The first is a survey posted to the RAC listserv, which received a response from 26 states (including Illinois). The second is a series of phone interviews conducted in the spring of 2010 with 25 states (including Illinois) participating.
- *Chapter Three: Results* – This chapter details the results of the surveys and phone interviews with descriptive statistics, graphs, and tables.

- *Chapter Four: Analysis and Recommendations* – This chapter provides an analysis of the results of the surveys and phone interviews. Additionally, this chapter contains recommendations that draw from the results of the surveys, interviews, and literature review.
- *Chapter Five: Implementation Planning Initiatives* – This chapter details the launch of IDOT's two implementation planning initiatives: the Implementation Planning Worksheet and the Implementation Planning Database.
- *Chapter Six: Conclusion, Limitations, and Recommendations for Further Research* – This chapter summarizes the findings of the study, addresses research limitations, and offers suggested topics for future research.

1.2: Background

A review of the literature on post-results implementation at state transportation departments identified multiple articles and publications on the topic from the past 40 years. These ranged from a series of National Cooperative Highway Research Program (NCHRP) reports and synthesis publications to peer exchange summaries. Of notable mention is 2001's NCHRP Synthesis 300 (Sabol, 2001), which is cited by NCHRP's Web-Only Document 127 (Krugler, et al, 2006), Pennsylvania DOT's "Implementing Transportation Research" publication (Sivak and Garrett, 2002), and others as a premier implementation publication.

One of the earliest documents found that exclusively discusses implementation is NCHRP Synthesis 23, "Getting Research Findings into Practice" (Highway Research Board, 1974). Some of its recommendations would be echoed throughout later NCHRP publications and other literature. The main recommendations involve including key end-users and front-line employees in research project planning sessions, providing shorter results summary documents to management, and making provisions in contracts to facilitate the implementation of results. Additionally, this synthesis discusses the importance of sharing research findings with other states and agencies through conferences, national transportation agencies such as AASHTO and FHWA, and training seminars.

Peer exchanges are an important communication channel to share research findings among multiple states. Numerous peer exchanges have met in recent years to discuss the topic of implementation. A peer exchange in 2002, "Implementing Transportation Research: PENNDOT Peer Exchange October 28 to 30, 2002" (Sivak & Garrett, 2002), generated a list of key implementation techniques and strategies discussed at the exchange. Many of the items in the list recommend increasing communication activities, garnering upper management support, and adopting various administrative techniques to ensure research results are implemented. Some communication and management recommendations include developing an organizational culture that emphasizes and seeks out implementation, making implementation a strategic goal, and including upper management and industry liaisons in more meetings throughout a project. Additionally, some of the administrative recommendations include tracking milestones and outputs during a research result's implementation, having research staff keep track of goals stated in an implementation plan

and comparing them to actual outcomes met, and finally, to assign implementation "enablers" or champions, throughout the entire transportation department's staff. In December 2010, the Michigan Department of Transportation hosted a peer exchange on this topic and provided opportunities for other states to discuss this timely issue. Key recommendations from this peer exchange included identifying a person in the agency dedicated to leading implementation efforts, encouraging DOT managers to include research and implementation efforts in employee performance evaluations, developing implementation performance measures which resonate with DOT management, and determining the long-term impacts and benefits of implemented research (Michigan Department of Transportation, 2010).

The literature discussed in the remainder of this chapter will identify key articles and reports, define important implementation terms, and further discuss general recommendations in the literature. Important concepts include types of research, project champions, performance measurement, strategic planning, and employee motivation.

1.3: Literature on Types of Research

Before discussing implementation, it is necessary to first define research and identify the types of research that may lead to implementation. NCHRP Synthesis 300 (Sabol, 2001) states that the term "research" has a variety of definitions and interpretations. At state transportation agencies, research may imply a task that "requires more than standard operational time to conduct or implement, but not necessarily the revision of understanding and not necessarily performed under any standard operating parameters such as the scientific method". The most commonly agreed upon interpretation of the term among managers in the transportation industry is that there are two types of research, "basic" research and "applied" research. Basic research is defined as a type of research with the purpose of creating new knowledge that does not have a direct application. This is most often referred to as scholarly research, such as a study on a social phenomenon or mathematical theorem. Though basic research does not have a direct goal other than knowledge creation, state agencies will still fund some research of this type for the furthering of a field of practice. Applied research, the type most commonly used at transportation agencies, is a specific research project commissioned to answer a question or provide a usable outcome.

What could be considered a third type of research for transportation agencies is actually another type of applied research: policy research. This research type seeks the same goal as an applied research project, to produce an outcome that can be enacted; however, policy research is usually conducted in a different way than what one might consider a "traditional" applied transportation research project. Many types of applied transportation research projects evaluate new transportation engineering practices or tools using field studies, graphical analysis, and technical scientific exploration. A policy research project involves data analysis of trends, personnel practices, funding practices, and other soft-research analyses. Another important difference is that policy research projects often originate from a

law-making body, the financial office of the department, upper management, or the research office itself. An applied research project may instead originate from a need established in the field or by a transportation department staff member. Thus, as will be discussed in the results section, state transportation department employees tend to consider policy research as "soft" research or group it under planning studies.

No matter what the label, policy research is increasingly important today. In a 1999 survey of transportation research offices, NCHRP Synthesis 280 (Deen & Harder, 1999) found that most states performed policy research or considered it an important part of transportation research offices. The Synthesis states that even though applied engineering research remains the top concern for transportation agencies, increased pressure from citizens and law-makers to research how transportation systems are constructed and their effects on the environment is increasing the need for policy research. Also, with state budget crises throughout the country and pushes for increased effectiveness and efficiency in state government, law-makers are soliciting policy research from transportation agencies to ensure they are using their budget allocations efficiently.

1.4: Literature on Transportation Industry Implementation

Implementation is defined by Rogers (2003) as when a new technique or product has been incorporated into an organization as the ordinary way of doing things. In the context of research in the public transportation industry, this concept is essential to its success. In many cases, if a research project's usable results are not integrated into practice at the public transportation agency following the project's completion, the agency sees little to no benefit for the resources directed into the research project. Because of its importance to this industry, implementation is a focus of many NCHRP research projects. Key reports published between the 1970s and the early 2000s include Synthesis 300 (Sabol, 2001); Report 442: Systems Approach to Evaluating Innovations for Integration into Highway Practice (Worchester Polytechnic Institute, 2000) and Report 382: Facilitating the Implementation of Research Findings: A Summary Report (Transportation Research Board, 1996). NCHRP, in a document discussing the implementation of the Second Strategic Highway Research Program, or SHRP 2 (TRB, 2009), stresses to all agencies receiving funding to reflect on how research results can be made usable by practitioners. NCHRP necessitates that the final report for most projects includes a section on usefulness of the results to practice. These sections are usually a chapter titled "Summary of Findings" and a chapter titled "Interpretation, Appraisal, and Application of Results."

In a presentation on the reputation of implementation at state transportation agencies, Rogers commented that states are not implementing enough transportation research for the amount of research being conducted (Rogers, 2005). He identifies several main reasons why research projects at transportation agencies may not always translate to implementation. One reason is the tendency for transportation agencies to perceive research as irrelevant compared to other agency functions. Another is a lack of information and training on how to effectively implement research findings; and consequentially,

considerations for research findings implementation may take place too late in the research process. Last, researchers lack the time and resources to plan out how research findings can be implemented.
To counter these roadblocks, Rogers states that researchers can use several strategies to increase implementation (2005). Agencies can change attitudes toward research and implementation, use project "champions" to make sure research results are implemented, and change any hindering rules and regulations toward implementation. In a report about the implementation of research findings in Indiana, implementation was found to benefit the state transportation system by saving money, improving efficiency of service, increasing safety, increasing service life, and finding a way to reuse waste materials to benefit society (Indiana Department of Transportation, 1995).

Policy research implementation – another item which Rogers cites as a much-needed area of improvement for the public transportation industry – necessitates research staff trained in the nuances of the research process (2005). Similar to implementing applied research, policy research results are often not implemented because of funding issues; implementation is an afterthought, research is perceived as unimportant, and the belief that research projects have concluded following the publication of the final report.

Roger's suggestions when facing these roadblocks is to change the perceptions of the research program, use results champions outside of the research staff, and make effective use of peer networks. In a commentary to Rogers' recommendations, Sweedler (2005) adds that research staff should develop relationships with policy makers early on in the research project's life to ensure subsequent implementation. Another of Sweedler's suggestions is to "strike while the iron is hot" or to attempt to implement a research finding when the topic is timely or in the news. An example of a research project results implementation using this principle would be outfitting state-owned snow plows with new gas-saving equipment during an oil crisis as the result of a research study.

1.5: Research on Implementation Barriers

According to numerous publications, one of the most effective ways to increase implementation in the state transportation industry is to identify the common barriers to results implementation. According to the Transportation Research Board (TRB) journal article "Overcoming Roadblocks to Innovation: Three Case Studies at the California Department of Transportation" (Orcutt & AlKadri, 2009), there are six common barriers to implementation of new ideas or research findings in public transportation agencies. The first barrier is the diversity and complexity of transportation as a system. The diversity of transportation leads to great competition among constituencies for limited resources to implement new innovations. The second barrier is restrictions of intellectual property and procurement unique to public sector practices, such as low-bid processes and competitive bidding requirements. Another barrier is risk aversion – described as the low tolerance for risk – that is commonplace in the public sector. The next barrier is resistance to change in the public sector. Public sector agencies are naturally resistant to change, and if an

innovation requires a knowledge set that an organization does not have, the organization will be wary of adopting that innovation or policy. Next, the lack of a profit motive in the public sector hinders innovation. Compared to the public sector, which is a sector more concerned with serving the public effectively and efficiently, the private sector is more willing to implement new ideas because innovation is more likely to stimulate short-term profits. The last barrier discussed is the lack of robust product evaluation criteria. The authors state that new product evaluation guidelines can be slow to develop because the reporting process can be extensive and cumbersome.

Another way to conceptualize implementation barriers is as an aversion to innovation. If a research result requires the use of a new product or technique, preexisting values about the product or technique currently in use may be the greatest barrier. Transportation conference contributor Everett Rogers discusses the barriers to innovation in his diffusion-of-innovations model. According to the model, diffusion is "a process in which an innovation is communicated through certain channels over time among the members of a social system" (Rogers, 2003). The adoption rate of an innovation, new practice, or product, will largely depend on five main factors:

- *Relative advantage*: How much more effective the innovation is compared to the preexisting technique or product.
- *Compatibility*: How well the innovation will fit into other existing practices.
- *Complexity*: How difficult it is to understand the innovation and its benefits.
- *Trialability*: How easily the innovation will be able to be tested.
- *Observability*: How easily the benefits of the innovation will be clear to end-users.

These factors can be evaluated during the research project selection process at state transportation research offices to determine which projects will most likely lead to implementation. Potential research results that will be perceived as having greater relative advantage, compatibility, complexity, trialability, and observability in comparison to other research project results will be more likely to see actual implementation. For research divisions that identify as applied research and implementation only, these five factors will be critical to the success of the program.

1.6: Research Results Champions

Key to effective implementation, "champions" are the individuals who ensure a research result is adopted in an organization. Implementation champions in the public transportation sector are defined by Rogers (2005) as those who promote a research finding among communication networks, even in organizational atmospheres that are unfavorable toward innovation. Other terms for implementation championship include change agent, project champion, and research results champion.

Many studies have defined the characteristics of a project champion. This person is usually described as charismatic and early studies have identified him or her as someone with a powerful position in organizational hierarchies. More recent studies, however, have found project champions located throughout organizational hierarchies instead of only at the top. A study by Goodman and Steckler (1989) found that many project champions originated from middle or lower management, not exclusively from upper management. The study also identified other characteristics that could predict effective results championship other than hierarchy. The most important criteria, according to this study, was the fact that individuals had a high degree of sociability and had contact with many other employees. Howel and Higgins (1990a) published a study that also found communication skills to be a key attribute to successful championship. The authors compared 25 Canadian public sector employees who had successfully championed an implementation with 25 who had not and found that the championing employees were significantly more likely to take risks, use persuasion, and be persistent. Last, in a study that both validates and counters previous research stating that high hierarchal control leads to successful championship, Fernandez and Pitts found that lower-level and front-line employees are less likely to be champions compared to management levels. However, the authors also found that with the appropriate work environment and strong communication networks, any front-line employee can easily become an effective and useful research results champion (Fernandez & Pitts, 2007).

To summarize the literature on research results champions, managers at all levels of an organization, as well as research staff, can take steps to increase championship in their organizations. Howell and Higgins' interviews (1990b) with 25 successful information technology champions in the private and public sectors resulted in five key managerial actions or behaviors leading to successful championship:

1. *Make a commitment to vision-supporting innovation* – Before someone can be willing to place themselves in the position of results champion, they need to know that they work in an environment that treats innovation favorably. Thus, to increase willingness to champion research results, upper management should demonstrate that it values introducing new products or ideas into the work environment instead of relying only on tried-and-true products and techniques. A study by Bikson, Law, and Markovich (1995) of surface transportation managers found that as upper management support for championship increased, so did propensity to champion research results.
2. *Provide job autonomy and diverse career experiences* – Managers should provide some flexibility when defining jobs roles for employees in order to encourage original ideas outside of the typical job description. Allowing an employee to take on a variety of job roles may also increase his or her exposure to various aspects of an organization.
3. *Provide visible recognition for creative ideas* – Recognizing implementation successes and risk-taking provides additional motivation for employees to take on championship roles.

4. *Offer sponsorship* – Managers who actively support the new product or technique throughout the organization will encourage future implementation championship and will demonstrate to potential champions that this type of effort is valued.
5. *Run interference* – Rogers (2005) states that paperwork and bureaucracy are roadblocks in implementation in the public sector. If a manager offers to clear a path through the department for the implementation of a research finding, an employee will be more likely to take on a championship role.

1.7: Communication

As previously discussed, in the past decade state transportation research offices have been faced with increasing pressure to justify their budget allocation and continued existence. Three of the most-cited reasons for this in the literature and NCHRP implementation research documents are 1) economic crises and state budget cuts; 2) increased legislative focus on making the public sector more efficient; and 3) the public's desire for a cleaner and more efficient transportation system. One of the most significant performance measures that can justify a research office's funding and existence is the amount of benefit brought to a parent agency by funding research projects. Assisting state transportation research offices to increase implementation is the purpose of this report; however, it would also be helpful to examine techniques research offices can use to communicate their value to their parent agencies. Research offices may communicate their value to multiple targets, including upper management (internal communication), policy-makers (internal and external communication), and the public (external communication).

1.7.1: Internal Communication

According to a study of state transportation agencies' communication plans, about 75 percent of research offices feel they communicate well internally (Knott & Martinelli, 2005). Internal communication activities are any communications from one office of an agency to employees within that office or to any other office within the parent organization. At state transportation agencies, this includes communication that ranges from front-line road workers to their managers to appointed officials to an agency's research office. Examples of internal communications include internal memos, e-mails, internal newsletters, and transportation department intranet Web sites. Non-traditional examples of internal communications include informational posters about the research program, pamphlets about key research projects, and hidden communication networks. The latter is defined by Rogers (2003) as communication channels among employees that transfer any type of information outside of formal methods. Because hidden communication networks form organically, they are often more influential than formal communication networks. An example of a hidden communication network is the pre-meeting conversations before a monthly formal administrative meeting; because the formal meeting uses a static agenda, some topics may not be discussed but will be mentioned prior to the formal meeting,

1.7.2: External Communication

Though most state transportation offices report that they communicate well internally, less than half report feeling confident with their external communication activities (Knott & Martinelli, 2005). According to Poister and VanSlyke (2002), this is partly because transportation departments are more likely to have employees with engineering and quantitative analysis backgrounds rather than ones with communications and marketing backgrounds. Though many state transportation research offices may lack staff with marketing and public relations skill sets, external communications with other states or constituencies is a principle held by NCHRP and other federal transportation agencies such as TRB. For instance, states receiving SHRP funding are requested to make efforts to contribute research findings to other states and constituencies using communication networks or channels such as peer exchanges, intra-state conferences, Internet list-servers, and academic symposiums (TRB, 2009). Thus, not only do state transportation agencies report feeling as though they need to improve their external communication, federal transportation agencies are applying pressure to do so.

CHAPTER 2: METHODS

This chapter will describe the two instruments used to determine the results and recommendations discussed in this report. The instruments themselves, including their purpose and design, will be described, followed by a section that discusses the analysis methods used for each instrument. The number of participants and timetable for each instrument will also be described. Table 1 provides an overview of the two instruments and identifies where the protocols (lists of questions) for each can be found in this report.

Table 1. Instrument Overview

Instrument	Data Gathering	Interview Type	Question Lists	Participants	Results Publications
Initial E-Mail Survey	December 2009 to January 2010	Structured, closed-ended questions	Appendix A	26 states including Illinois	RAC Web Site
Telephone Interviews	March 2010 to April 2010	Semi-structured, open- and closed-ended questions	Appendix B	25 states including Illinois	Final report

2.1: E-mail Survey Description, Protocol, and Purpose

The initial e-mail survey was sent through the AASHTO RAC listserv on December 30, 2009. The RAC listserv is a compilation of electronic contact information for transportation research professionals from the public and private sectors throughout the United States and Canada. The initial e-mail sent to the listserv requested that surveys be returned by January 22, 2010. On January 19, 2010, a second e-mail was sent to the listserv with the same questions and introduction and extended the return-by date.

The survey contained six closed-ended questions and a final question that asked for the contact information of a person at their research division that could be contacted for further questions about research results implementation. Respondents were asked to respond to the e-mail with their response for each question highlighted or written within the original e-mail. Respondents were not prompted to provide rationale or additional explanation for their responses, but were allowed to do so for one or more questions. For certain questions, respondents were requested to provide an attached document or link to a document that describes the implementation activities of their research divisions. A total of 26 states participated in the initial surveys. A list of the questions used for the initial surveys can be found in Appendix A. The results of the initial surveys, which include all answers from each

participating state as well as any comments made by participants, can be found on the RAC Web site at:
http://research.transportation.org/Pages/ImplementationofResearchFindings.aspx

There were three main purposes of the initial surveys. First, the initial surveys were designed to gather background information about the implementation activities of transportation departments throughout the United States. This information would then be able to be adapted and used immediately by all RAC listserv users upon the publication of the initial survey results, which occurred in February 2010 on the RAC Web site. Second, the surveys were designed to assist in developing the questions for the phone interviews. Also, the feedback and comments from the surveys would be used to further guide the literature review. Last, the initial surveys were designed to gather the contact information of participants so that they could then be interviewed later by phone. The last question asked for the contact information of the person who should be contacted at that state transportation department for further queries on the topic of research results implementation. Most of the participants who filled out the survey responses listed themselves as the contact for further queries on research results implementation.

2.2: Phone Interview Description, Protocol, and Purpose

The telephone interviews were conducted beginning March 2010 and concluded in April 2010. After the conclusion of the telephone interviews, an additional in-person interview with a research division staff member from the Illinois Department of Transportation (IDOT) was conducted in May 2010. The protocol for the phone interviews was replicated as best as possible for the in-person interview in order for the data to be incorporated adequately into the results of the phone interviews.

Each phone interview began with an introduction by the researcher followed by the questions contained in the telephone interview protocol (Appendix B). In the introduction, the interviewer introduced himself to the participant and identified the transportation department he was affiliated with as well as the purpose of his call. The interviewer asked the participant to identify a time and day to be interviewed and stated that the interview would likely take a little more or less than 30 minutes. Once the interview began at the designated day and time, the interviewer explained the purposes of the interview and the study. After the participant consented to being interviewed, the interviewer began asking the questions contained in the interview protocol.

The interview protocol questions contain a mix of open-ended and closed-ended questions used to gather information about implementation. Baxter and Babbie (2004) describe this type of interview as “semi-structured.” The closed-ended questions were designed to gather ordinal, or categorical, data that could later be used to compare data gathered in answers to the open-ended questions and other closed-ended questions. The open-ended questions

were designed to gather details and information about the research results implementation activities of the participants' state transportation department.

As recommended by Keyton (2006) and Strauss (1987) regarding qualitative research design, the questions in the interview protocol did not remain static across interviews. As interviews were conducted, compelling or recurring themes that appeared in the interviews resulted in questions being added or modified in subsequent interviews. (See Section 3.3 for explanations of open-ended questions, closed-ended questions, and the constant-comparative method). Appendix B contains the final list of questions used for the interviews (including all later additions and changes).

The main purpose of the telephone interviews was to gather detailed information about research results implementation activities from U.S. transportation departments that could not be attained by the survey. As previously described, the questions were partially developed based on the answers and feedback from the initial e-mail surveys. The results of the surveys assisted in determining the types of questions asked and the number of questions asked for each topic, taking into consideration what information was already gained by the surveys and what topics from the survey prompted the most comments and feedback.

Because the literature review did not find many studies with a purpose similar to this study, it was important to select a research and interview method that would allow the researcher to examine the context and environments in which implementation takes place or does not take place at research divisions at U.S. transportation departments. Lindlof (1995) states that qualitative data excels compared with quantitative data when little previous research exists. The strengths of interview research are that an interview can probe deeply into specific topics, follow-up questions can be quickly posed, and the researcher can pursue a topic that he or she did not expect to address (Keyton, 2006).

Telephone interviewing was chosen as the instrument for the second part of the data-gathering for this research project because of its practicality, low cost, and convenience. Telephone interviewing also allowed for a semi-structured interview protocol. As stated in Baxter and Babbie (2004), semi-structured interviewing allows the interviewer to dictate the order of questions in a way that makes sense in the flow of the conversation. For instance, a participant may answer two questions in answering one question. In a semi-structured interview, the interviewer is allowed to avoid asking the second question that the participant already answered.

2.3: Survey and Interview Data Analysis

Data analysis for the initial e-mail survey results occurred following the receipt of all surveys and throughout the remainder of the research process. The chapter on results, Chapter 4, contains the initial e-mail survey analysis. Mathematical means were computed using Microsoft Excel for each of the questions from the survey, and are reported in that chapter.

The analysis method used for the telephone interview data was a modification of the constant-comparative method as described by Strauss (1987). This type of analysis is used for qualitative data and is used to identify patterns and core categories across a series of interviews or texts. The constant-comparative method traditionally involves a three-step coding process, starting with open coding, then axial coding, and ending with selective coding. Open coding involves categorizing data and is used to identify core themes across data. The next type of coding, axial, involves reviewing the data identified in the open coding step. This step allows the researcher to discard or data minimize information that ends up becoming irrelevant to the core categories of the results. The axial coding step allows the researcher to identify connections and differences among sets of data, specifically recognizing outlier responses and recurring themes across responses. The final step, selective coding, allows the researcher to delineate and define the data's core categories. This type of coding was used to identify the six categories listed throughout the results section and the discussion and recommendation section.

CHAPTER 3: RESULTS

The interviews and initial surveys resulted in six core categories across the responses. This chapter will introduce and define each category before discussing specific participant responses. Patterns and themes across responses will be discussed with special consideration for nonstandard responses. The subsequent chapter will discuss these results in the context of the literature review, and provide recommendations and suggestions for future research for each of the six core categories.

3.1: Core Category One: Implementation Philosophy

This core category encompasses responses from interviewees that reveal how each participant views implementation of research results in relation to their research division.

3.1.1: Percentage of Results Implemented

Each respondent in the phone interviews was able to provide an estimate of what percentage of research projects under the authority of his or her state's research department sees actual implementation. Most participants defined "actual implementation" as some type of tangible alteration to an existing engineering practice, specification, manual, or policy. All participants were able to identify approximately what percentage of the research projects undertaken by their department are implemented; however, only a few participants were able to provide an actual estimate off-hand, and most needed to rely on a preselected category in their answer (none, 30 percent or less, between 30 and 60 percent, between 60 and 90 percent, between 90 and 100 percent, and 100 percent). Figure 1 presents these responses by category with exact estimates considered within the preselected categories.

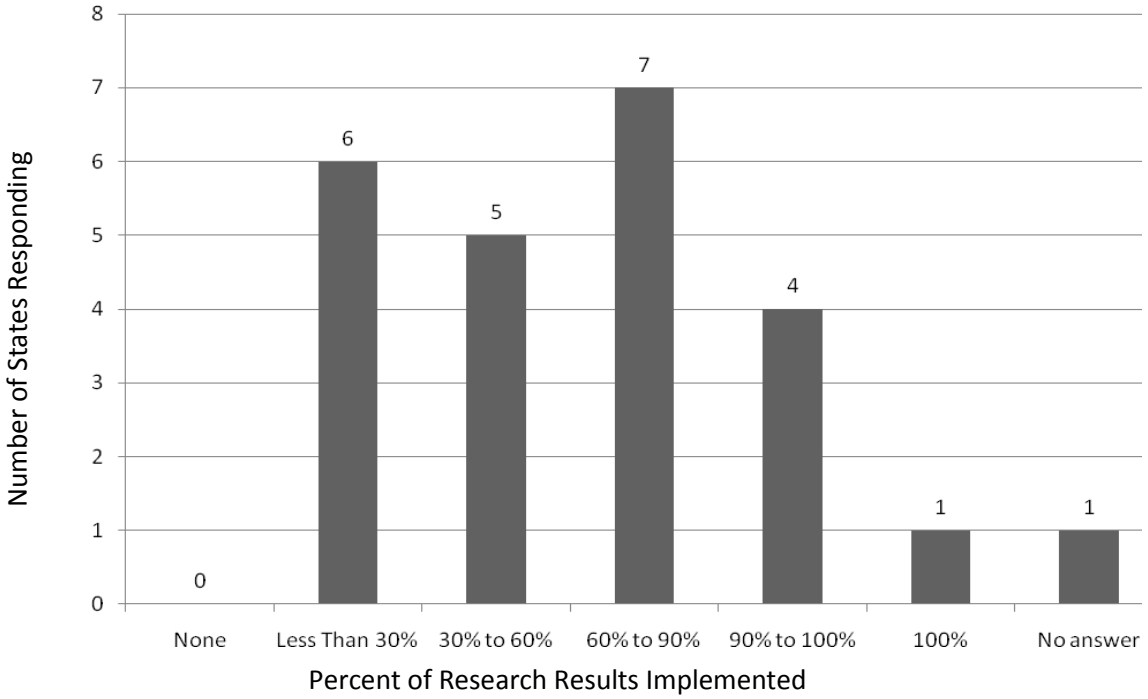

Figure 1. Self-reported percentage of research project results implemented, number of states per preselected categories

Some respondents also considered a research study that found that the potential new specification change or engineering practice being researched was invalid as having an actual implementation. One such participant stated that these types of results are still considered implementation because finding a result as invalid would allow their department to focus on a new type of research project which would then likely see an actual implementation. Another participant commented that some of their department's research projects exist for the purpose of validating or invalidating an existing practice. If the research results indicate that the practice needs to be discontinued, this finding is implemented in the act of discontinuing the ineffective method. Most participants, however, reported that a research study result is implemented if the research outcome resulted in a tangible alteration to an existing specification, manual, policy, or engineering practice. Respondents provided multiple reasons for research study results not seeing an actual implementation. These reasons will be expounded in subsequent core categories.

3.1.2: Role of Implementation in Research Program

The interviews revealed three main views on implementation's role in each respondent's research program. These main views were that their research division was an implementation-as-luxury division, an implementation-when-appropriate division, or an implementation-only division. Figure 2 presents the percentage of respondents that apply to each view.

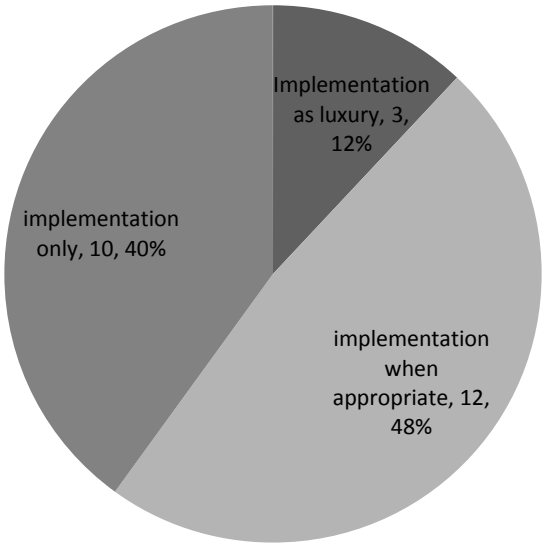

Figure 2. Inferred and explicitly-stated perspectives on role of implementation in participants' research divisions.

Implementation as luxury. Three respondents, or 12 percent, described implementing research results in their program as a struggle. As a result of budget cuts, staffing issues, or both, the research department and engineers at these respondents' states only have enough time and energy to perform the core functions of the department. One respondent stated that their research department considers receiving a final report from a researcher usually as far as it goes with the research program. These respondents clarified that the status of their research department was the result of one or more of the following:

- Budget cuts
- Staff reductions
- Lack of appropriate implementation accountability mechanisms
- Motivation and ability of research results champions
- Other barriers that will be discussed later.

*Implementation-Only***.** Ten respondents, or 40 percent, held the view that his or her research division only funded studies that held inherent value of providing an implementable outcome. These respondents were more likely to report research result implementation percentages of 60 percent or more. Respondents provided multiple reasons for this view, the most common of which being that his or her research division had limited resources and thus could only expend funds for studies that were extremely likely to provide some type of

benefit. One participant self-reported an implementation percentage rate of 100 percent and stated that this was their department's funding philosophy.

*Implementation-When-Appropriate***.** Twelve respondents, or 48 percent, held views toward implementation of research results in his or her research division that fell between the views of "implementation-as-luxury" and "implementation-only." Some participants stated that he or she will sometimes select projects without inherent implementation value because these projects contain value outside of a change to a specification, manual, or policy. One participant stated that their division focuses primarily on projects that contain inherent implementation value, but occasionally they will do something different when selecting projects to fund.

3.2: Core Category Two: Project Champions

This core category encompasses participant responses about the roles of project champions in research results implementation. Prior to discussing project champions in the interviews and before answering the relevant question in the initial surveys, participants were provided this statement: "For this survey, project implementation champions are defined as those who support and advocate for implementation of a research finding, even in organizational atmospheres that are unfavorable toward implementation."

3.2.1: Division Hierarchy

This subcategory encompasses the responses to the initial survey and phone interviews about where project champions are selected from within the hierarchy of the respondents' state transportation departments. Survey respondents were asked the following question: "If an implementation champion is identified, what level of the organization is the champion typically from?" The answers to this survey question are presented in Figure 3.

Multiple respondents noted that project champions could be found at more than one level from the potential responses; each hierarchy level noted for each response was recorded. Also, five respondents did not select one of the potential options; this was either to note that research results champions could be found at none of the potential options, or that champions are not an essential aspect of his or her research program.

- *Working level***.** Respondents who identified that champions were most likely to come from the working level of the organization hierarchy usually provided the reasoning that staff members from the working level are more likely to have real-world technical expertise in the topic area being researched. According to one participant, working level staff members are most familiar with the specification or process that is being researched and will know which steps need to take place in order to implement a research result.

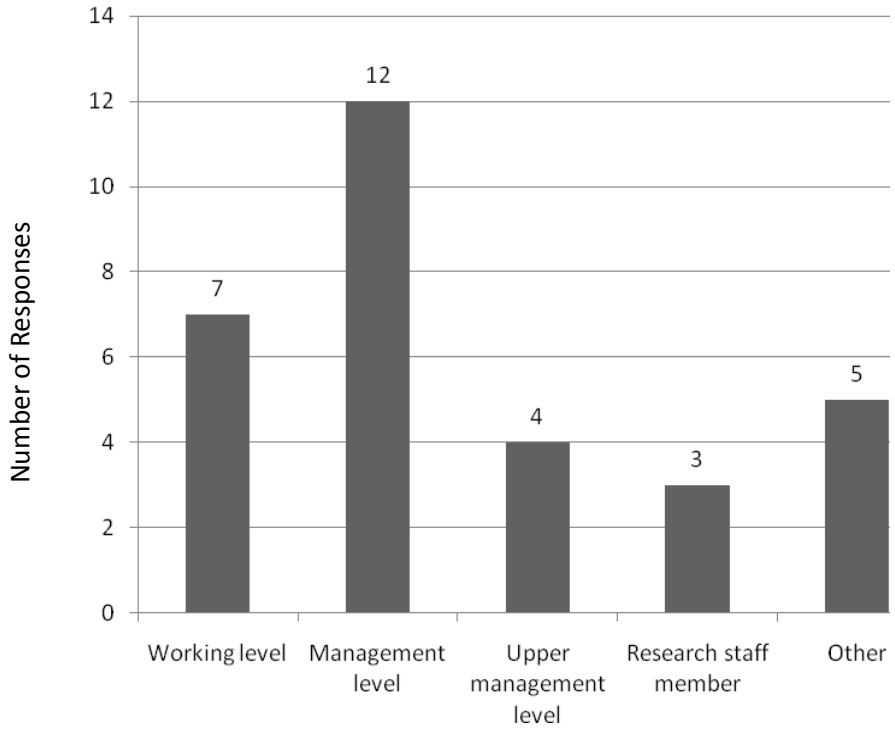

Figure 3. Self-reported placements in the transportation hierarchy where project champions are most likely to originate. (Many participants selected more than one position in the transportation hierarchy.)

- *Management levels***.** Participants who stated that champions are most likely to come from the management or upper management areas usually stated that it is important for project champions to have authority and the ability to influence change in the transportation department. One such participant stated that it is a standard of practice in their research division to have one or more champions from the management or upper management level sit on a research project panel. Another participant stated that the responsibility of being a project champion is usually divided among the managers directly over the department area most appropriate for the research project topic.

- *Multiple levels.* Last, some participants stated that department hierarchy was less important than other factors when selecting a project champion. Some participants stated that it was more important to find someone interested in the subject area as a champion, and thus, working-level staff members were chosen to be project champions. However, nearly all participants who indicated champions come from multiple levels stated that finding an interested staff member who is also higher within the department hierarchy is preferred.

3.2.2: Motivation and Time

When asked to describe any difficulties or lessons learned with using project champions to facilitate research results implementation, nearly all participants commented on the difficulty of finding project champions with enough motivation and time to provide assistance in the implementation process. Some participants commented that project champions must be selected early and must be favorable toward the research results, or at least come from the division in the transportation department most directly connected to the subject area of the research project. If a project champion is not favorable toward the research results or disinterested in them, they may inadvertently or purposely prevent the results from being implemented by remaining inactive. Multiple participants stated that it is essential that a project champion has passion for the subject material. Only those who are truly interested in implementing a research result will put in the additional time on top of all their other duties to navigate the implementation process to completion. Also commenting on the issue of time, another participant stated that tracking the implementation of a research result is a luxury; however, if a research result is not implemented soon enough, new technology may replace it or subsequent research studies may invalidate the findings.

3.2.3: Technical Expertise Versus Communication Expertise

There was consensus across all participants that good communication skills are an essential characteristic of qualified project champions. The overall perspective shared by respondents was that having communication skills are as important, if not more important, than having technical expertise in the subject matter of the research finding. Commenting, one participant stated that not being able to communicate knowledge can be crippling to research results implementation. Another participant stated that communication skills are important in order for a project champion to succinctly explain, or sell, a research finding to other engineers, upper management, or private sector companies.

Though some respondents noted that communication skills were more important than having the technical knowledge in a research finding subject area, about half the respondents noted that subject matter expertise was essential to being an effective implementation champion. Some participants stated that implementation champions absolutely must be subject matter experts to be effective. One participant went as far as saying that they will hire a consultant to implement a research result if there is no one already present at the department with the expertise necessary to implement the result properly. Last, many respondents commented that the preferred implementation champion is one who has both technical and communication expertise. Though this is the preferred implementation champion, participants conceded that this person can be difficult to find. Some participants commented that the best implementation champion achieves a balance of technical expertise and communication skills: being knowledgeable enough to understand the subject matter, but still able to communicate to others the importance of the research result in a way that will make sense and is persuasive.

3.3: Core Category Three: Policy Research

Responses about policy research fit into three subcategories: 1) definitions of policy research, 2) the amount of policy-specific research performed at their agency compared to traditional research, and 3) implementation considerations specific to policy research as compared to traditional research.

3.3.1: Definitions of Policy Research

Respondents provided a variety of definitions of what constitutes transportation policy research. Among them:

- Research that comes from the upper levels of the transportation department.
- Research that originates from the policy or personnel office.
- Best-practice studies.
- Research on how other states operate administratively.
- Something that addresses transportation policy such as tolling, revenue, or taxing.
- Research that does not have hard science behind it.
- Anything that will change a transportation policy.
- Research on the ways in which the department does business or funds activities.

3.3.2: Percentage of Policy-Specific Research

Respondents offered a variety of responses when estimating what percentage of the research their research division funds that is strictly about policy compared to traditional research. Estimates ranged from as low as 2 to 3 percent to as high as 50 percent. Figure 4 depicts the levels of policy-related research across the respondents. Each respondent was asked to identify whether their division funds a large amount of policy-related research, a moderate amount of research, a very small amount of research, no policy-related research, or their division only funds policy-related research projects. Some respondents provided an estimate or exact percentage of policy-related research.

Several respondents reported that the research division at their transportation agency is not involved with policy research because a separate division within their agency conducts or funds all policy research. One respondent reported that all policy research conducted for their agency is performed in-house using research staff. Some respondents reported a similar arrangement, though policy research from outside contractors such as the state universities still occurs.

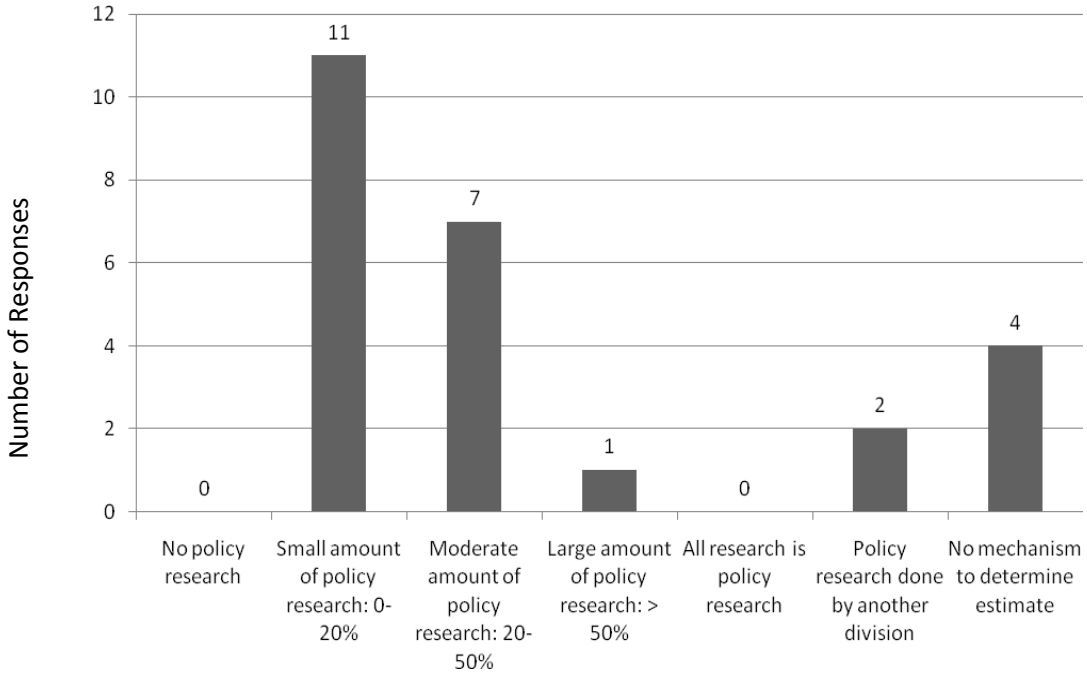

Figure 4. Self-reported percentage and/or category selection for amount of policy-specific research undertaken or funded by research division. (Participants provided a percentage estimate, selected from a preselected category, or both. Some research divisions reported that other divisions within their transportation department conducted or funded all policy research.)

3.3.3: Considerations for Implementing Policy Research Results

In terms of implementation considerations specific to policy-related research as compared to traditional research, respondents offered a variety of insights:

- It is even more important to have upper management and executive buy-in for policy research projects.
- It is important to stay in contact with FHWA regarding use of SPR funds for policy research, especially if the policy research project is on a highly politicized issue.
- Policy research findings implementation is generally more difficult than traditional research results implementation because policy research results tend to be even more abstract.
- It is more difficult to track whether policy research has been implemented due to the abstract nature of policy research.

3.4: Core Category Four: Implementation Barriers and Solutions

This core category encompasses participant responses about the common barriers their research division faces when attempting to implement a research result. About two-thirds of respondents identified one or more common barriers that prevent a research result from being implemented. The remaining one-third stated that either there were no common barriers to a research result being implemented, or research results at his or her state transportation department are nearly always implemented with little difficulty.

3.4.1. Implementation Barriers

This subcategory encompasses interview responses about common barriers that prevent a research finding from being implemented. Participants discussed a large variety of roadblocks. The following roadblocks were the most notable:

Time Barriers. Time was a barrier for multiple participants. If there is too much of a time gap between the research finding and its implementation, the research need or available technology has changed too much for the research finding to be valid. Sometimes a research project is not completed in time for the project champion to implement it because the project champion may have moved onto another position or taken on new responsibilities that prevent them from implementing the research finding. Sometimes it takes too much time to validate the results for certain research projects, especially if additional funding needs to be appropriated for results validation. Last, one participant commented that another time barrier occurs when contracted researchers do not provide deliverables on schedule.

Ambiguity of research results prediction. One participant stated that a key implementation barrier is not being able to adequately predict what type of finding will result from a research study. Similarly, another participant commented that the immediate acceptability of the results of a research project affect whether an implementation will occur.

Internal communication within hierarchy. One participant stated that communication roadblocks among various offices in their state's government reduces the diffusion of research results implementation. More than one participant noted that needing to attain legislative approval to implement a research finding can also be a major barrier.

Aversion to innovation. A notable barrier mentioned across respondents was aversion to new innovations internally. However, participants who stated that their research division had a high degree of executive support were less likely to report any barriers to implementation. One participant commented that they feel that their research division does not usually have any barriers to implementing a research result because senior management has been very supportive. In contrast, another participant commented that the lack of executive support was the largest barrier to implementation because the level of funding for his research division is directly connected to the level of executive support in

their division. They were able to compare the experiences of his research division, from a time when it had a high level of executive support to the division's current state which now has little executive support since the previous executive switched positions within the transportation department. The importance of internal support is not only at the executive level; another participant commented that even if a research finding shows that a new specification or engineering technique will benefit the department, the engineering staff at the department may be averse to innovation because they are used to an old technique and may actively prevent the result from being implemented.

3.4.2. Unique Implementation Barrier Solutions

This subcategory encompasses interview responses about unique solutions to implementation barriers employed by some participants. These are solutions that were not discussed among the other core categories of responses. Two unique solutions that were discussed by two or more participants each were setting aside "special implementation funds" to be used by researchers or project champions, and using consultants for research results implementation activities.

*Special implementation funds***:** One participant stated that their research division sets aside "seed" money each year for implementation activities. These funds can be used to purchase new equipment, provide training, repair or modify old equipment, or address other implementation requirements. This funding differs from the funding used for research contracts because his research division is able to provide this funding upfront at its own discretion to researchers and project champions. Another participant stated that their research division has $100,000 each year under the discretion of the research division to be used specifically to further implementation of research findings. This funding has been used for training and purchasing new equipment. In contrast, a different participant commented that they believe having a set-aside "implementation fund" would assist their research division tremendously in implementing its research projects' results by allowing them to expeditiously fund brief training programs or manuals.

Administrative consultants: The second unique implementation barrier solution discussed was using private-sector consultants for implementation tracking and certain implementation activities. In the most robust case of this, one state reported using consultants to develop and administer training courses that diffused research findings within the transportation department. These consultants produced newsletters written about research findings within the department that were used for the actual implementation of a research result. A different participant also reported extensive use of consultants within their research program. At this state, consultants produce video briefs and other communications media that depict research results. Consultants were also used to perform many of the administrative functions of the research division including implementation tracking. Last, a third participant reported that their research division occasionally uses consultants to write new specifications; and a fourth participant's research division occasionally contracts out implementation of policy-related research.

3.5: Core Category Five: Implementation Administration And Tracking

This core category encompasses responses to the initial surveys and the phone interviews about the implementation tracking and administrative functions of each participant's research division. Some participants also provided the actual implementation planning and tracking documents used in their research divisions as well as documents about the structure and functions of his or her research division. These results will also encompass these documents. Some participants' research divisions have additional implementation planning and tracking documents on their Web site; however, only the documents provided by the respondents were included in the analysis.

Only about half of the participants reported using a formal implementation tracking system, yet most that do have a tracking system reported that their division's current system was outdated, ineffective, or not used consistently. Participants discussed how their implementation tracking method was selected, whether the selected method has proven useful, as well as personnel and budget considerations that accompany implementation planning and tracking methods. Concurrent with previous responses about roadblocks to implementation, nearly all respondents reported time limitations and reduced staff sizes as reasons why implementation tracking was not being used effectively at their agency or why no tracking takes place. However, for every participant, motivation did not appear to be an issue because each participant identified implementation tracking as an essential activity of a research division at a transportation agency. Some respondents self-reported that they lacked the ability to conduct implementation tracking, either because of newness to their position, the lack of necessary skill sets, or an extreme lack of resources in their division.

3.6: Core Category Six: Communication And Marketing

The final core category encompasses all participant responses about the marketing of research results activities undertaken by the participants' research divisions. As a function of research results implementation, marketing may occur at a research division internally, externally, or both.

3.6.1: Internal Marketing

Participants reported a variety of internal marketing techniques. In terms of internal marketing for policy-related research projects, one participant stated that their research division produces brief research results documents for policy makers. These documents are intended to be concise and easy-to-read to accommodate policy makers' full schedules. Some participants stated that his or her research department uses internal marketing to communicate research results upward within the transportation department. One such participant uses a special committee to draft reports that are provided to upper management. Last, several participants use verbal communication networks within the transportation department to spread the word about a research result. The verbal internal communication networks will also be used to determine whether a research result has been

implemented, or how much of the result has been implemented. In contrast, one participant reported that internal communication has been a roadblock to implementing research results because of lack of cohesiveness among staff members.

3.6.2: External Marketing

About half of all participants commented that marketing research results outside of his or her respective state is either an important marketing function of the research division, or he or she would like it to be an important function of the research division. The following are external marketing activities discussed by participants that are intended for audiences outside of their state:

- Peer exchanges
- National newsletters
- Research Advisory Council Web site
- Conferences
- Transportation Research Board of the National Academies

The following are external marketing activities meant for outside of the transportation department but still within the state:

- Newsletters
- Video briefs
- Web pages on department Web site
- Brief research project summaries for other state departments
- Diagrams, posters, and/or informational booths about notable research projects

One participant mentioned that state-related external marketing was important because their research division needs to ensure that the legislature and the general public know that the research program is performing well. Another participant stated that it is important for their research division to continually be in touch with the public through external marketing and direct interaction.

CHAPTER 4 ANALYSIS AND RECOMMENDATIONS

This chapter will analyze the results of the surveys and phone interviews in order to compare the implementation activities of the participating states against the literature on implementation in transportation departments. Specific recommendations will be made for each core category that can be used to improve an aspect of research results implementation at a transportation department. A recommendation will be made only if it is notable and there is sufficient evidence in the literature, surveys, and/or phone interviews to support the recommendation.

4.1: Rationale for Tracking Implementation of Research Results

Tracking research results implementation (or increasing this activity) can be conceptualized as leading to one of two outcomes. First, tracking the implementation of research project results could help "sell" the importance of funding research projects if implementation tracking can show evidence that the research result benefited the department in some way. Second, tracking the implementation of research findings that results in revealing that very little of what has been researched is implemented could increase motivation to ensure research results are implemented among research division staff, and if communicated properly, throughout the department as well.

Slightly less than half of the participants reported using a formal implementation tracking system, and most that did have a tracking system reported that their division's current system was outdated, ineffective, or not used consistently. Participants discussed how their implementation tracking method was selected, whether the selected method has proven useful, and personnel and budget considerations that accompany implementation planning and tracking methods. Concurrent with previous responses about roadblocks to implementation, nearly all respondents reported time limitations and reduced staff sizes as reasons why implementation tracking was not being used effectively at their agency or why no tracking takes place. However, for every participant, motivation did not appear to be an issue because each participant identified implementation tracking as an essential activity of a research division at a transportation agency. Some respondents self-reported that they lacked the ability to conduct implementation tracking either because of newness to their position, the lack of necessary skill sets, or an extreme lack of resources in their division.

The surveys and phone interviews revealed that more than half of the state transportation department research divisions do not currently track the implementation of research results. Fourteen, however, indicated a system would be launched. According to the Transportation Research Board Special Report 296 (2009), transportation departments using funds from the Second Strategic Highway Research Program should track and evaluate the implementation of research results regularly using quantitative and qualitative methods. This management practice remains beneficial no matter what the context; participants that

reported they tracked the long-term implementation of research results reported easier upper management buy-in for their research division, increased support from project champions, and/or increased ease in reporting to FHWA.

Some participants stated that it should be a requirement for a research division to have an implementation tracking system. Participants claimed that tracking implementation is the only way to be accountable to tax-payers and the only way to be able to make improvements to the research division in the future.

4.1.1. Implementation Tracking Recommendations

Recommendation No. 1: Develop an Implementation Tracking System, Or Increase Implementation Tracking Activities. Overall, the phone interview results show that participants who reported that they have implementation tracking systems in place receive a higher level of upper management support, find it easier to find and motivate project champions, experience fewer roadblocks to implementation of research findings, and are more easily able to "sell" the importance of funding research projects to upper management.

Recommendation No. 2: Establish Implementation And Implementation Tracking As Key Goals Of Research Division, Transportation Department. An effective mission statement for an agency (or division within an agency) specifies the goals of the agency, helps the staff of that agency understand the purpose of their employer, and describes how the performance of an agency will be evaluated (Smith, et al, 2001). If a research division does not have implementation and implementation tracking within its mission statement or as one of its strategic goals, employees cannot be expected to view these activities as important or vital to their success at this agency. One of the most significant reasons Rogers (2005) identifies for why transportation agencies fail to implement research results is that overall, staff members tend to perceive research as "irrelevant" to their concerns. If the importance of implementation is embedded into the mission statement and strategic goals of the research division and department, it will be easier to achieve buy-in across managers and front-line staff workers throughout the organization. Value congruence is a source of intrinsic motivation (Ren, 2010).

4.2: Choosing Implementation Champions and Making Them More Effective

Rogers' influential work on project champions shows that project champions that have a high degree of institutional power or control tend to be more effective in achieving results (2003). This perspective was partially manifested in the results of the surveys: Respondents were most likely to identify the management level as the location of implementation champions at their transportation department (n = 12, in comparison to the second most likely response, working level, n = 7). However, more recent studies show a trend toward identifying individual characteristics of effective project champions instead of looking primarily at hierarchal power in an organization (Goodman and Steckler, 1989). Though

some respondents identified the management level as the location where implementation champions are more likely to originate, more than half of the respondents identified multiple levels of the organization as originating project champions. More importantly, many of these respondents brought this issue up in discussion during the phone interviews; they stated that though organizational hierarchal power is very helpful in garnering effective implementation championing, other factors cannot be ignored or are overall more important. Participants in the phone interviews discussed factors such as motivation, the time dimension, technical or subject matter expertise, and communication skills as important factors in the effectiveness of a project champion. Thus, the results indicate that for the sample, state research divisions echo both bodies of championship literature.

4.2.1: Recommendations for Choosing Effective Implementation Champions

Figure 5 depicts the four characteristics or considerations for choosing the most effective implementation champion. These characteristics are most important according to the results of the phone interviews and are verified by the literature on champions.

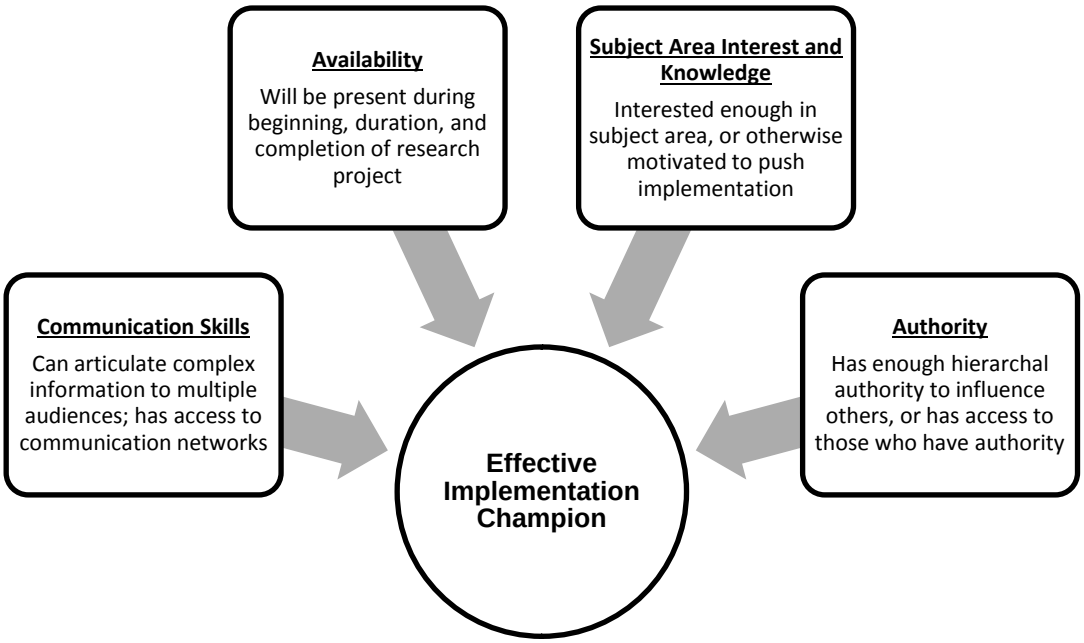

Figure 5. The four most important considerations when selecting an implementation champion for a research result, according to the results of the surveys, phone interviews, and the literature review.

Recommendation No. 1: Choose Someone With Communication Skills. Rogers (2003) states that one of the most important aspects of an effective project champion is his or her communication skills. Rogers discusses characteristics such as sociability, access to communication networks, and degree of presence among employees. Research divisions should choose an employee that is sociable, has a degree of access to the communication networks relating to the subject of the research project he or she is being assigned to, and has a moderate or greater amount of presence among relevant staff members. Participants in the phone interviews also indicated that a champion with good communication skills is able to articulate complex terminology and concepts to multiple audiences – from front-line engineers to policy makers.

Recommendation No. 2: Choose An Employee That Will Most Likely Be With the Agency At The Inception, Duration, and Completion of the Research Project. In a presentation on implementation in transportation agencies, Rogers (2005) states that one of the most significant reasons why research results at transportation agencies are not implemented is because implementation planning may take place too late in the research process. It is important to find a project champion that can be involved with the inception and beginning stages of a research project so that they can begin the process of planning for implementation. However, it is just as important to select a project champion that will be present during the concluding stages of a research project. A few participants in the phone interviews reported having the misfortune of losing their implementation champion before the research project concluded, resulting in a complete lack of implementation of the results. Participants noted that this particular issue has become more prominent in recent years due to staffing and budget cuts.

Recommendation No. 3: Choose Someone Who Has Subject Area Knowledge and Interest In Subject Area (Or Other Motivation To Implement the Research Result). Many participants discussed difficulties in motivating employees to be active in the implementation of research results. This manifests in difficulty in getting employees to attend planning meetings, fill out implementation planning forms, get in contact with contracted researchers, and numerous other implementation activities. Simply, research divisions need to select implementation champions that have the motivation to do all the necessary work that comes with championing the implementation of a research result. According to agency theory, employees naturally lean toward self-interests over the interests of the organization (Ren, 2010). Thus, choosing someone who is self-interested in a research result being implemented, as compared to someone who may not prefer the result to be implemented, is an important consideration.

Recommendation No. 4: The Higher Up In the Organizational Hierarchy the Project Champion Is, the More Effective They Will Likely Be. The literature states that champions that have a high degree of institutional power or control tend to be more effective. This is especially the case if they are implementing something new or innovative. The importance of choosing someone with a degree of institutional influence is also reflected in the results of the surveys and phone interviews; participants who reported having champions from the

management and upper management levels reported higher implementation rates compared to those that only had champions from the working or research division levels.

Recommendation No. 5: If Appropriate, Consider Delegating Champion Responsibility. Several participants' approaches to delegating implementation and implementation tracking tasks involved designating these responsibilities to a specific position in each division of the transportation department. The person in this position would be responsible to carry out all implementation tracking tasks for that area of the department. It is better to assign the responsibility to a position within each division (usually pre-existing) instead of a person because of retirement and turnover considerations. If this responsibility is assigned to a position, the research division will be more able to hold this person accountable for tracking what research results are in fact implemented in their division. There are key benefits and drawbacks to this approach; it is beneficial because if the task is delegated to a specific position in each division, the research division has an accountability measure it did not have before that can be used to motivate staff members to complete this task. A drawback is that this may not be realistic during times of budget and staffing cuts.

Recommendation No. 6: Use Techniques to Increase Motivation to Champion Research Results Implementation. As previously discussed, Rogers states that apprehension about the importance of implementation of research results is a significant reason why transportation agencies have difficulty implementing research results (2005). Research divisions can use several techniques to increase motivation to champion the implementation of research results. One of Rogers' recommendations to increase motivation to implement research results is to remove communication roadblocks for implementation champions. This means making any necessary forms shorter, easier to understand, and less time-consuming. It also means taking some of the communication responsibilities away from implementation champions if the responsibilities can be taken on by the research division staff. This can include setting up meetings, establishing communication networks, and enforcing communications deadlines. With budget and staffing cuts in transportation departments throughout the country, however, this is becoming a less feasible – though still an effective - technique. Another recommendation of Rogers' is to increase motivation by communicating the value of implementing research results. This can be done as previously mentioned by establishing the importance of implementation in the mission statement and/or strategic goals of the research division and/or transportation department.

4.3: Considerations for Implementing Policy Research Results

As was the case in the literature review, there were a variety of definitions from participants about defining policy research. The definitions provided were as broad as "research that does not have hard science behind it" to as specific as research projects about best-practices from other states. No conclusions could be made about participants' definitions of policy research other than rarely did more than two or three states share similar definitions.

Also as expansive were the percentages identified for the amount of policy-related research funded at research divisions compared to other research types.

TRB's Special Report 296 (2009) emphasizes that strong implementation programs contain accountability, planning, and oversight. For the Second Strategic Highway Research Program, the NCHRP guidelines stated that state transportation departments should use implementation oversight committees composed of principal users, state DOTs, local transportation agencies, metropolitan planning organizations, appropriate private-sector organizations, and academic representatives. These recommendations provide suggested activities for research divisions hoping to ensure smoother implementation of policy research, an already decidedly ambiguous and difficult type of research result due to potential roadblocks caused by politics, industry considerations, and the abstract nature of some policy research results. The following recommendations may offer some guidance for research divisions dealing with implementing results from policy research projects.

Last, state transportation research offices should embrace the positive qualities that policy research can bring to their programs. NCHRP Synthesis 280 (Deen & Harder, 1999) states that including policy research as part of the program has the key benefit of developing a healthier and more communicative relationship between the research office and upper management. Policy research brings the research office and upper management closer to understanding each other's needs. Second, policy research can better inform upper management's decisions, benefiting the department as a whole. Finally, without policy research, upper management may not see the value in having a research office and may reduce its funding and resources.

4.3.1: Recommendations for Implementing Policy Research Results

Recommendation No. 1: Relate Policy Research Results Implementation to Department Strategic Goals. Policy research will have more meaning if it can be related to a larger transportation department goal. Department strategic goals are designed for all subsequent, lower divisions to follow, and if used properly can motivate staff and hold them accountable to performance standards (Brown, et al, 2004). If the policy research is connected to the strategic goals, it will be easier to achieve buy-in among the important staff needed for implementation.

Recommendation No. 2: Establish Strong Communication Networks With FHWA and State Policy Makers. Sometimes policy research can "fall through the cracks." Rogers (2003) discusses the importance of acknowledging both formal and informal communication networks since some of the most important information or innovations come from informal networks. Informal communication networks can provide the best ideas for research projects because there is no filter for research project ideas for informal networks. Formal networks tend to squash some ideas because of aversion to innovation and other factors.

Recommendation No. 3: Consider Including Key Industry Representatives In Policy Research Project Meetings. Industry participation in policy research project meetings may be useful for certain types of policy-related research projects such as those that may result in a change in specification (or a new specification) or simply any project that may significantly affect how one or more segments of the transportation industry conducts their business. Participants should remain as objective as possible, and any risks associated with their participation will hopefully be outweighed by their invaluable insight. They may be able to bring up points about a research project that the researchers or contractor may miss if they themselves are not active in the industry topic they are researching. Other benefits may include that when the new specification comes out, the industry representatives that participated may feel as though they had a say in the research process, mitigating the hard feelings that may arise if the new regulation is not entirely beneficial to that industry. Last, industry representation may ensure an expeditious and smooth implementation since there already exists direct contact and communication with industry representatives once the research results are ready for implementation.

4.4: Addressing Barriers to Implementation of Research Results

This section will address some of the solutions participants discussed for the common roadblocks their research divisions face when attempting to implement research results.

4.4.1: Recommendations for Research Divisions for Common Roadblocks

Recommendation No. 1: Set Aside a Small Implementation Fund for a String Of Implementation Successes. One method to encourage a successful implementation function of research programs is to begin with a string of small implementation successes. These successes will encourage further implementation, and eventually implementation of larger and larger research results. Participants who have set aside special implementation-task funds reported being able to divvy out small amounts of funding for small implementations, such as purchasing new equipment based off of research results and funding training sessions.

Recommendation No. 2: Consider Consultants for Certain Implementation Tasks. Several participants reported using consultants for certain administrative tasks. If a research division's staff does not have the necessary skill sets to properly address an aspect of implementation administration, contracting the task out will prevent time loss (so that an employee does not need to learn a skill set) and potentially produce a better product or service. Examples of contracting out administrative tasks included internal newsletters about implementation, development and maintenance of an implementation tracking system, training sessions, and certain external marketing tasks.

Recommendation No. 3: Include Implementation Plan Development As Part of Research Contract. One participant discussed successfully integrating the development of an

implementation plan into the research project contract. This meant that the researcher or consultant working on the research project was tasked with developing the implementation plan for the research results (if applicable). This would include any research or planning necessary to determine the best course of action for implementing the research result.

4.5: Developing an Implementation Tracking System

The recommendations in this section may provide guidance for research divisions on who should maintain an implementation database and what methods should be used to determine whether a research result was implemented.

4.5.1: Recommendations for Developing or Enhancing an Implementation Tracking System

Recommendation No. 1: Tracking System Maintenance: Research Division or Other Divisions. The issue of maintaining the implementation database was discussed throughout the phone interviews and participants divvied out this task in multiple ways. According to the results of the survey, 17 of the participants' research divisions delegate the task of implementation tracking to one of its staff members. This number is misleading, however, in that several participants' research office assigns implementation monitoring to staff throughout the transportation department. Also, very few research offices have a staff member whose sole responsibility is to monitor and track implementation effectiveness.

The participants whose research divisions keep implementation tracking within the division reported success when the division had staff members with the necessary skill sets. Two participants discussed with great pride particular staff members at their divisions who specialize in database design and maintenance. These participants reported high implementation of research results percentages and other successes. Other participants without tracking and database specialization have found mixed results in terms of effectiveness in tracking and being able to keep up with tracking.

For the most part, participants who assign the task to transportation department staff in other divisions reported experiencing success with this technique. However, the roadblocks of time and motivation can be decisive when using this technique, especially if the task of implementation tracking is not part of the job description or department goals for this employee. As such, the few participants who reported using this technique were likely only able to do so after overcoming these barriers. Most participants reported that they would not be able to task other divisions with implementation tracking due to the staff members' lack of time and motivation. Table 2 details the pros and cons of each approach. Ultimately, having both the research division and individual staff members at other divisions all track research would be the ultimate target for transportation departments, if at all possible or feasible.

Table 2. Pros and Cons For Implementation Tracking Designation		
	Research Division Staff	**All/Assorted Division Staff**
Pros	• Allows staff from other divisions to focus on their own responsibilities • Research division staff member will be most familiar with database tracking system • Can create external communications based off research results implementation	• Generally, most familiar with research project and subject matter • Provides opportunity to see first-hand how much the research they are involved with sees or does not see implementation • Motivates to make sure a research finding is implemented
Cons	• Research division staff member may not be as familiar with technical aspects of research results • May not have access to essential communication networks that other division staff have	• Very difficult to enforce unless already part of job description • May not understand purpose of implementation tracking

Recommendation No. 2: Choose Performance Evaluation Methods That Are Right for Your Department. NCHRP's Web-Only Document 127 (Krugler, et al, 2006) describes the research and analysis process behind the NCHRP Research Performance Measurement (RPM) System, a performance measurement system used by several of the participants and possibly by some of the states not interviewed for this report. The authors recommend that state transportation departments that are just beginning to determine the effectiveness of their research program should evaluate their research divisions on only several critical performance areas, coming from one or more of the following categories: outcome measurements, output measurements, resource allocation measurements, efficiency measurements, and stakeholder measurements. At the time of the introduction of the RPM System, there had yet to be a commonly accepted group of critical performance measures across state research departments. A consensus of critical measures would be preferable because states would be able to establish common ground when determining the success of their research division.

The RPM System refers to the overall effectiveness of research divisions, with implementation of research results (including percentages and money saved versus funding spent on the research project) as one dimension of program effectiveness. Still, the same principle applies: each state's transportation department has individual needs and unique political environments. Geography is important as well; a large, sparsely populated state

may benefit from a different performance measure compared to a small, densely populated state with vastly different transportation needs. Though a universal set of performance measures for all states would be useful, in its absence state research divisions should choose implementation effectiveness measures that will be meaningful to their transportation department and state.

Recommendation No. 3: Use Both Quantitative and Qualitative Evaluation Methods. Quantitative and qualitative evaluation methods are both essential if a research division wants to comprehensively evaluate whether its research results implementation activities are effective. In the context of implementation effectiveness evaluation, quantitative evaluation can be defined as a numerical analysis that determines the relationship strength between variables, such as money spent versus money saved; qualitative analysis in this context can be described as an investigation into the context surrounding the numerical data. In other words, quantitative analysis can be used to tell a staff member how much money or how much time was saved by the implementation of a research result, but qualitative analysis can describe whether variables such as time and money saved adequately reflects reality. Both analysis types need to work in tandem in order to determine an assessment that both has the mathematical strength of determining the relationship between variables while adequately reflecting the numbers in practice. Research division staff must also be careful about using either type of evaluation method. NCHRP Synthesis 300 states that qualitative measures "are subjective, and a specific measure may have a different meaning depending on who is providing the interpretation," and a quantitative measure "is generally perceived to be objective and understandable among various members [in transportation] … however, these same members might not agree on what a 'good' road is" (Sabol, 2001).

Thus, when evaluating whether a transportation department's research results implementation activities are effective, implementation trackers should use both analysis methods and must be skilled at both. According to NCHRP Synthesis 300 (Sabol, 2001), state transportation departments do not use enough quantitative performance measures when evaluating the overall success of their research programs and would benefit from using more. Luckily, the research states that transportation departments have a quantitative advantage compared to other types of state governing bodies – part of transportation research and activities already involves the gathering and analysis of quantitative data (Poister & VanSlyke, 2002).

4.6 Increase Internal and External Communication Activities

Multiple participants in the phone interviews discussed internal communication strategies to increase awareness of his or her research division. Most participants discussed external communication strategies in the phone interviews. Strategies discussed for both internal and external communication of research results will be provided in this section.

4.6.1: Recommendations for Increasing Internal and External Communication Activities

Recommendation No. 1: Create Web and Print Summary Documents for Internal and External Communication Purposes. Participants described a variety of research projects conducted at their transportation department, extending across numerous engineering and architectural fields. Not everyone in a transportation department is an expert in or even simply knowledgeable of the variety of subjects research projects are based upon. This becomes an issue when upper management or policy makers are unaware of the context that the research division functions in because they do not understand the purpose of many or all of the research projects the division funds. Creating Web or print-based project summaries that use concise, everyday language can remedy this problem considerably.

Recommendation No. 2: Increase Internal Communication Visually. Some participants discussed internal communications that fostered various benefits for their research program. One state research division has a permanent kiosk at the entrance to the state department that highlights key research projects or research results. This helps to keep all employees at the office aware of the research program and fosters goodwill by highlighting the program's successes. Other internal communications can include internal newsletters, posters about key projects, and educational meetings. Like external communications, these can be contracted out.

Recommendation No. 3: Establish Communication Networks With Other States/Conferences. The literature notes in multiple sources that states do not communicate enough with each other. At best for some states, pooled fund studies may bring together regionally similar state transportation departments. Participation in national conferences may help, as well as national newsletters or e-mailing to other states.

Recommendation No. 4: Use the Department's Communication Office. In a report on communication activities of state transportation research offices, Knott and Martinelli (2005) state that only about a third of state research offices regularly use their department's communication office. These offices can be very helpful and save a considerable amount of time and resources at most state transportation departments. These offices usually have staff members with established relationships with the media, interest groups, other state departments, and policy makers.

CHAPTER 5: IMPLEMENTATION PLANNING INTIATIVES

As a result of the literature review, surveys and interviews with U.S. state transportation departments, and analysis of similar systems, the Illinois Department of Transportation (IDOT) developed two new implementation planning and tracking initiatives. The first initiative, the Implementation Planning Worksheet form (Appendix C), was implemented in October, 2010. Its purpose is to introduce the topic and importance of implementation planning and tracking earlier in the research planning process. The second initiative, the Implementation Planning Database spreadsheet (Appendix D), was implemented in November, 2010. This spreadsheet tracks the administration of implementation planning and calculates percentages of implementation tasks completed. Also, certain sections of the Implementation Planning Worksheet are linked to the Implementation Planning Database, as will be described in Section 5.2.

Both implementation planning efforts were developed over a several month timeframe and received extensive field testing throughout their development. During the creation of the implementation planning worksheet, four separate IDOT employees who were currently or had previously been a technical review panel chair were consulted in order to refine and edit the form. Upon the completion of the final draft of the form and the spreadsheet, the form was immediately disseminated to all new research contracts beginning from a set time period. During the subsequent month, IDOT found that the form was received most positively by new panel chairs. However, panel chairs who had served in that capacity previously also demonstrated that they were receptive to the form and were willing to collaborate with the research office on implementation planning and tracking efforts.

5.1: Implementation Planning Worksheet

Multiple sources of information and inspiration contributed to the development of the worksheet. As a response to the state of the public sector transportation industry as described in the literature review, many aspects of the form and its use were designed to address the most pressing issues. Rogers (2005) states that one of the most significant factors contributing to ineffective and inefficient implementation is that consideration of results implementation takes place too late in the research process. This worksheet addresses this by initiating this discussion as early as possible in the life of the research project, preferably at or before the first meeting of the researchers and the technical review panel. As directed by the worksheet, technical review panel chairs are encouraged to conduct a brainstorming session with the researchers and other panel members at the first meeting. Previously, implementation was only formally discussed near the end of the life of a research project. Last, this worksheet attempts to establish accountability for implementation earlier by requesting a list of all anticipated implementation activities as well as an assigned implementation task champion.

Another way in which the worksheet addresses the literature review is by alleviating one of the most commonly noted roadblocks to implementation: champions having little motivation and time to plan for implementation. In his presentation, General Theory on Translating Research into Policy and Practice (2005), Rogers recommends making forms shorter, easier to understand, and less time-consuming. Efforts were made to make IDOT's form as user-friendly and streamlined as possible. For each section, the directions are clearly defined and there should be little question about what information needs to be added. Another way in which this form is user-friendly is that in the directions section at the end of the form, submitters are provided contacts they can use if they have any difficulty filling out the form. To streamline the form, the electronic version of the form contains drop-down menus to reduce the need to input certain repetitious information. The form also uses check-lists and numbers lists to visually organize information while providing ample room for additional comments or details that cannot be gleaned from lists.

5.1.1. Implementation Planning Worksheet Description

The first part of the worksheet, "Intended Outcomes", asks submitters to identify what types of information or tools will be gained by the end of the research project. It then requests the submitter to identify who will be most affected by, benefitted by, and/or interested in the research results. The purpose of this section is to prompt research project chairs to brainstorm what the research project results will be and who will be most affected by the results. This information directly connects to the subsequent sections of the form and may also inspire discussion on what additions may need to be made to the panel membership in order to ensure representation from important internal and/or external agencies.

The second part, "Securing Implementation", requests that submitters identify the challenges to successful implementation of research results and the strategies that will be used to facilitate research implementation. The goal of this section is to force submitters to consider something they may not have yet been prompted to identify. Generally, implementation planning has taken place near or at the end of the life of a research project. If the Technical Review Panel chair identifies the challenges to implementation and the strategies to achieve successful implementation at the beginning of a research project, they can tailor the research plan to circumvent or address these challenges or adjust as needed throughout the life of the project.

The subsequent section, "Technology Transfer", ties directly to the first section and prompts submitters to identify both internal and external target audiences. It then prompts submitters to identify how the research results will be communicated to these audiences. The goal of this section is to consider audiences for the research results that may not have been previously identified.

The fourth section, "Implementation Activities", is the section most directly connected to the Implementation Planning Database. Once completed, the details provided in this section will be entered into the Implementation Planning Database for tracking by research staff at

IDOT. It requests a brief description of the implementation task, the estimated date that this task will be completed, and perhaps most importantly, who will be assigned as champion for this task. Submitters of this form will be encouraged to appoint other panel members to various tasks rather than assigning himself or herself as task champion for each. The subsequent section, "Further Details", may include information pertinent to any section throughout the form.

5.2: Implementation Planning Database

This spreadsheet-based database works in conjunction with the Implementation Planning Worksheet. This database provides IDOT research staff and upper management with both macro- and micro-level perspectives into the entire research program. The macro-level perspective, "Main Progress View (Sheet One)," provides all the essential information from the Implementation Planning Worksheet related to stakeholders and communication. It also tracks the use and versions of the Implementation Planning Worksheet over the course of a project's lifespan. The micro-level perspective, "In-Depth Activities View (Sheet Two)," lists all items provided from its accompanying planning worksheet section, "Part IV: Implementation Activities." The main difference is the addition of the column titled "Status," which tracks whether a task has been completed by the provided estimated due date. This column also provides a "percentage completed" value for the implementation tasks provided by the submitter of the Implementation Planning Worksheet. It is coded to divide the number of completed tasks by the number of tasks listed. This calculated percentage is also relayed to the first sheet of the database spreadsheet, where it is recorded in the final column. This feature allows IDOT's research division the ability to track implementation activities on a project basis.

CHAPTER 6: CONCLUSION, LIMITATIONS, AND RECOMMENDATIONS FOR FURTHER RESEARCH

The purpose of this report was to investigate research results implementation practices at state transportation agencies. The results of a literature review led to the development of survey questions that were used to gather preliminary information about research results implementation tracking at state transportation departments. Following the receipt of the surveys, an interview protocol was developed in order to further probe the context and environment for research results implementation at state transportation departments. Questions focused on topics ranging from research results champions, implementation of policy research, internal and external implementation communication practices, amount of implementation tracking, implementation research philosophy, and barriers to effective research results implementation. Answers provided in the phone interviews were analyzed qualitatively using the constant comparative method. The results of this analysis were compared against the results of the literature review when appropriate to assist in achieving triangulation and providing historical context to the present-day struggles of state transportation department research divisions. Last, recommendations were provided in this report that can be used to assist any transportation agency in increasing research results implementation. These recommendations were developed from the results of the surveys, results of the phone interviews, and additional context provided from the literature review.

6.1: Future Research Opportunities

In a study similar to the present one, Bikson, et al (1995), found major discrepancies in transportation implementation proficiency among the local, state, and county levels. Local and county transportation agencies were found to implement much less frequently, though their implementation successes were as substantial (or more-so) compared to the state level. A future study could identify the reasons for the discrepancies by conducting interviews at the county and local levels and comparing the results to this study.

6.1.1: Implementation Tracking

A future research study could evaluate the mission statements and strategic goals of research divisions at state transportation departments to determine whether they contain implementation and implementation tracking. A researcher could study the correlation (if one exists) between identification of implementation as an important goal and the amount of implementation and implementation tracking that occurs at the research division.

6.1.2: Implementation Champions

A potential future research opportunity relating to implementation champions is how budget and staffing cuts influence project champion selection. Nearly every participant made some

mention of staffing and/or budget cuts within the previous year that have reduced the transportation department's ability to implement research results. These cuts have also affected the ability of staff members in the participants' research divisions to monitor whether research results are implemented. Simply, as the number of staff at a transportation department decreases, the remaining staff members are forced to take on the tasks and responsibilities of the positions that have been eliminated. As this occurs, it is less and less likely that the remaining staff will have enough time to devote to research result implementation or tracking whether a result has been implemented. Another dimension of this relates to time and need. If there is little immediate need to implement a new research result, the implementation of the research result may be put off in favor of more immediate needs. Especially when employees are being required to take on more and more tasks with the same amount of funding and time, it is easy in this type of organizational atmosphere for implementation to be put off to take care of more immediate needs. Though not a common theme, some participants did mention how the lack of appropriate skill sets affects the implementation of research results and tracking of implementation. This led to two participants' states hiring consultants in order to perform implementation activities such as changing specifications or creating research summaries for upper management.

6.2: Limitations

The limitations of the research conducted for this study will be discussed in this section. Additionally, the limitations inherent for qualitative research will be discussed. The researcher made every attempt to address and minimize all research limitations throughout this study.

6.2.1: Response Rate

According to Miller and Kobayashi, (2000), 50 percent is considered a "good" response rate for hand-written surveys. Though 25 states (50 percent) participated for the surveys and phone interviews, this means that the data presented in this report only encompasses information and opinions from half of the states in the United States. Keyton (2006) recommends having a sample rate of 60 percent or higher for quantitative research, so the 50 percent sample size used here is less than desirable. However, qualitative research is not held to the same standard as quantitative research as qualitative research in itself involves subjective interpretation of text or dialogue.

One of the key issues regarding response rate limitations is "non-response bias," or the meaning behind why some individuals in the sample responded and why some did not. A potential non-response bias for this study would be that the 25 states that did not respond work for research offices that do not implement any research results. If this were the case, then the results presented in this study would be incorrect in stating that states have a variety of implementation rates; in reality, only some states would have implementation rates above 30 percent and most states would have implementation rates below 30 percent.

Alternately, the non-responding 25 states may not have responded because they were too involved in implementation activities. Also in this case, the results of this study would be incorrect. To address the non-response bias limitation, multiple attempts were made to encourage states to respond to the survey and the state RAC members were provided ample time to respond to the survey.

However, the states that responded are representative of each region of the United States other than Alaska or Hawaii and represent a variety of geographic sizes and population densities. Though a higher response rate would have been preferred, the 50 percent response rate still ensures that the results are valid. The full list of participants in the phone interviews can be found in Appendix E.

6.2.2: Qualitative Research Limitations

The results from the phone interviews presented in this study are subject to limitations present in qualitative research. According to Keyton (2006) and Baxter and Babbie (2004), one of the main limitations of qualitative research and analysis is that the analysis is subjective to the researcher. As such, multiple attempts were made to minimize this limitation. First, the results of the phone interviews were organized by similarities and coded into categories to strengthen the resulting analysis. Second, interviewees were asked to clarify themselves whenever their assertions were unclear to the researcher. Third, the information gathered in the phone interviews were compared against a large body of literature on implementation and state-transportation-specific research studies. This study found many similar findings compared to similar studies conducted in the past several decades. These limitation-reducing activities have increased the validity of the results and recommendations of this report.

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APPENDICES

APPENDIX A

SURVEY ON IMPLEMENTATION OF RESEARCH FINDINGS

(SENT BY E-MAIL)

Survey on Implementation of Research Findings

1. **Does your agency have documented procedures related to the implementation of project findings?**

   a) Yes (If procedures are available online, could you provide a link?)

   b) No

2. **Is an implementation plan required at the beginning of a project?**

   a) Yes, for every project

   b) Yes, for select projects

   c) No

3. **Are implementation activities identified, documented, and monitored at the end of a project?**

   a) Yes, for every project

   b) Yes, for select projects

   c) No

4. **Do you hold a meeting at the end of a project where the findings are summarized and discussed and implementation tasks are identified?**

   a) Yes, for every project

   b) Yes, for select projects

   c) No

5. **If an implementation champion (person responsible for ensuring that implementation tasks are completed) is identified, what level of the organization is the champion typically from?**

   a) Working level – person responsible for the implementation task(s)

   b) Management level – mid-level person over the area responsible for implementation tasks

   c) Upper management level – person over all organizational units involved or impacted by the implementation activities

   d) Research staff member

   e) Other _____

6. **Do you have staff members in your research division whose role is to monitor implementation of research findings?**

   a) Yes

   b) No

7. **Please provide a primary point of contact for further inquiry on this subject.**

   Name:

   Title:

   Phone:

   Email:

Please send your responses via email to Thomas Bukowski, Research Coordination Assistant, at Thomas.Bukowski@illinois.gov, by January 22nd, 2010.

APPENDIX B

FINAL IMPLEMENTATION INTERVIEW PROTOCOL

(READ OVER PHONE)

Final Implementation Interview Protocol

SECTION ONE: Implementation Philosophy

For this survey, transportation research implementation is defined as "A research finding that is translated into a real-world transportation application such as a new product, specification, technique, policy change, or other influence."

1). How important is the implementation of a research project in comparison to the research findings? Please indicate the level of importance on a scale of 1 to 5 with 1 being "implementation is much less important than research findings" and 5 being "implementation is much more important than research findings."

a) 1 – Implementation is much less important
b) 2
c) 3
d) 4
e) 5 – Implementation is much more important
f) I do not know
g) Not applicable

2). How do you decide whether a research project merits implementation?

3). Identify what percentage of your department's research sees implementation. If possible, please provide an actual percentage in the space provided. This percentage can be an estimate.

a) None
b) 30% or less
c) More than 30% to 60% or less
d) More than 60% to 90% or less
e) More than 90% but less than 100%
f) 100%
g) I do not know
h) Actual or estimated percentage (please mark which): _____ estimated/actual

4). Briefly describe one or more of your department's implementation successes.

5). What are some key common problems or roadblocks that come up during implementations of research projects (if any)?

SECTION TWO: Policy

1). In your own words, please define what the term “transportation policy” means.

2). How much of the research your department does is explicitly about transportation-related policy?

1) All research
2) Large amount of research
3) Moderate amount of research
4) Very little amount of research
5) No research
6) I do not know
7) Not applicable

3). If applicable, of this amount, how much of the research is eligible for state funding?

4). Are you able to use SPR funds for policy-related research? What can use funds and what cannot use funds?

5). If applicable, what percentage of the amount of transportation-related policy research your agency does sees implementation?

a) None
b) 30% or less
c) More than 30% to 60% or less
d) More than 60% to 90% or less
e) More than 90% but less than 100%
f) 100%
g) I do not know
h) Actual or estimated percentage (please mark which): _____ estimated/actual

SECTION THREE: Project Champions

For this survey, project implementation champions are defined as “Those who support and advocate for a research finding implementation, even in organizational atmospheres that are unfavorable toward implementation.”

1). Please describe, if applicable, two or more specific instances of how having a project implementation champion has aided the implementation of a research project. Please describe the topic of the research, the title and position of the project champion, and how they aided the securing of implementation.

OPTIONAL

2). (Follow-up to survey question No. 5) You indicated in the first survey that different types of studies see project champions from different levels of the agency. Please describe the process and reasons for selecting a level of an agency for a type of project.

3). Have you had instances where you had more than one champion attached to the implementation of a research project's results? Did they come from the same or different levels of the agency?

SECTION FOUR: Implementation Planning

1). How important is the potential for real-world implementation in the research project selection process?

1) Extremely important
2) Moderately important
3) Neither important or unimportant
4) Moderately unimportant
5) Extremely unimportant
6) I do not know
7) Not applicable

2). If applicable, what methods does your department use to evaluate the effectiveness and efficiency of implementation of research project results?

3). Is the research oversight group for a project the same as the implementation oversight group for a project (if applicable)?

SECTION FIVE: Communication

1). Tell me about the communication practices your research division undertakes to increase the spread of information of research results. Internal? External?

2). Tell me about an instance where communication was used in a unique way to increase the implementation of a research result. Describe the project or implementation result in detail if you can; also, describe what was unique about the specific communication practice.

SECTION FIVE: Wrap Up

1). What are some practices your research division has employed to ensure the success of project results implementation?

2). Are there any topics about transportation implementation that this survey did not address? If so, what are the topics?

3). Is there anything else we should know about your department's experiences with implementation that would be helpful to know?

APPENDIX C

IMPLEMENTATION PLANNING WORKSHEET

(CURRENT VERSION AS OF MAY, 2011)

Illinois Department of Transportation

Implementation Planning Worksheet
Bureau of Materials and Physical Research

Your name:	**Today's Date:** / /
Your title:	**Are you the TRP Chair?**
Proposed IDOT Research Project Title:	**Project Number: R**
	Project Status:

Is this research project conducive to implementation? ☐ Yes ☐ No *If yes, please continue below. If no, please fill out as much as you can and select "Not Applicable" for sections that do not pertain to this research study.*

PART I: INTENDED OUTCOMES ☐ **Check box if not applicable and section will not be completed.**

A. What is/are the intended outcome(s) of this research project? Check all that apply.

☐ <-New/updated specification(s)	☐ <-New/updated software	☐ <-Peer exchange(s)
☐ <-New/updated policy/guideline(s)	☐ <-Training courses/modules	☐ <-Other:

Comments/further details (if applicable):

B. Who or what will be affected by/benefitted by/interested in the intended outcomes of this research project? List all relevant items. If not sure, leave section blank. Please attach another page if necessary.

Internal *IDOT bureau(s)/district(s)*	***External*** *(i.e. "concrete industry," "IEPA")*	*Comments/further details*
1.	1.	
2.	2.	
3.	3.	
4.	4.	
5. Other:	5.	

PART II: SECURING IMPLEMENTATION ☐ **Check box if not applicable and section will not be completed.**

A. Which of the following strategies will be used to facilitate implementation? Check all that apply.

☐ <-Including key stakeholders (SPECIFY BELOW)	☐ <-Statewide meetings (districts or agencies)
☐ <-Ad hoc committees (SPECIFY BELOW)	☐ <-Training sessions online and/or in-person
☐ <-Presentations to upper management	☐ <-Other:

Comments/further details (if applicable):

B. Identify challenges to implementation. (Leave blank if not sure/applicable)

1.

2.

3.

PART III: TECHNOLOGY TRANSFER **Check box if not applicable and section will not be completed.**

A. Who are the target audiences of the results of this research project? (internal and/or external)	B. What communication channels will be used to disseminate the results? Check all that apply.	
☐	☐ Peer exchanges	☐ Online databases
☐	☐ Conferences	☐ Publications
☐	☐ Training (in-person)	☐ Presentations
☐	☐ Training (online)	☐ Other:
☐	☐ E-mail list-servers	☐ Other:
☐	☐ Display cases	☐ Other:

Comments/further details (if applicable)

PART IV: IMPLEMENTATION ACTIVITIES Required for completed projects, optional for in-progress projects.

Please list all the activities that will be required to implement the research results for this project. If the project is in progress, all completion dates are tentative. Please attach another page if necessary.

Activity	Contact or Sponsor (Champion)	Est. Due Date
1.	Name: Contact phone: Contact e-mail:	/ / or Month, Year:
2.	Name: Contact phone: Contact e-mail:	/ / or Month, Year:
3.	Name: Contact phone: Contact e-mail:	/ / or Month, Year:

PART V: FURTHER DETAILS

Are there any further details about the implementation of this project's results that would be helpful to know? Feel free to use bullet points, lists, links, or anything else in this field. Please attach another page if necessary.

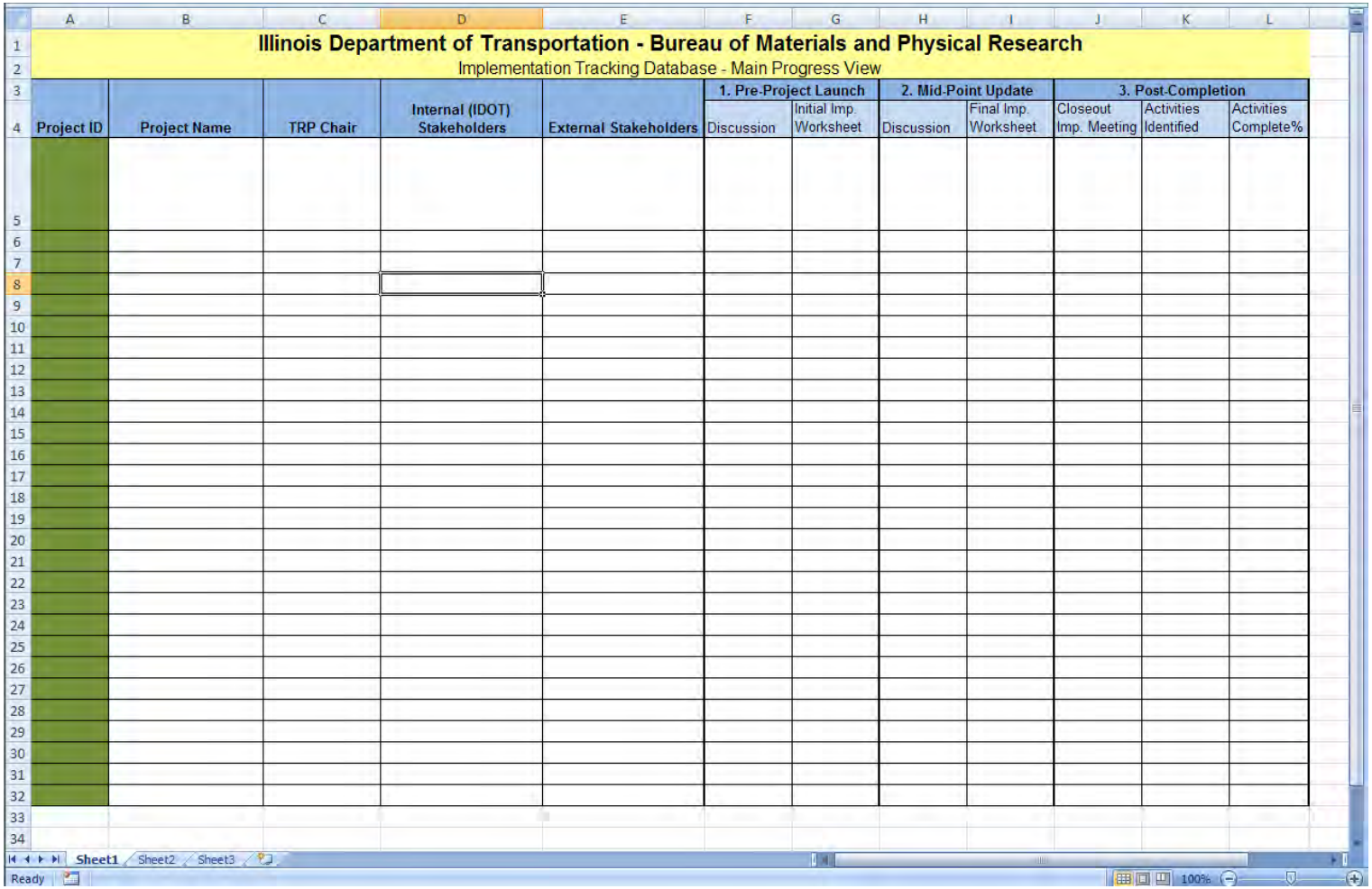
If you need assistance filling out this form: Please contact Thomas Bukowski (Thomas.Bukowski@illinois.gov), your Bureau of Materials and Physical Research TRP member, or Amy Schutzbach (Amy.Schutzbach@illinois.gov) for assistance filling out this form.

Directions for submission: Please return your completed form to Thomas Bukowski (Thomas.Bukowski@illinois.gov), your Bureau of Materials and Physical Research TRP member, or Amy Schutzbach (Amy.Schutzbach@illinois.gov).

APPENDIX D

IMPLEMENTATION TRACKING DATABASE

(CURRENT VERSION AS OF FEBRUARY, 2011)



Illinois Department of Transportation - Bureau of Materials and Physical Research

Implementation Tracking Database - Main Progress View

Project ID	Project Name	TRP Chair	Internal (IDOT) Stakeholders	External Stakeholders	1. Pre-Project Launch		2. Mid-Point Update		3. Post-Completion		
					Discussion	Initial Imp. Worksheet	Discussion	Final Imp. Worksheet	Closeout Imp. Meeting	Activities Identified	Activities Complete%

Sheet1 Sheet2 Sheet3

Ready

100%

Illinois Department of Transportation - Bureau of Materials and Physical Research

Implementation Tracking Database - In-Depth Activities View

Project ID	Project Name	Project Contact/TRP Chair	Task	Due Date	Champion	Brief Description	Status
			Implementation Activities				
			TASK 1				
Notes:			TASK 2				
			TASK 3				
			TASK 4				
			TASK 5				
			TASK 6				
						Percent Complete:	
			TASK 1				
Notes:			TASK 2				
			TASK 3				
			TASK 4				
			TASK 5				
			TASK 6				
						Percent Complete:	
			TASK 1				
Notes:			TASK 2				
			TASK 3				
			TASK 4				
			TASK 5				
			TASK 6				
						Percent Complete:	
			TASK 1				
Notes:			TASK 2				
			TASK 3				
			TASK 4				
			TASK 5				
			TASK 6				
						Percent Complete:	

Sheet1 Sheet2 Sheet3

Ready 100%

APPENDIX E

FULL LIST OF UNITED STATES DEPARTMENTS OF TRANSPORTATION

SURVEY AND PHONE INTERVIEW PARTICIPANTS

United States Departments of Transportation Participating in Surveys and Phone Interviews (in Alphabetical Order)

E-mail Surveys	Phone Interviews
Alabama	Alabama
Arizona	Arizona
Connecticut	Connecticut
Georgia	Georgia
Illinois	Illinois
Indiana	Indiana
Iowa	Iowa
Kansas	Kansas
Louisiana	Louisiana
Maine	Maine
Maryland	Maryland
Massachusetts	Massachusetts
Michigan	Missouri
Missouri	Montana
Montana	Nevada
Nevada	New Hampshire
New Hampshire	New Mexico
New Mexico	New York
New York	North Carolina
North Carolina	Ohio
Ohio	Oregon
Oregon	Pennsylvania
Pennsylvania	Tennessee
Tennessee	Texas
Texas	Wisconsin
Wisconsin	
Total: 26 States	**Total: 25 States**