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EVALUATING DEPARTMENT OF TRANSPORTATION'S RESEARCH PROGRAM: A METHODOLOGY AND CASE STUDY

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<p>Abstract: An effective research program within a transportation organization can be a valuable asset to accomplish the goals of the overall mission. Determining whether a research program is pursuing relevant research projects and obtaining results for the sponsoring organization has been a challenge in the past.</p> <p>This report will present a methodology for conducting an evaluation of a research program within a transportation agency. The methodology provides ten performance measures that are used to summarize the findings of the evaluation. These performance measures are quantifiable, meaning they are designed to place a score or value on the accomplishments of the research program which can then be used to make managerial decisions for the research program.</p> <p>The developed methodology was implemented for the Wyoming Department of Transportation's Research Program to demonstrate how the methodology can be utilized. Specific recommendations and conclusions for the WYDOT Research Program are presented in the final chapter of this report. Final recommendations for implementing the methodology for any other agency looking to perform an evaluation of their research program are also presented in the final chapter of this report.</p>			
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SI* (Modern Metric) Conversion Factors

Approximate Conversions from SI Units

Symbol	When You Know	Multiply By	To Find	Symbol
Length				
mm	millimeters	0.039	inches	in
m	meters	3.28	feet	ft
m	meters	1.09	yards	yd
km	kilometers	0.621	miles	mi
Area				
mm ²	square millimeters	0.0016	square inches	in ²
m ²	square meters	10.764	square feet	ft ²
m ²	square meters	1.195	square yards	yd ²
ha	hectares	2.47	acres	ac
km ²	square kilometers	0.386	square miles	mi ²
Volume				
ml	milliliters	0.034	fluid ounces	fl oz
l	liters	0.264	gallons	gal
m ³	cubic meters	35.71	cubic feet	ft ³
m ³	cubic meters	1.307	cubic yards	yd ³
Mass				
g	grams	0.035	ounces	oz
kg	kilograms	2.202	pounds	lb
Mg	megagrams	1.103	short tons (2000 lbs)	T
Temperature (exact)				
°C	Centigrade temperature	1.8 C + 32	Fahrenheit temperature	°F
Illumination				
lx	lux	0.0929	foot-candles	fc
cd/m ²	candela/m ²	0.2919	foot-Lamberts	fl
Force and Pressure or Stress				
N	newtons	0.225	poundforce	lbf
kPa	kilopascals	0.145	pound-force per square inch	psi

Approximate Conversions to SI Units

Symbol	When You Know	Multiply By	To Find	Symbol
Length				
in	inches	25.4	millimeters	mm
ft	feet	0.305	meters	m
yd	yards	0.914	meters	m
mi	miles	1.61	kilometers	km
Area				
in ²	square inches	645.2	square millimeters	mm ²
ft ²	square feet	0.093	square meters	m ²
yd ²	square yards	0.836	square meters	m ²
ac	acres	0.405	hectares	ha
mi ²	square miles	2.59	square kilometers	km ²
Volume				
fl oz	fluid ounces	29.57	milliliters	ml
gal	gallons	3.785	liters	l
ft ³	cubic feet	0.028	cubic meters	m ³
yd ³	cubic yards	0.765	cubic meters	m ³
Mass				
oz	ounces	28.35	grams	g
lb	pounds	0.454	kilograms	kg
T	short tons (2000 lbs)	0.907	megagrams	Mg
Temperature (exact)				
°F	Fahrenheit temperature	5(F-32)/9 or (F-32)/1.8	Celsius temperature	°C
Illumination				
fc	foot-candles	10.76	lux	lx
fl	foot-Lamberts	3.426	candela/m ²	cd/m ²
Force and Pressure or Stress				
lbf	pound-force	4.45	newtons	N
psi	pound-force per square inch	6.89	kilopascals	kPa

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FORWARD

An effective research program within a transportation organization can be a valuable asset to accomplish the goals of the overall mission. Determining whether a research program is pursuing relevant research projects and obtaining effective results for the sponsoring organization has been a challenge in the past.

This report will present a methodology for conducting an evaluation of a research program within a transportation agency. The developed methodology is an evaluation process that encompasses a multilevel analysis that focuses on the outcomes, implementable benefits, and results that research projects and the research program has generated. The methodology provides ten performance measurements that are used to summarize the findings of the evaluation. These performance measurements are quantifiable, meaning they are designed to place a score or value on the accomplishments of the research program which can then be used to make managerial decisions for the research program.

The developed methodology was implemented for the Wyoming Department of Transportation's Research Program to demonstrate how the methodology can be utilized. It was found that the WYDOT Research Program was an effective and valuable asset for WYDOT and the transportation community. Specific recommendations and conclusions for the WYDOT Research Program are presented in the final chapter of this report. Final recommendations for implementing the methodology for any other agency looking to perform an evaluation of their research program are also presented in the final chapter of this report.

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CHAPTER 1 INTRODUCTION

1.1 Background

Evaluating research programs of federal, state, and local transportation agencies is thought to be a necessity to attain the most efficient and relevant results from the program. Evaluations of research programs insure that transportation agencies get the highest return on their investments. A valuable research program in a transportation agency provides improvements in highway safety and enhances the progress of the overall organization by improving infrastructure, infrastructure management, and cost avoidances for a variety of systems. When a research program is operating efficiently, not only does the sponsoring agency benefit, but so does the transportation community as a whole

In 2007, “A Methodology for Evaluating DOT Research Programs, A Case Study: Wyoming DOT” developed a methodology that identified ten performance measurements that were used to determine the direction, effectiveness, and accomplishments of the Wyoming Department of Transportation (WYDOT) Research Program. These performance measures were derived using a 2001 NCHRP study, Performance Measures for Research and Technology Programs (Sabol, 2001). From that study and surveys taken from DOT’s across the country, the ten performance measurements were selected. These measurements were created to link WYDOT’s strategic goals to their research program. The goals of the performance measurements are to improve the management of the research program by linking program funding, program strategy, and project selection to support WYDOT’s strategic plan. Using the linkage of the performance measurements to the strategic plan, the following three categories of performance measurements were formed:

- Strategic Portfolio Measures – These performance measurements link WYDOT’s policies to the direction of the research program, including a balance of projects supporting different goals, and a distribution of funded projects from pooled fund studies to contracted research to in-house research.
- Project Output Measures – These performance measurements focus on the results and outcomes of the research projects and the benefits or implementations that resulted from the projects.
- Program Efficiency and Management – These performance measurements look at the cost-benefits of the program, as well as administrative and overhead costs compared to the program’s overall budget.

From the three categories of performance measurements described above, a total of ten performance measurements were developed for summarizing the findings of a research program evaluation, as described by the methodology. The ten performance measures were formed with the following guidelines:

- Use as few measurements as possible.
- Focus on the outputs and results.
- Non-research personnel should understand the measurements; some measurements are for internal purposes only.
- Each measurement should be quantifiable, meaning that comparisons could be made after multiple evaluations were completed.
- These ten performance measures are presented in the methodology section of this report (Schneider et. al., 2008).

1.2 Problem Statement

Evaluating the effectiveness and relevance of DOT research programs will be a necessity as the funding for these programs becomes performance based. Traditionally, some transportation research programs in the United States were allocated funding based on earmarks. Earmarks are provisions in legislation that allocates money for certain programs. In more recent transportation legislation, earmarks are being cut and programs like transportation research are now competing for the funding. In the future, transportation legislation could decrease or drop earmarking completely. DOT research programs could also face similar funding cutbacks if the trends in transportation legislation remain. More information on transportation legislation and funding can be found in the Literature Review, Chapter 2.

DOT research programs that can perform evaluations on the funded projects, the overhead they incur, and on the effectiveness of the program as a whole will probably improve the outputs of their programs as opportunities for improvement can be identified. Having such evaluations in place will also ensure DOT research programs stay competitive with one another and continue to receive the federal funding they require to operate.

An evaluation method is proposed in this report that can be utilized by DOT research programs to ensure that they are a valuable asset, not only to their sponsoring organization, but also to the research community as a whole. The methodology is presented in the coming chapters of this report with a case study of how the methodology can be utilized through the Wyoming Department of Transportation Research Program.

1.3 Research Objectives

The following list contains the research objectives of this report:

- Present the developed methodology for evaluating DOT research programs.
- Demonstrate the methodology using the WYDOT Research Program as a case study.
- Make conclusions and recommendations about the effectiveness of the WYDOT Research Program.
- Make recommendations for implementing the developed methodology for any DOT research programs.

1.4 Report Organization

A total of seven chapters are contained in this report. Chapter 2, the Literature Review, contains background information pertaining to the current surface transportation funding in the United States, including total dollars spent on highway construction and total research dollars for all State Programming and Research Programs. A brief history and discussion of the importance of performance measurements and technology transfer are also discussed in Chapter 2. The evaluation methodology is described in Chapter 3, including both the stage I methodology and the stage II methodology that was developed by this study. Chapter 4 demonstrates the Stage I methodology as a case study on the WYDOT Research Program. The stage II methodology is also presented as a case study of the WYDOT Research Program in Chapter 5. Chapter 6 is an evaluation of the WYDOT Research Program Website, and contains recommendations on possible opportunities that the website could take advantage of based on other DOT research program websites. The conclusions and recommendations of the report are discussed in Chapter 7.

CHAPTER 2 LITERATURE REVIEW

2.1 Surface Transportation Funding

The highway system in the United States plays a critical role for the US economy, private and commercial activities, and plays an instrumental role in the daily lives of most Americans. The surface transportation infrastructure in the US is funded by federal, state, and local governments. The federal contribution of funds has been increasing over the past 50 years, but the rate of increase has slowed down. The Federal Highway Administration (FHWA) estimates that if current funding including inflation adjustments is maintained, then the overall condition of the highway system would start to decline because of additional traffic volumes. Figure 2-1 shows the federal spending for highways, from 1956 to 2009. The term “Nominal Dollars” used in Figure 2-1 refers to actual dollars spent and does not account for inflation. When the money is placed on the same scale as shown with the 2009 dollars, the amount of spending on highways in the United States has not increased as fast as the nominal dollars spent, as shown in Figure 2-1. This shows inflation was not always considered when highway funding was approved.

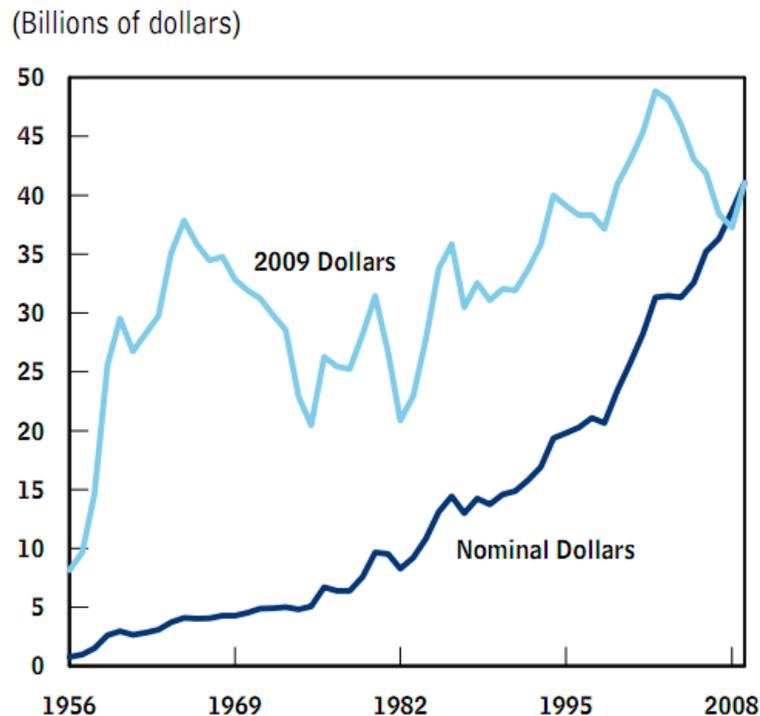


Figure 2-1 Total Federal Spending for Highways (Shirley, 2011)

In 2007 alone, approximately \$146 billion was spent to build, maintain, and operate the nation’s interstate, state, and local surface transportation systems. About one quarter of the \$146 billion was funded through the federal government under The Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU) in 2007 (FHWA, 2005).

SAFETEA-LU is transportation legislation that was enacted in August of 2005. SAFETEA-LU was originally \$244.1 billion of transportation legislation that was initially intended to be enacted through 2009, but extensions have carried this legislation into 2012 (FHWA, 2005). Out of the \$244.1 billion allotted by SAFETEA-LU, \$180.2 billion was authorized for surface transportation programs. From the funding for surface transportation programs, \$3.2 billion was reserved for federal, state, university, and other national organization’s research programs. Approximately 25 percent of this \$3.2 billion, \$798 million, was reserved for research activities for state research programs directed by the state departments of transportation (DOTs). Figure 2-2 illustrates how the surface transportation funding from the initial SAFETEA-LU bill of 2005 is broken down for the State Programming and Research (SP&R) programs for all 50 states for the initial five year funding period (Williams et. al., 2005).

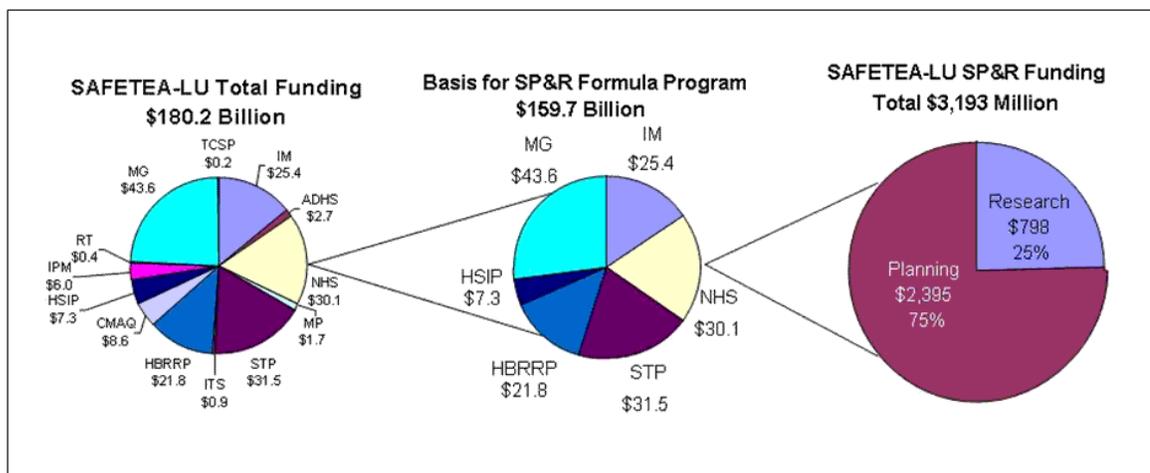


Figure 2-2 State Research Funding from SAFETEA-LU (Williams et. al., 2005)

SAFETEA-LU allocated \$3,193 million dollars for the state planning and research (SP&R) programs from 2005-2009. Extensions for additional funding for SP&R were passed for 2010, 2011, and 2012. Two percent of every state’s total funding from the highway trust fund is allocated to SP&R. As stated earlier, 25 percent of the SP&R funds for each state must be spent on research-related projects. These projects should be aimed at finding solutions to local, regional, and statewide problems for each state. State DOT research programs generally fund only applied research, with minimal funding to general research. The applied research includes implementation of new technologies and technology transfer. Technology transfer is the process of demonstrating, training, and distributing information about new technologies and research findings to support the implementation. Generally, the research projects that states fund range from \$100,000 to \$300,000, but projects can be as low as \$5,000 and as high as \$1,000,000 (Williams et. al., 2005).

SP&R programs not only fund state research projects, but contribute to national research organizations for the coordination of pooled fund studies and national research activities. For

example, each state contributes 5.5 percent of their SP&R budget to the National Cooperative Highway Research Program (NCHRP). NCHRP is involved with research that affects multiple states or national needs. SP&R programs also spend upwards of half of their budget to support central research needs such as the Transportation Research Board (TRB). TRB holds an annual meeting to promote transportation research activities, maintains the Transportation Research Information Database, and supports over 200 TRB standing committees. SP&R programs also fund local technology transfer centers and local technical assistance programs (Williams et. al., 2005).

The funding for SP&R programs increased over the 2005-2011 time period, from approximately \$600 million to \$765 million. However in 2012, over 50% of the funding was cut from SP&R programs (NCHRP Reports to State DOTs). This is due to the possible new transportation legislation that is currently being considered. If the new transportation legislation is not passed in 2012, state research programs may not receive any additional funding. Figure 2-3 shows the funding of SP&R programs from 2006 through 2012. Research, Development and Technology (RD&T) comprises 25% of the SP&R budget as shown on Figure 2-3 (NCHRP, 2006).

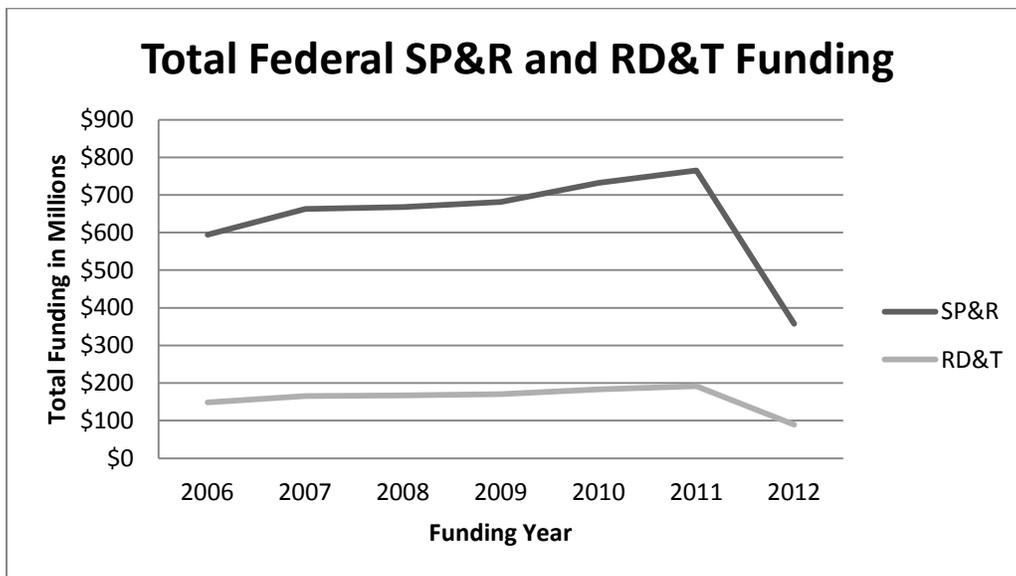


Figure 2-3 Total SP&R and RD&T Funding for the United States

SAFETEA-LU states that all research activities are to include performance measurements and evaluations. The results of research projects should be outcome-based and the utilization of performance measurements will help DOTs select projects with the highest rate of return (FHWA, 2005). As funding for transportation research has seen a major decrease in the last year, it will become imperative for DOT research programs to use performance measurements to quantify their research accomplishments. In the new transportation legislation, it is expected that research funding will be geared to performance based programs.

2.2 Performance Measurements

“Performance measures are assessment data or techniques that strongly, directly, or quantitatively reflect the degree to which the results meet the needs and expectations of the customer.” (Sabol, 2001)

Traditionally, business primarily used performance measurements. Businesses use the results from the performance measurements for evaluations, such as output measures and overall efficiency. Performance measurements maximize outputs and minimize unnecessary costs by monitoring program effectiveness through quantifiable measures. Government agencies set objectives and funds are then allocated based on the needs of those objectives. Evaluating the performance of government agencies is done by measuring the successful completions of the set objectives. Translating the exact performance measurements from businesses, whose main focus is profitability to the public sector whose driving force is satisfying the public can be a challenge. The public sector is being faced with difficulties including resource constraints, restructuring of programs and cutbacks of earmarks. Performance measurements have found their place in the public sector because the now limited resources are being competed for among a variety of agencies and programs (USDOT, 1997).

When evaluating a research program three key areas need to be addressed. These areas are process management, program quality, and program value. Performance measurements are tools that can be used to evaluate a research program in those three areas. According to the NCHRP Synthesis 300, less than half of the States’ DOT Research Programs have formal performance measurements in place for their research programs (Sabol, 2001). The state of New York established, through *Operational Goal 94-8*, the following list of areas that can be evaluated by performance measurements:

- Resources utilization.
- Evaluation of completed work.
- Rate completed work against standards.
- Compare similar projects for efficiency and effectiveness.
- Determine project outputs and performance.

From the list above, managers can then evaluate their programs by ensuring goals are being met, defend present resources, justify additional resources, measure efficiency, and improve performance (USDOT, 1997).

Applying these performance measurements to the research programs of state DOTs will ensure their research results are meeting the needs of the agency. Research programs that are progressive are essential to improve operations, implement new technologies, and keep their

agency at the forefront of the transportation field. A research program that is thriving within an agency will be viewed as a vital asset to the organization. If a research program is not contributing or perceived to be not contributing to its sponsoring agency then it can be viewed as an unnecessary program (Sabol, 2001). An effective DOT research program can produce the following outcomes for the DOT and traveling public:

- Cost and resource savings.
- Innovations.
- Improved safety.
- Improved customer satisfaction.

A viable and productive research program addresses the issues of an agency's transportation system by providing relevant and effective outcomes that have a positive impact. Impacts to the program, agency and transportation system as a whole should be the driving force of DOT research programs. Having research that is completed on-time, within budget, and providing results that the sponsoring agency can benefit from will enhance the transportation system (Sabol, 2001). DOT research programs that use performance measurements that are tied to their strategic goals will ensure their efforts are effective and relevant.

2.3 Technology Transfer

Technology transfer activities are cited in SAFETEA-LU as a means to demonstrate, train, and distribute information about new technologies and research findings from DOT research programs (Williams et. al., 2005). Implementing the findings from research programs is of the utmost importance to maintain a viable and successful research program. Technology transfer activities encourage the results of research projects to be accessible and transferable (Walton et. al., 1999). The following four steps for technology transfer were identified by the TRB Special Report 265:

1. Identify innovative technologies from numerous sources, such as national research programs, state highway research programs, university research, etc.
2. Select and prioritize technologies to be utilized by the state and local highway agencies and the highway industry.
3. Determine, develop, and apply effective technology transfer methods.
4. Continue to modify the technology transfer process in accordance with feedback on which technologies and which methods of technology transfer have been successful.

State research programs can contribute significantly not only to their sponsoring state, but also at the national level. Ensuring that state research programs can easily and effectively make their research results available at the local and national level is crucial for technology transfer. All

state DOT research programs have multiple resources to help promote research findings and new technologies that they produce. The Local Technical Assistance Programs (LTAPs), FHWA, National Research Advisory Committee (RAC), and NCHRP are a few of the resources that state research programs can use to distribute their research findings (Walton et. al., 1999). Another resource that many states are utilizing at the local level is their DOT webpage. A research program that can provide final research reports on the internet will have greater opportunities for technology transfer.

2.4 Chapter Summary

The literature review that was presented in this chapter discusses the funding of surface transportation in the United States and how state research programs are allocated funding. The current transportation bill was originally intended to be enacted until 2009, but extensions have carried the legislation to 2012. The current future of surface transportation funding is uncertain but reductions in earmarking and a greater emphasis in performance based research is likely. Performance measurements will allow DOTs to secure funding for many years to come by insuring they are producing effective and relevant results that advance the transportation community. Utilizing effective technology transfer tools and resources will help DOT research programs to distribute their results and remain a valuable asset for addressing research needs. The following chapter, Chapter 3 Evaluation Methodology, presents a methodology for conducting a performance based evaluation of DOT research programs in a two stage process.

CHAPTER 3 EVALUATION METHODOLOGY

The evaluation methodology presented in this chapter is a two stage process that can be used to evaluate the performance and effectiveness of DOT research programs. Figure 3-1 shows how the evaluation methodology is organized by the two stages.

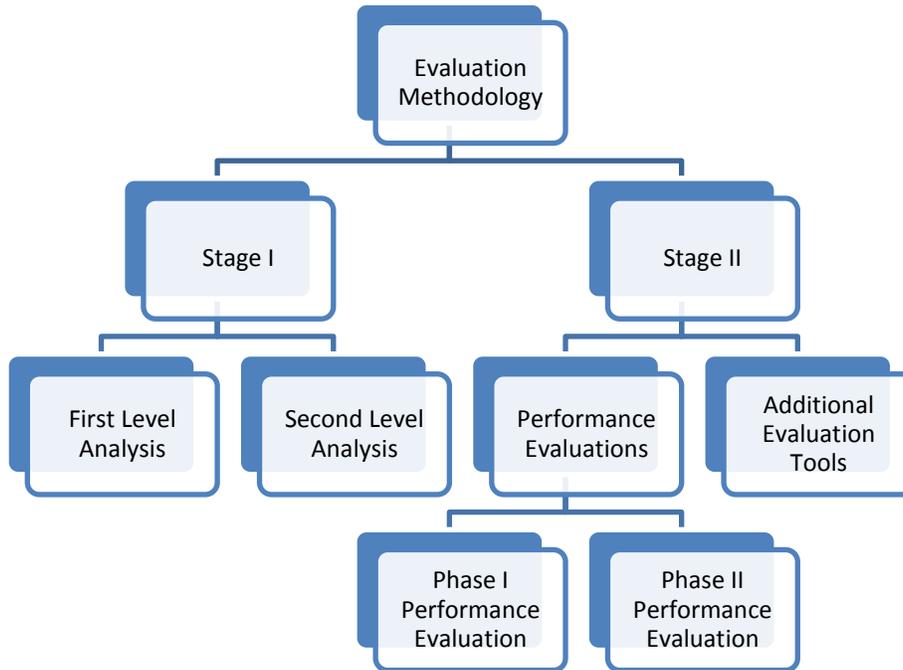


Figure 3-1 Breakdown of the Evaluation Methodology

The stage I methodology includes the first and second level analyses. The first and second level analyses gather the necessary information from the DOT research program to address the performance measures which are described later in this chapter. The stage II methodology includes the performance evaluations and other additional evaluations that DOTs may want to include for the review of their research programs.

3.1 Stage I Methodology

The stage I methodology was developed by Schneider et. al. in “Evaluation of WYDOT’s Research Center and Research Program” in 2008. The methodology was developed for the Wyoming Department of Transportation’s (WYDOT) Research Program. The stage I methodology described in this report generalizes the above methodology for use by any state DOT research program. Changes and additions were added to the original methodology and are described and organized below.

3.1.1 First Level Analysis

The first level of the evaluation involves identifying all projects proposed and funded by the research program. Looking at projects that are not only funded, but are also proposed allows for further analysis to determine the direction that the research program has taken during the identified time period. Identifying the projects for analysis requires a close working relationship with the research program staff. The information they provide is crucial in completing an evaluation of their research program. Typical documents that are provided by the research staff include: annual work programs, minutes from meetings, individual project documents, etc. These documents are then analyzed to obtain relevant information. Some information to be collected includes identifying the following: total funding, the principal investigator, sponsoring organization, research agency sponsor for the project, the project's focus area and sponsoring program, proposed starting date, estimated completion time, and completion date. After this information is collected, the initial analysis can be completed.

After all projects have been identified and the necessary information has been gathered, they need to be grouped for analysis. The first breakdown of the projects is done by project category, which describes the way in which the research was conducted. The different project categories include in-house research, contracted research, and pooled fund studies. The next breakdown of the projects should be by their strategic intent. Some common strategic intent categories for transportation agencies include: infrastructure upgrade, preservation of infrastructure, public affairs, safety, and shared knowledge (Schneider et. al., 2005). When grouping the projects by strategic intent, other categories not listed above may need to be created at the discretion of the principal investigator and the research program.

Once the projects are grouped by project category and strategic intent, summaries need to be completed using the performance measurements that are later identified in this chapter. The summaries will include tables and figures to compare the proposed and funded projects. As stated earlier, comparing the proposed and funded projects shows the funding direction that the research program has taken during the selected time period. The case study of the WYDOT Research Program will show examples of the summaries.

3.1.2 Second Level Analysis

The second level of the analysis indicates the effectiveness and shows the accomplishments of the research program. The second level analysis begins by identifying projects for further detailed analysis. These projects should preferably be started and completed within the predetermined time period. The projects selected should be a good representation of all of the projects identified from the first level analysis, including all types of project categories and strategic intent categories. The first task in the second level analysis is conducting interviews with both the principal investigators and the project sponsors from the DOT or research program.

Collecting information from the completed project files is the next task in this analysis. By conducting the interviews and collecting the additional information from the project files, the effectiveness and accomplishments of the research program can be determined using the criteria given below.

The interviewing process begins with a series of questions pertaining to the proposal process. These questions are intended to determine the initial direction of the project and show what benefits the principal investigator and research program wanted to gain from the project. The following list of questions is asked for the proposal process:

- What is the project's scope?
- What are the objectives of this project?
- How was this research opportunity identified?
- Was a cost/benefit analysis of the project included in the proposal?
- Are the beneficiaries identified in the proposal?
- What were the expected outcomes?
- Would the results of the project be implementable; if so, was an implementation plan included?
- Does the proposal include a technology transfer plan?

In addition to the questions listed above, pooled fund studies also need to address the following questions:

- What states participated?
- Did your agency have a representative on the project advisory board?
- Did your agency have input on the project's proposal?
- If so, what was the nature of the input? (Schneider et. al., 2008)

Both the principal investigator and project liaison from the research program are asked the questions listed above, if applicable. The answers to the questions indicate the agency's involvement with the project's inception; the beginning objectives of the project, the projects expected outcomes, and plans for implementation. Identifying the entity that pursued the project indicates how progressive and reactive the research program personnel are to its agency's needs. Being able to compare how the research program and the principal investigator answer questions pertaining to the objectives and expected outcomes allows discrepancies in the project's direction to be identified.

To determine the accomplishments and relevance of each project, questions pertaining to the final product need to be addressed. The interviewing process for the completed projects is essential in determining if the benefits of the project relate to the mission or goals of the research

program's sponsoring agency. The following list of questions addresses the final outcomes of the project:

- Did the project go according to the proposal? Were there any time or funding extensions?
- Were interim briefings or progress reports provided to the research program?
- Were the proposed objectives achieved?
- Was a final report created?
- Were the results of the project presented in any professional forums?
- Has this research project spawned any additional research?
- How were the results of this project implemented throughout the research program or sponsoring agency?
- Have any other agencies implemented or inquired about the findings of this project?
- Were the benefits identified in the proposal realized?
- Will/were additional phases be proposed under this project?

If the research project was a pooled fund study, the following questions would also be asked:

- Did the research program have a representative who was able to give input on the research during the course of the project and, if so, how?
- Was the research program representative able to review the final report and provide input? (Schneider et. al., 2008)

The questions listed above will be asked to both the principal investigator and research program sponsor of the project, if applicable. Determining if the project went according to the proposal is important to verify that the principal investigator had a good understanding of how the project would be executed. In research, unexpected changes may occur during the course of the project, and how readily the research program is able to react to these changes indicates the versatility of the research program. Looking at the impacts of a research project, not only on the sponsoring agency, but on other transportation agencies, shows how relevant the research project was to current needs within the transportation field. Finding how the results of a project are implemented within the sponsoring agency indicates how effective the project was at meeting its proposed objectives and plan for implementation.

3.1.3 Performance Measurements

The performance measures that are identified in this section of the report summarize and quantify the information that is gathered from the first and second level analyses. The following ten performance measurements for evaluating research programs were developed (Schneider et. al., 2005):

1. Number of projects and amount of funding per project by strategic intent.
2. Number of proposals responding to the research program solicitations.
3. Number of needs statements submitted by the agency's programs.
4. Outcomes of a project: specifications revised, new methodologies implemented, dollars saved/costs avoided, facilities with extended life, crashes reduced, fatalities reduced, new products evaluated and implemented, policy/legislative impacts, etc.
5. Number of research reports completed each year and number of research reports not completed within three years.
6. Cost-benefit analysis for individual projects.
7. Cost-benefit analysis for the program.
8. Percentage of administrative costs to overall program funding.
9. Funds requested by research community versus funds available.
10. Percentage of projects completed on-time and within budget.

The performance measurements listed above are a way to organize the findings of the research program evaluation methodology. These performance measurements are effective tools when evaluating the efficiency, direction and accomplishments of the research program. The first performance measurement is an overall indication of the direction in which the research program is moving. Performance measurements two and three show how responsive the research program is to needs of its in-house programs and how willing its programs are to utilize their research program. The project outcomes are summarized in performance measurements four and five; they show which projects resulted in relevant and implementable products, new knowledge, or standards for the DOT. Performance measurements six and seven look at cost-benefit analysis for both projects and the overall system. Placing benefits on research projects can be challenging, so performance evaluations were developed to address this issue and are presented in the stage II methodology. The administrative costs are evaluated in performance measurement eight and are a check for the research program to ensure the greatest return on investment for the research program as a whole. Performance measurement nine allows the research program to fiscally plan ahead and try to meet their proposed research needs. The final performance measurement, performance measurement 10, is an internal check to identify research projects that are not completed in a timely manner, as well as projects that meet their proposed budgets and time lines.

The performance measures presented in this report are designed to give a good indication of the effectiveness of the research program and the projects that it funds. Although some research programs may require additional performance measurements to meet their individual needs, the ten performance measurements presented above are a solid foundation for evaluating DOT research programs.

3.2 Stage II Methodology

The stage II methodology addresses performance measurements six and seven, dealing with the cost-benefit of the individual projects and the overall program. The report, “A Methodology for Evaluating DOT’s Research Programs, A Case Study: Wyoming DOT” recommended that the DOT research programs follow the methodology for the cost-benefit analysis of research projects presented in the NCHRP report “Performance Measurement Tool Box and Reporting System for Research Programs and Projects.” The cost-benefit analysis that is presented for research projects in the NCHRP report is a great tool for research programs to quantify and analyze the safety or cost avoidance effects of research projects, but not all research projects within DOTs address those topics. Therefore, this study created performance evaluations to address all of the research projects that are conducted by DOT research programs.

This section will discuss performance evaluations that quantify completed projects conducted by state DOT research programs. A two phase evaluation will be completed for each project at the initial competition date as well as two years after completion. Performance measurements six (cost-benefit analysis for individual projects) and seven (cost-benefit analysis for the program) are addressed by these performance evaluations. The performance evaluations are designed to place a grade or level of success on completed projects by looking at the execution of the project and how the results of each project have impacted the DOT. The first phase of the performance evaluation focuses on how the project was executed and how the project’s results could potentially be implemented. The second phase of the performance evaluation focuses on the project’s impact on the DOT, the cost-benefit of the project, as well as impacts to outside agencies. Both evaluation forms will be completed by the sponsoring employee from the DOT, and some assistance from the research program may be required.

3.2.1 Developing Performance Evaluations

The performance evaluations are designed to gauge the success of the individual projects and the success of the research program as a whole. The process for developing a performance evaluation can be used for both the phase 1 and phase 2 performance evaluations. Developing the performance evaluations is a seven step process that will be explained in detail in this section.

Determining the exact evaluation criteria that will be included is the first step in developing the performance evaluation. The criteria to be included for the evaluation should be selected by the research program manager and staff in conjunction with the principal investigator, who is preparing the performance evaluation. The following list of evaluation criteria shows possible areas that could be included for performance evaluations and is from the NCHRP report “Performance Measurement Tool Box and Reporting System for Research Programs and Projects”:

- Projects completed within budget.
- Projects completed on time.
- Projects/products implemented.
- Level of increased knowledge.
- Technology transfer activities.
- Quality of final research reports.
- Return on investment or benefit-cost ratio.
- Construction, maintenance, & operations cost savings.
- Reduction in crashes Lives saved.
- Reduction in system delays.
- Contribution to the overall mission of the department.
- Management & policy improvement.

Selecting the proper criteria for the performance evaluation is completed by the research program and principal investigator. Selecting the appropriate measures will ensure the areas of interest or concerns for the research program and DOT are addressed. After the evaluation criteria have been identified and selected, they are to be ranked by order of importance. The research program and principal investigator will determine the ranking for each of the criteria measures selected, using a simple ranking system such as 1, 2, or 3, with 1 being the most important. Once the rankings have been designated for the selected criteria, the principal investigator can begin creating the evaluation form. The evaluation form can be created in Microsoft Excel as this is a well-known program used by most DOT agencies. A weighting system is determined based on the ranking or importance of each criterion. After a performance evaluation process and form have been developed, a test run of sample of projects will refine the evaluation process and the weightings of the criteria. Figure 3-2 shows the entire process from identifying the performance criteria to implementing the performance evaluation process.



Figure 3-2 Development of the Performance Evaluations

3.2.2 Differences in Phase 1 and Phase 2 Performance Evaluations

As stated earlier in section 3.2, a two phase performance evaluation is recommended for DOT research program projects. The two phase evaluation is required to assess multiple aspects of the project from initial expectations such as level of implementation at the completion of the project to the actual level of implementation two years after completion. Looking at how projects are expected to perform within the DOT and how they actually perform within the DOT is important.

This section will discuss the differences between the two recommended phases for the performance evaluations. Both of the phases follow the performance evaluation process that was developed in the previous section.

The goal of the first phase of the performance evaluation is to quantify the execution of the project, identify the potential applications of the results that the DOT can utilize, and assesses the overall success of the project. The phase 1 performance evaluation needs to be conducted at the completion of the project. The DOT employee who sponsored the project is primarily responsible for the completion of the phase 1 performance evaluation. The research program staff will assist in completing this phase when needed. The performance evaluation should be easy to complete by the sponsoring employee, and then easily interpreted by the research

program staff for evaluation and grading. The following areas of interest are suggested for inclusion in the first phase performance evaluation:

- Project's completion in relation to proposed timeline.
- Project's completion in relation to proposed budget.
- Expected level of future implementation.
- Fulfillment of proposed objectives.
- Technology transfer activities.
- Quality of the final report.

The second phase of the performance evaluation is intended to quantify the actual impacts the project's results had on the operations of the DOT, impacts to outside agencies, and a benefit-cost analysis. The phase 2 performance evaluation should be completed two years after the project has been completed. Evaluating the project two years after the completion date will allow enough time for any implementation within the DOT as well as quantification of the benefits associated with the implementation. The DOT employee who sponsored the project should complete this evaluation with the help of the research program. This performance evaluation is a longer process, compared to phase 1, as a benefit-cost analysis and more detailed explanation are included. As research projects have varied outcomes, not all projects will have results applying to construction, maintenance, safety-related, and user costs, therefore a benefit-cost analysis cannot be used on such projects. The following areas of interest are suggested to be included in the second phase performance evaluation:

- Contributions to the overall DOT mission statement and strategic goals.
- Actual level of implementation within the DOT.
- Benefit-Cost analysis.
 - Return on investment or benefit-cost ratio.
 - Construction, maintenance, & operations cost savings.
 - Reduction in crashes and lives saved.
 - Reduction in system delays.
- Impacts of project results to outside agencies.

3.3 Chapter Summary

The methodology presented in this chapter can be used by DOT research programs to evaluate research projects as well as the research programs as a whole. The stage I methodology that was described in this chapter looks at the research program as a whole using the ten developed performance measurements. Multiple aspects of a research programs performance are evaluated including: the type of projects being funded and the resulting outcomes, the number of research

projects completed each year, overall administrative costs of the program, total funding versus funds available, and the number of projects completed within their timeline and budgets. The stage 2 methodology that was described in this chapter can be used to determine the effectiveness and relevance of research projects to their sponsoring agency. The performance evaluation process that was developed will allow DOT research programs to quantify their research projects and their overall research program. The evaluation methodology will be demonstrated as a case study on WYDOT's Research Program in the following two chapters, Chapter 4 and Chapter 5. The stage I methodology is presented in Chapter 4, while the stage II methodology is presented in Chapter 5.

CHAPTER 4 IMPLEMENTATION OF THE STAGE I METHODOLOGY

4.1 Introduction to the WYDOT Research Program

The WYDOT Research Center is a unique program, in that it is flexible and able to easily act on research projects as they are brought forth. The research program funds over one million dollars in research projects annually. With less than 10 percent of the budget going to administrative costs, the WYDOT research program is able to direct most of its funding towards research projects. The research program has a Research Advisory Committee (RAC) which meets four times each year and votes on which proposed projects to fund. When selecting the projects, the RAC's main goal is to fulfill the mission statement of WYDOT. The mission statement is as follows:

“To enhance the economic well-being and quality of life in Wyoming by working with public and private partners to produce a safe and efficient transportation system”

4.2 First Level Analysis

The evaluation began by identifying all research projects that were proposed and funded during the 2005-2010 time period. The research program has kept very detailed and organized minutes from every RAC meeting over the last decade. All of the proposed and funded projects, including their requested funding, amendments, WYDOT sponsors, sponsoring organizations, principal investigators, estimated project durations, and final decisions on the projects were obtained from the RAC minutes. A total of 65 proposals, requests for increased funding and pre-proposals were identified for this analysis. The list of identified projects can be found in Appendix A1. Proposals refer to research projects that are being proposed to the RAC. Requests for increased funding refer to any additional funding requests for existing research projects. Pre-proposals are used by the RAC to identify research topics that WYDOT may want to pursue. If the pre-proposal is accepted by the RAC, then the principal investigator is able to present the topic as a full proposal at a later meeting. Table 4-1 is a summary of the number of projects by type of projects and in which year, from 2005 to 2010, the projects were brought forth to the RAC.

Table 4-1 Breakdown of Project Types Proposed to the RAC

Project Type	2005	2006	2007	2008	2009	2010	Totals
Proposals	10	12	6	8	5	9	50
Approved Proposals	8	10	6	7	5	8	44
Proposals w/ Amendments	4	0	1	2	0	2	9
Requests for Increased Funding	1	1	3	1	2	2	10
Approved Increased Funding	1	1	1	3	1	1	8
Requests for Increased Funding with Amendments	0	0	1	0	0	0	1
Pre-proposals	0	0	1	3	1	0	5
Approved Pre-Proposals	0	0	1	3	1	0	5
Pre-proposals w/ Amendments	0	0	0	3	0	0	3
Total Projects for Analysis =							65

Table 4-1 shows that 44 out of 50 proposals and 8 out of 10 requests for increased funding were approved by the RAC for the specified time period. Out of the five pre-proposals approved shown in Table 4-1, two were later presented as full proposals and three out of the five did not advance as research proposals. After the initial projects were identified, they were grouped by strategic intent categories and were then summarized by the corresponding performance measurements. The summaries of projects by specific groupings are presented with the associated performance measurements in Section 4.4.

4.3 Second Level Analysis

Out of the 65 identified projects from the first level analysis, 21 completed and on-going projects were selected for the second level analysis. The list of projects selected is presented in Appendix A2. In this group of 21 projects, 15 were contracted research projects, 5 projects were pooled fund studies, and 1 project was an in-house research project. Contracted research projects are research projects that are contracted out to principal investigators outside of WYDOT, pooled fund studies are collaborative efforts completed amongst multiple states, and in-house research projects refer to research projects that are completed internally within the DOT. The projects encompassed a wide variety of WYDOT Programs including, Bridge, Construction, Geology, Maintenance, Materials, Planning, Safety, and Traffic. After identifying the projects, interviews were conducted with both the principal investigators and WYDOT project sponsors. The questions listed in the methodology section were asked during the interviews. The project interviews resulted in information on the benefits these projects had for WYDOT as a result of implementing research findings. All but 1 of the 21 projects identified for the second level analysis have completed project summaries from conducting the interviews. Figure 4-1 shows

a project summary from the second level and the typical information that was gathered from the RAC meeting minutes, and interviews with WYDOT sponsors and the principal investigators.

In-House Research Project	RS01(206) Characterization of WY Hot Mix Asphalt with the Hamberg Wheel-Tracking Device (HWTD)
Background Information	
Project Category	Standards
Funds Obligated/Expended	\$120,000/\$69,013
WYDOT Program	Materials
WYDOT Sponsor	Vicki Bonds
Started	November, 2005
Completed	October, 2006
Participants	WYDOT
Objectives	
<ul style="list-style-type: none"> • Predict the effects of stripping in asphalt mixes in addition to rutting using the HWTD. • Verify that the results of the Hamberg device are representative of the results observed in the field. • Prepare a formal operating procedure and formulating guidelines for Wyoming Asphalt mixes. 	
Execution and Performance	
<ul style="list-style-type: none"> • The project was able to meet 2 out of 3 objectives using \$69,012.50 of the \$120,000 proposed budget, additional research is on-going. 	
Project Outcomes	
<ul style="list-style-type: none"> • The calibration of field cores and lab mixed samples was inconclusive; replacing the current TSR specifications with the Hamberg specification is premature. • A tentative guideline for future research was developed. 	
Recommendations	
<ul style="list-style-type: none"> • Current testing and further data collection is being conducted internally in the materials office to make recommendations for future specifications. • The HWTD is an effective tool for the WYDOT materials department and further internal and external research with Texas DOT. 	
Implementation	
<ul style="list-style-type: none"> • The Hamberg Wheel-Tracking Device is being used in the WYDOT materials lab to collect further data. Eventually, specifications for the HWTD will be created for WYDOT after sufficient data has been collected and analyzed. 	
Level of Implementation	
<div style="display: flex; justify-content: space-around; width: 100%;"> None Partial Full </div>	

Figure 4-1 Project Summary from the Second level Analysis

As shown in Figure 4-1, each project summary includes information pertaining to the project objectives, project execution and performance, project outcomes, recommendations, and implementation. The level of implementation is shown and is segmented into 3 groups: none, partial and full. Projects are categorized into these groups based on their level of implementation within WYDOT based on the recommendations and outcomes of each project. All of the completed project summaries can be seen in Appendix B.

From the project summaries, observations were made based on the three project types; in-house research, contracted research, and pooled fund studies. Comparisons between level of implementation and completion with respect to the proposed budget and timeline were made according to project type. Figure 4-2 shows the number of projects for each level of implementation as determined from the project summaries.

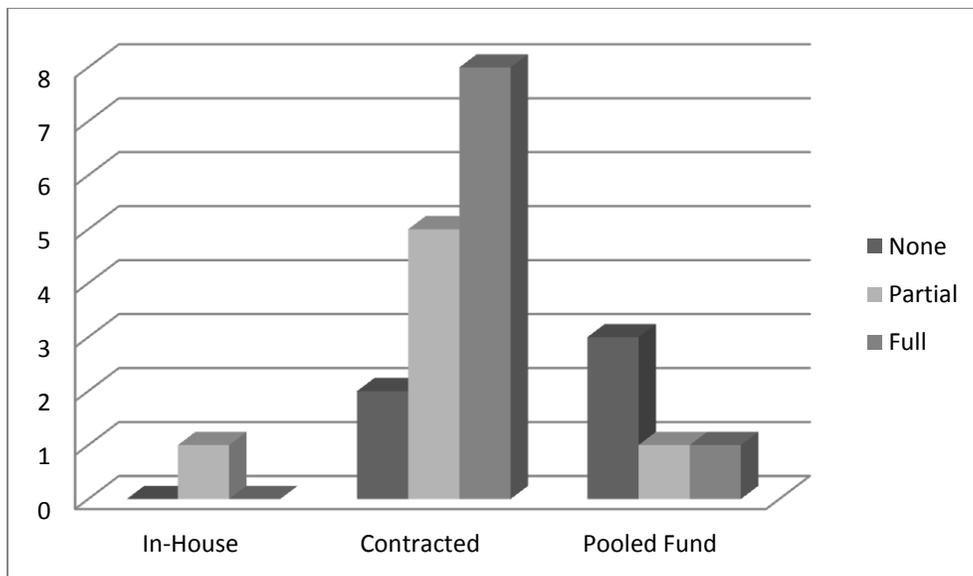


Figure 4-2 Level of Implementation by Project Category

Out of the 15 contracted research projects that were identified for the second level analysis, 8 projects had full implementation, 5 projects had partial implementation, and 2 projects had no implementation. The pooled fund study projects have 3 out of 5 projects with no implementation and 1 project in both the partial and full implementation category. The single in-house research project had partial implementation. (It is noted that most of the pooled fund studies are still ongoing, and the level of implementation for these projects refers to the level of implementation that is expected by the sponsoring WYDOT employee, once they have been completed).

4.4 Evaluation Based on Performance Measurements

This section summarizes the findings of the various performance measurements selected for evaluating WYDOT's Research Program. The information that was used to complete these performance measurements came from the first and second level analyses. Conclusions will be given under each performance measurement and general conclusions and recommendations for the research program will be presented in Chapter 7.

4.4.1 Number of Projects and Amount of Funding per Project by Strategic Intent

A total of six strategic intent categories were selected for this evaluation and are as follows: Infrastructure Upgrade, Preservation, Public Affairs, Safety, Shared Knowledge, and Wildlife Studies. The information for this performance measurement is from the summaries of the 65 projects that were identified from the first level analysis. The number of projects, as well as their funding, for projects that were both proposed and funded is shown in Figure 4-3 and Figure 4-4.

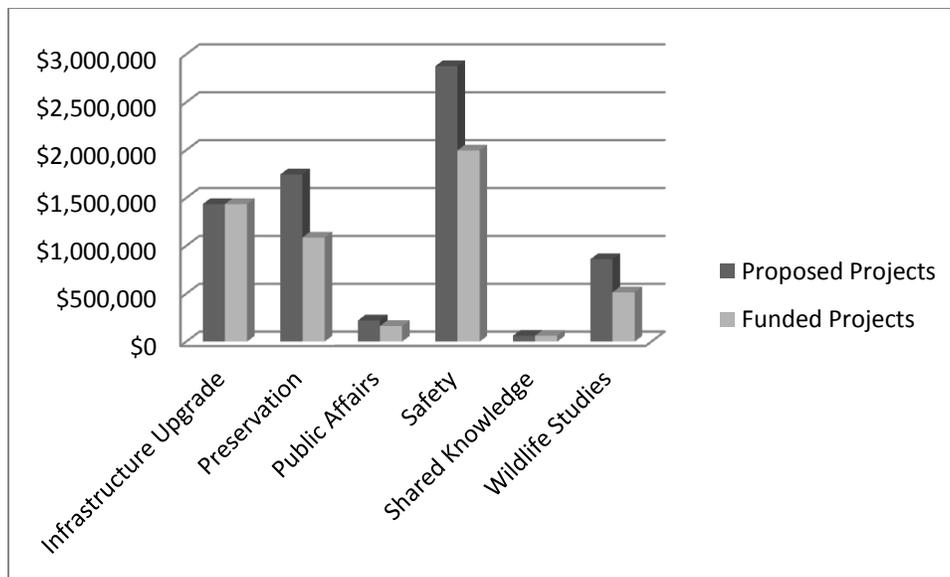


Figure 4-3 Funding by Strategic Intent

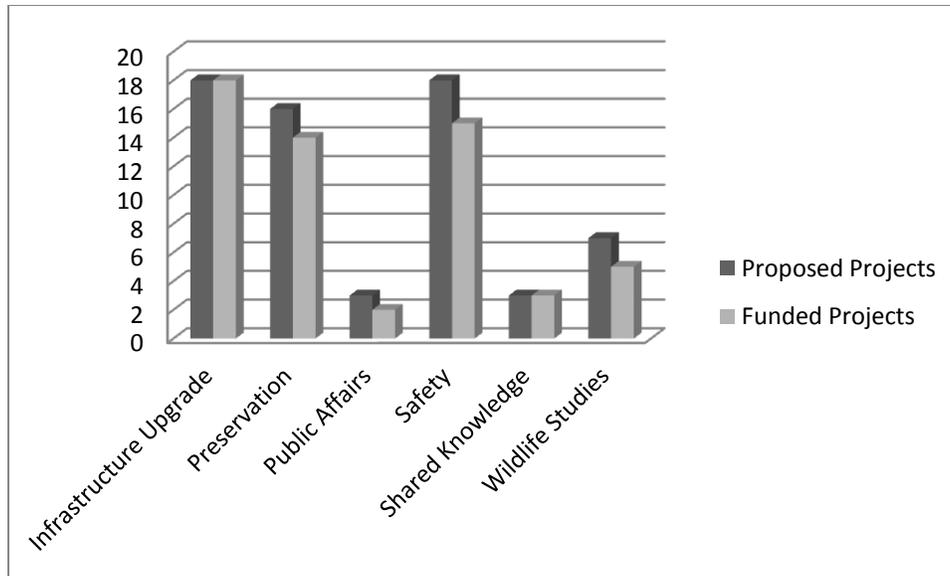


Figure 4-4 Number of Projects by Strategic Intent

Figure 4-3 and Figure 4-4 show the projects that were proposed and funded by the different strategic intent categories. Safety is the largest category for both proposed and funded projects, which is consistent with the overall mission statement of WYDOT. Infrastructure upgrade and preservation are also highly funded projects, and these activities also directly relate to the WYDOT mission. A separate category for wildlife studies was also created due to the large number of proposals that had some relationship to wildlife. The wildlife studies projects included the following; vehicle-wildlife crashes, wildlife monitoring systems, and wildlife underpass structures.

4.4.2 Number of Proposals Responding to Research Program Solicitations

The in-house and pooled fund study projects were not included in this PM as in-house projects come directly from WYDOT and currently no pooled fund projects are being led by WYDOT, therefore only contracted research projects were reviewed for this PM, for a total of 15 projects. It was determined that 9 out of 15 contracted research projects in the second level analysis were solicited by WYDOT. WYDOT has a majority of their contracted research projects being solicited from within the agency. The WYDOT Research Program meets the needs of many WYDOT programs by completing research projects in accordance with those solicitations.

4.4.3 Number of Needs Statements Submitted by the Agency's Programs

The programs within WYDOT are involved with research and are willing to work on research projects. All projects that are presented to the RAC must have a WYDOT sponsor to help coordinate between the principal investigator and WYDOT to ensure the project remains on scope to obtain relevant and beneficial results for WYDOT. Figure 4-5 and Figure 4-6 show which programs within WYDOT are proposing and sponsoring projects.

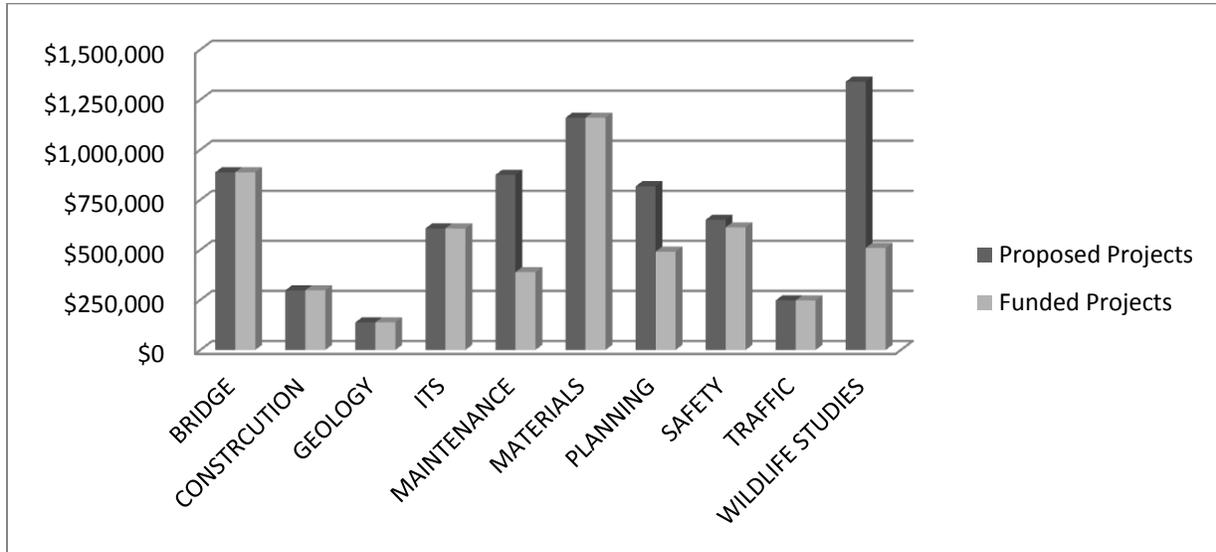


Figure 4-5 Funding by WYDOT Program

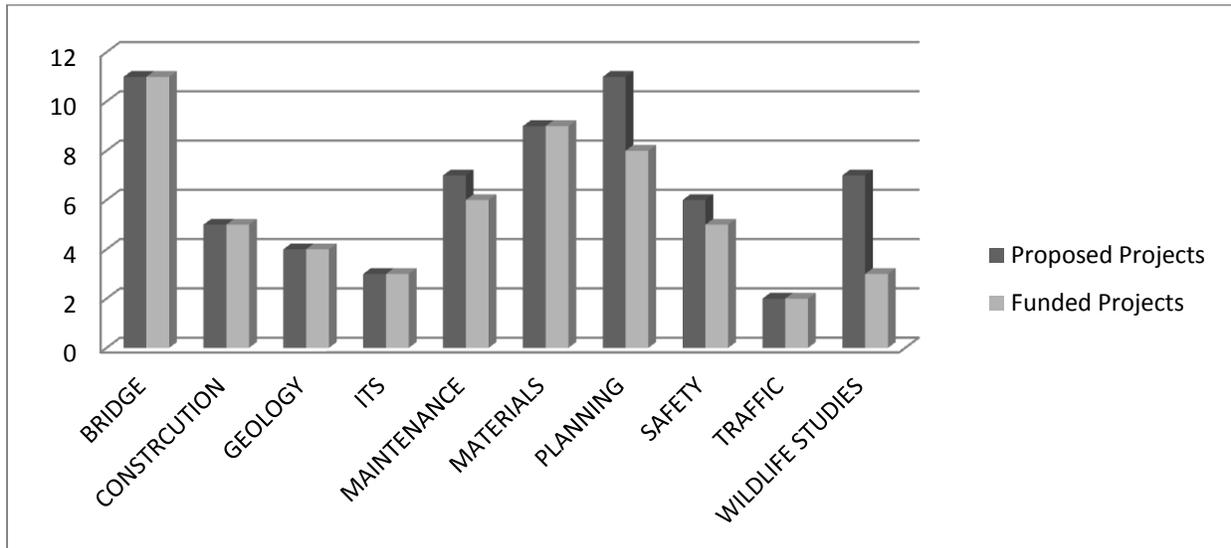


Figure 4-6 Number of Projects by WYDOT Program

Although wildlife studies is not a program within WYDOT, it was separated to show how many projects and the amount of funding that has been proposed and funded compared to the other

actual WYDOT programs. Most programs within WYDOT sponsor projects that will have an impact on the organization and therefore most of their proposed projects are funded. The safety program appears to have substantially less projects proposed and funded in these summaries, but these figures only pertain to the sponsorship of each project not the strategic intent of the project. For example, the bridge program may sponsor a safety related project.

4.4.4 Outcomes of the Research Projects

All of the projects identified for the second level analysis were used to complete this performance measurement. The outcome categories that were selected for this study include knowledge, products, and standards. The categories were left very broad as this study is concerned with whether or not the results of the projects are relevant, beneficial, and implementable for WYDOT. Figure 4-7 and Figure 4-8 show the 21 projects from the second level analysis by outcome category and the number of projects and funding based on the level of implementation.

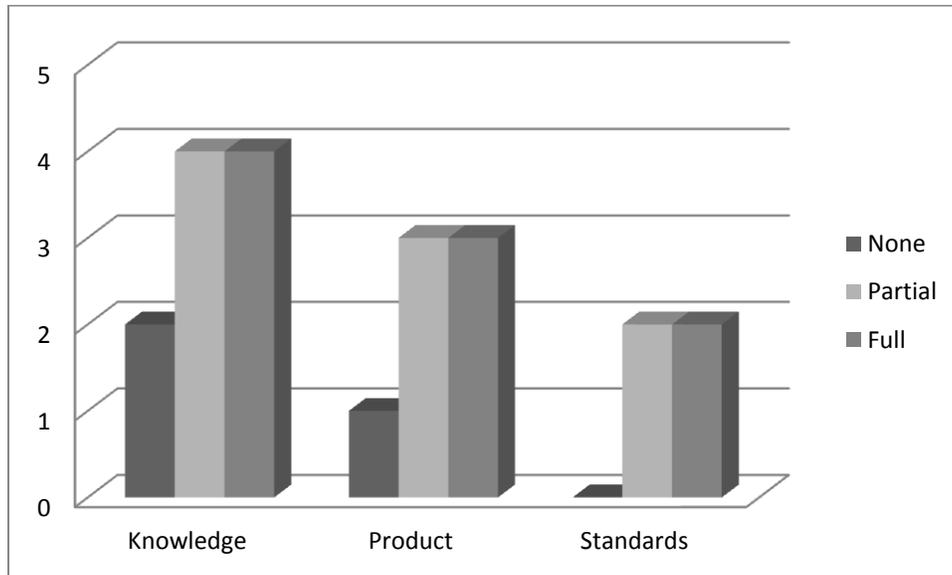


Figure 4-7 Level of Implementation by Project Outcome

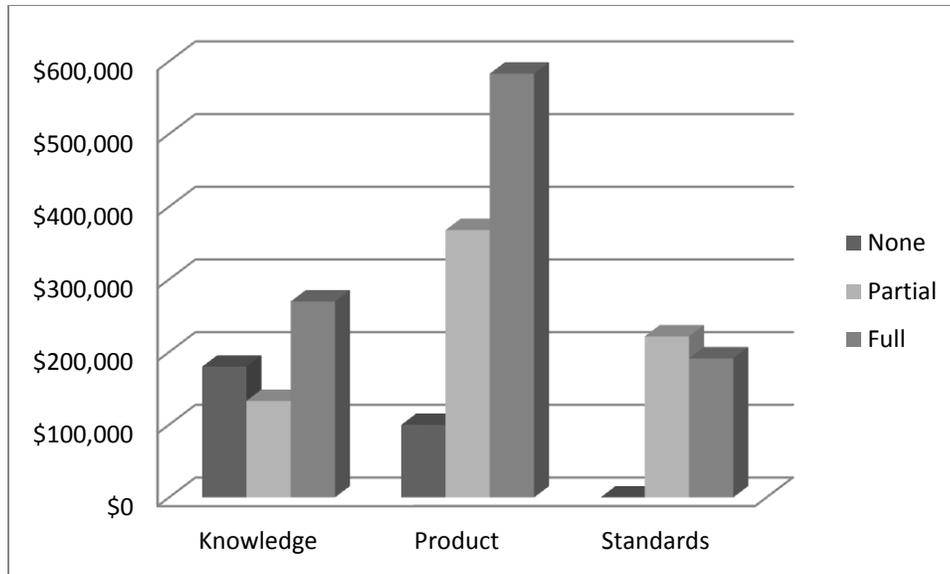


Figure 4-8 Level of Implementation by Funds Proposed by Project Outcome

All Projects that have outcomes concerning standards have some level of implementation. Proportionally, the projects resulting in products and standards have similar levels of implementation. Overall, a high level of implementation is seen across the different project outcome categories, but projects resulting in knowledge have an overall lower level of implementation. The RAC may want to look at ensuring that projects that have knowledge based outcomes have project objectives that result in products, standards, specifications, etc., based on the gained knowledge from the project. By clarifying the results that are expected with projects resulting in knowledge, a higher level of implementation may be achieved within WYDOT.

Out of 21 projects that were evaluated using the second level analysis, 10 of those projects resulted in new knowledge. The knowledge category includes specifications, design guidelines, product performance, product evaluation, etc. Eight of these projects' results are being utilized either fully or partially throughout WYDOT, and two of the projects have received inquiries from other external agencies. Only one project in the knowledge category has spawned additional research.

Seven projects out of the 21 projects selected for the second level analysis resulted in some type of product. These products include software, ITS programs for variable speed limits, avalanche monitoring systems, etc. All of the projects that resulted in a product are currently in use by WYDOT, except one. Also, all of the products that have been developed have been of interest to many transportation and private organizations. WYDOT is not only fulfilling their needs within the research community, but they are completing projects that are relevant to many different organizations. Two of these projects have spawned additional research that is currently on-going with WYDOT.

Four of the projects out of the 21 projects selected for the second level analysis resulted in the new standards category. These standards include different categorizations for materials, methods for treating pavement deterioration, and safety evaluations for local governments. All four projects results are currently being used to some extent by WYDOT and local governments around Wyoming. One of these projects has spawned additional research.

In general, all of the projects WYDOT has sponsored that were evaluated in second level analysis had results that are implementable and relevant to WYDOT. A total of 16 projects out of the 21 projects that were selected for the second level analysis are completed and have submitted final reports to WYDOT; the 5 projects that are still on-going are all pooled fund studies. Out of the 16 projects that are completed, 11 were presented in professional forums from the Transportation Research Board Conference to The International Snow Science Workshop. All of the completed projects are presented to the RAC and are often presented to the sponsoring programs within WYDOT. When the projects were not successful or had results that were not implemented within WYDOT, the reason was often attributed to miscommunication with respect to the direction of the project between the principal investigator and WYDOT. It is recommended that if the WYDOT sponsor is not able to fully commit to the project, then another sponsor should be identified or the future of the project with WYDOT should be discussed. If the direction of a project begins to shift from the expected direction that WYDOT has envisioned for the project, then meetings should be called with the principal investigator, the WYDOT Research Program, and the WYDOT sponsor to discuss options to get the project back on track.

A total of five pooled fund studies were examined for in-depth second level analysis. Out of these five pooled fund studies, three seem to be perpetual “research programs” with no foreseeable end. These pooled fund studies are a good tool to get large projects completed, but transportation agencies such as WYDOT should be cautious before committing to such projects. Some portions of these pooled fund studies are relevant and would be effective for WYDOT, but other portions may not be applicable to WYDOT or Wyoming in general. In an activity report submitted to the RAC by the “Clear Roads: Research For Winter Maintenance” pooled fund study, it was stated that a total of eight research projects were selected but that only two of those eight projects were identified to have direct benefits for WYDOT. These research projects are proposed to the RAC and are given budgets and time lines, but increased funding and time extensions are common for pooled fund studies. To ensure that the pooled fund studies are relevant for WYDOT, a Pooled Fund Extension Form was created. The form can be seen in Appendix C. The pooled fund extension form can be used by the WYDOT sponsors to easily justify, to the RAC, additional funds and time extensions for pooled fund studies. The following questions are asked on the Pooled Fund Extension Form:

- What products /knowledge /policies /etc. have resulted from this project?
- How have these results been implemented throughout WYDOT?

- If these results have not been implemented, what obstacles are being faced?
- What are the expected outcomes if additional funding and time is approved?
- Is a plan for implementation throughout WYDOT being developed or has one been developed?

In addition to the questions that will be addressed above, the project history including original funding, any funding extensions, original proposed timeline, and any additional time that was approved by the RAC should be addressed. This form will allow the RAC to determine which pooled fund studies are having or will have the greatest benefit for WYDOT.

Table 4-2 shows the amount of funding per year that is spent on pooled fund studies versus the overall WYDOT Research Center budget.

Table 4-2 Funds Obligated per Year for Pooled Fund Studies vs. Research Program Budget

	2005	2006	2007	2008	2009	2010	2011	Averages
Pooled Fund Studies	\$170,000	\$108,000	\$170,000	\$297,000	\$85,000	\$140,000	\$140,000	\$158,571
Overall Research Budget	\$923,795	\$1,061,660	\$559,716	\$628,172	\$1,212,314	\$1,375,280	\$1,359,808	\$1,017,249
Percent Pooled Funds	18.4%	10.2%	30.4%	47.3%	7.0%	10.2%	10.3%	19.10%

As shown in Table 4-2, WYDOT spends an average of approximately 19 percent of their budget for pooled fund studies. In 2007 and 2008, the funds for the pooled fund studies jumped to 30 and 47 percent of the overall budget, respectively. The large increase was due to the funds already being obligated for those years, but the overall budget was substantially less. The research budget depends on federal funding each year as discussed in Chapter 2. WYDOT's Research Center and the RAC should allocate funds, as needed, on a yearly basis to allow for unforeseen budgetary problems as experienced in 2007 and 2008.

4.4.5 Number of Research Reports Completed Each Year

Out of the 21 projects from the second level analysis, all but 2 of the contracted research and in-house projects were completed within their proposed time lines. The two projects that went over their allotted time lines were given extensions due to unforeseen circumstances. One project was not able to acquire the proper permits from the United States Forest Service, and the weather did not allow completion for the other project.

In the first level analysis only two projects out of 65 had timelines lasting over three years, and a total of two contracted projects had not completed their projects on time. The pooled fund studies all went over their initial proposed time lines and budgets.

4.4.6 Cost-benefit Analysis for Individual Projects and the Research Program

The cost-benefit analysis for the research projects and the Research Program were completed using the performance evaluations and are presented in the following chapter, Chapter 5.

4.4.7 Percentage of Administrative Costs to Overall Program Funding

The WYDOT Research Center has only one full time employee, the research manager. This unique organization allows for the administrative costs to be kept low. Table 4-3 shows the administrative costs for the overall program funding.

Table 4-3 Total Funds Directed to Administrative Costs per Year

	2005	2006	2007	2008	2009	2010	2011	Averages
Administrative Costs	\$16,360	\$69,433	\$103,993	\$81,877	\$118,183	\$118,642	\$118,642	\$89,590
Overall Research Budget	\$923,795	\$1,061,660	\$559,716	\$628,172	\$1,212,314	\$1,375,280	\$1,359,808	\$1,017,249
Percent Admin. Costs	1.8%	6.5%	18.6%	13.0%	9.7%	8.6%	8.7%	9.57%

In the year 2005, approximately two percent of the budget went to administrative costs, while the succeeding years show a higher cost. This is due to changes in accounting practices by WYDOT. Employee salary and benefits are included in years 2006-2011, while 2005 only had department overheads. The last three years, 2009-2011, show the administrative costs are below 10% and remain constant.

4.4.8 Funds Requested by the Research Community Versus Funds Available

The RAC has been given a unique opportunity within the research community. They were instructed that if funding for research projects is exhausted and a promising and needed research project were to arise, that funding could be made available. This ensures the RAC does not have to pick and choose between relevant and possibly beneficial research projects for WYDOT. Tables 4-4 and Table 4-5 illustrate the funds proposed and funded for all strategic intent categories and project types for research projects from 2005- 2010.

Table 4-4 Summary of Proposed Projects from 2005-2010

Project Area	Total Requested Funding				Total Number of Requested Projects			
	Contract	Pooled Fund	In-house	Total	Contract	Pooled Fund	In-house	Total
Infrastructure Upgrade	\$742,147	\$575,000	\$120,000	\$1,437,147	7	10	1	18
Preservation	\$1,354,300	\$392,000	\$0	\$1,746,300	8	8	0	16
Public Affairs	\$220,972	\$0	\$0	\$220,972	3	0	0	3
Safety	\$2,644,705	\$232,500	\$0	\$2,877,205	16	2	0	18
Shared Knowledge	\$61,150	\$0	\$0	\$61,150	3	0	0	3
Wildlife Studies	\$860,549	\$0	\$0	\$860,549	7	0	0	7
Totals	\$5,883,823	\$1,199,500	\$120,000	\$7,203,323	44	20	1	65

Table 4-5 Summary of Funded Projects from 2005-2010

Project Area	Total Approved Funding				Total Number of Approved Projects			
	Contract	Pooled Fund	In-house	Total	Contract	Pooled Fund	In-house	Total
Infrastructure Upgrade	\$742,147	\$575,000	\$120,000	\$1,437,147	7	10	1	18
Preservation	\$695,450	\$392,000	\$0	\$1,087,450	7	7	0	14
Public Affairs	\$162,972	\$0	\$0	\$162,972	2	0	0	2
Safety	\$1,764,287	\$232,500	\$0	\$1,996,787	13	2	0	15
Shared Knowledge	\$61,150	\$0	\$0	\$61,150	3	0	0	3
Wildlife Studies	\$514,849	\$0	\$0	\$514,849	5	0	0	5
Totals	\$3,940,855	\$1,199,500	\$120,000	\$5,260,355	37	19	1	57

Table 4-4 and Table 4-5 represent all 65 of the projects that were analyzed in the first level analysis. As shown, the total amount of funding proposed was \$7,230,323 and the total amount funded was \$5,260,355. All pooled fund studies and the one in-house research project were funded in that time period. Nearly 85 percent of the contracted research projects were also funded. From 2005-2010, all of the funds that were approved never exceeded the allotted budget. A small surplus was generally carried over to the next fiscal year. WYDOT is able to utilize the majority of their research dollars each year, as the program is the appropriate size for the funding allotted to the program compared to the research projects proposed.

4.4.9 Percentage of Projects Completed On-time and Within Budget

Figure 4-9 shows the percentage of projects that were completed on time and within budget for each of the project categories. As shown, out of the 15 contracted research projects, 87 percent were completed within their proposed timeline, and all of the projects were completed within their proposed budget. Out of the 5 pooled fund studies, none were completed within their proposed timeline and 40 percent were completed or still on-going with their proposed budget.

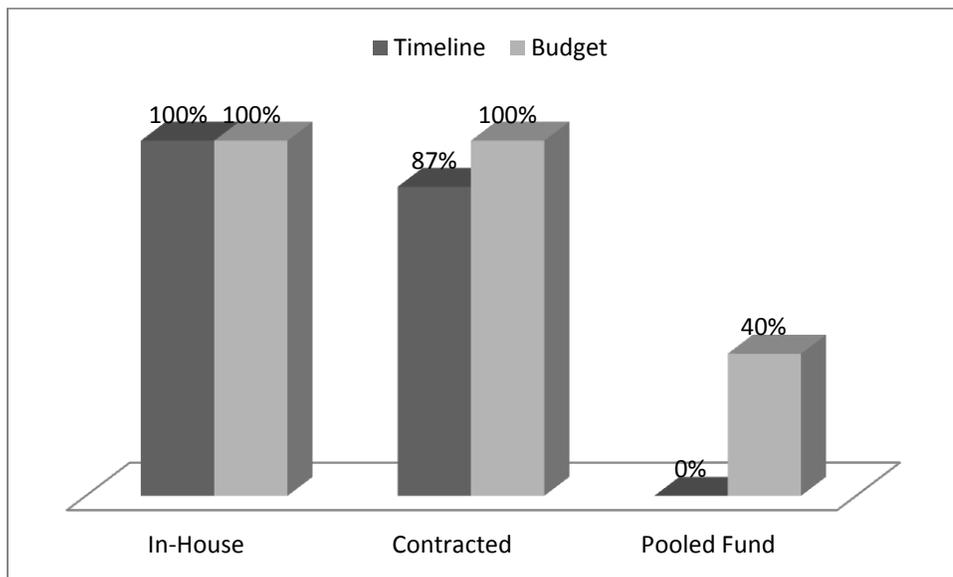


Figure 4-9 Percentage of Projects Completed on time and on Budget

4.5 Chapter Summary

The WYDOT Research Center is an effective and productive program, which accomplishes relevant projects that support WYDOT’s overall mission. The program is able to fund a variety of projects that benefit the traveling public, its employees, and the transportation research community. The organization of the research program allows it to remain flexible and proactive

when addressing changing research projects as they evolve throughout their life cycle. Research projects involving any aspect of safety have been one of the most numerous and funded project categories. WYDOT as a whole values and understands the importance of research as 60 percent of all projects were solicited from within. The outcomes and results of WYDOT's research projects are beneficial and implementable not only to WYDOT but the transportation community. Overall conclusions and recommendations for the WYDOT Research Program will be presented in Chapter 7.

CHAPTER 5 STAGE II METHODOLOGY

The WYDOT Research Program currently has no means to assess the performance of completed research projects. After research projects are completed and closed with the research program, the final reports are distributed to multiple research agencies and the project files are closed and archived. Performance measurements 6 and 7 from the stage I methodology were designed to determine the cost-benefit of projects and the research program, but placing a value or benefit on research can be difficult. Not all research projects have results that lead to cost avoidance, reduction in fatalities, or time savings, i.e. quantifiable benefits. Being able to evaluate projects based on selected criteria for all projects will allow for the research programs to determine the effectiveness and relevance of their funded research projects. Two performance evaluations were developed by this study to address individual projects and the research program as a whole. The phase 1 performance evaluation will be conducted at the completion of the research project and the phase 2 performance evaluation shall be conducted two years after the project has been completed. Components of a cost-benefit analysis are included in these evaluations, but a broader evaluation relating to actual project performance is achieved. This chapter will demonstrate how the performance evaluations were created for the WYDOT Research Program and how the WYDOT Research Program can attain full implementation for the performance evaluations.

5.1 Identifying and Selecting the Performance Criteria

Identifying and selecting the performance criteria was one of the most crucial steps in developing the performance evaluations for the WYDOT Research Program. The criteria had to be applicable to all research projects that WYDOT sponsored. After reviewing the NCHRP report “Performance Measurement Tool Box and Reporting System for Research Programs and Projects”, a list of initial performance criteria was identified. The following list of performance criteria was initially identified by this study:

- Phase 1 Evaluation Performance Criteria
 - Completion with respect to proposed timeline.
 - Completion with respect to proposed budget.
 - Fulfillment of project objectives.
 - Internal technology transfer.
 - External technology transfer.
 - Possible level of implementation within WYDOT.
 - Graduate student involvement.
 - Quality of the final research report.

- Phase 2 Evaluation Performance Criteria
 - Actual level of implementation within WYDOT.
 - Contributions to WYDOT’s overall mission goals.
 - Cost-benefit analysis (reduction in crashes, lives saved, cost avoidance, etc.).
 - Return on investment.
 - Additional research pursued.

The above performance criteria were presented to the WYDOT Research Program for review and suggestions. From that meeting, the performance criteria were refined to meet the needs of WYDOT. From the phase 1 performance evaluation, all of the performance criteria were accepted by the research program staff except for the criteria measuring graduate student involvement. In addition to the selected criteria, another measure was included; this measure related to the completion of a researcher feedback form. The research feedback form was created by “Evaluation of WYDOT's Research Center and Research Program” for the WYDOT Research Program, and is used to get feedback and constructive criticism on the inner workings of the program. The researcher feedback form can be seen in Appendix D. The phase 2 performance criteria were accepted as shown; one additional measure was also added. This measure looks at impacts the results of the project has had on national, regional, or local agencies.

5.2 Ranking and Weighting of the Criteria

Ranking of the performance criteria is a critical step in creating the performance evaluations. The weighting of the questions on the performance evaluation forms is directly related to the ranking of the performance criteria. The selected performance criteria and the ranking of the performance criteria for both phase 1 and phase 2 can be seen in Figure 5-1 and Figure 5-2, respectively. The highest ranking for the criteria is a one and the lowest is a four.



Figure 5-1 Phase 1 Performance Evaluation Ranking and Criteria



Figure 5-2 Phase 2 Performance Evaluation Ranking and Criteria

The ranking of the criteria was designated by the WYDOT Research Program staff, and the rankings are based on which performance criteria the staff felt was more important for evaluation of research projects. As stated, the weighting is directly related to the ranking. The performance criteria with a higher ranking will have higher weighting for the overall project grading. Therefore, a ranking of one will have the highest weighting and a ranking of four will have the lowest weighting. Both of the performance criteria in the fourth ranking, for phase 1 and phase 2, are not related to the actual performance of the project. The fourth ranked performance criteria will have little to no weight for the overall project grading but can be used for a variety of checks such as administrative checks. The weighting selected in the performance evaluations will be discussed in the next section.

5.3 Developing the Performance Evaluations

After the ranking has been established for the performance criteria, the performance evaluation forms can be developed. The performance evaluation forms for the WYDOT Research Program were created in Excel as all WYDOT employees have access to this program. The first step in developing the forms is turning all of the performance criteria into questions that can be easily answered. The questions that were developed for the WYDOT Research Program are listed below:

5.3.1 Phase 1 Questions

Figure 5-3 shows the questions that are included on the phase 1 performance evaluation.

1)	Were all of the proposed objectives of the research project fulfilled?
<input type="checkbox"/>	All objectives were fulfilled
<input type="checkbox"/>	Some objectives were fulfilled
<input type="checkbox"/>	No objectives were fulfilled
2)	Expected future level of implementation within WYDOT.
<input type="checkbox"/>	Full Implementation
<input type="checkbox"/>	Partial Implementation
<input type="checkbox"/>	No Implementation
<input type="checkbox"/>	Results do not recommend implementation
3)	External technology transfer.
<input type="checkbox"/>	Any National, Regional, or Local presentations, publications, etc.
<input type="checkbox"/>	No external technology transfer
4)	Internal technology transfer.
<input type="checkbox"/>	Presentations created and used by the Research Center or relevant departments within WYDOT
<input type="checkbox"/>	No internal technology transfer
5)	Was a research report created?
<input type="checkbox"/>	A professional and concise research report was created, meeting WYDOT's expectations
<input type="checkbox"/>	No research report was created or an inadequate research report was submitted
6)	Was the research project completed within its proposed timeline?
<input type="checkbox"/>	The project was completed within its proposed timeline or within approved extensions
<input type="checkbox"/>	The project was completed within one month of its proposed timeline
<input type="checkbox"/>	The project was completed after one month of its proposed timeline
<input type="checkbox"/>	The project was not completed
7)	Was the research project completed within its proposed budget?
<input type="checkbox"/>	The project was completed within its proposed budget or within an approved funding increase
<input type="checkbox"/>	The project was not completed within its budget
8)	Was the Researcher Feedback Form completed?
<input type="checkbox"/>	Yes
<input type="checkbox"/>	No

Figure 5-3 Questions on the Phase 1 Performance Evaluation

All of the questions that were developed for the phase 1 analysis can be simply answered with the check box as shown Figure 5-3. Making the performance evaluation as simple as possible will ensure that the evaluations will not be misinterpreted by the project sponsor or research program. All of the questions are weighted based on their assigned ranking, and the questions have a tiered weighting or scoring system. The first answer option is allotted full points, the second option is allotted half of the points of the first option, and the third option is allotted no

points. The questions with two answer options are scored similarly in that the first option is allotted full points and the second answer option is allotted no points.

The fulfillment of project objectives is the first question of the phase 1 performance evaluation as it was the highest rated. The expected level of implementation is addressed next. This question refers to the level to which the results and recommendations of the research project could be implemented within WYDOT. As research projects do not always recommend implementation of their findings, an option for “results do not recommend implementation” is listed. This option has the same weighting as the “full implementation” option as they are viewed as equal successes, as research projects do not always recommend implementation. As a cautionary note, research projects that do not recommend implementation due to poor project planning or performance should not be selected for this category. External and internal technology transfer are the next questions and reflect to how the principal investigator has presented and publicized their research efforts. The quality of the final research report is questioned next. Having a final research report that is not professional or presentable is combined with an incomplete final research report. Final research reports that are inadequate or not up to professional standards are not beneficial for the research program and therefore are classified with incomplete reports. The project’s completion with respect to its proposed budget and timeline are determined in questions six and seven. The final question identifies whether a researcher feedback form was completed or not; this question was added for administrative purposes and is not weighted. The addition of this question will hopefully remind the WYDOT project sponsor to distribute the research feedback form to the principal investigator of the project so the research program can get beneficial feedback.

5.3.2 Phase 2 Questions

The following list of questions shown in figure 5-4 is included in the phase 2 performance evaluation.

1) Have the results of this research project contributed to WYDOT's Mission?
 Yes
 No

1a) If yes, Briefly describe which aspects of WYDOT's Mission have been advanced or affected by the results of the research project:

2) Have the results of this research project been implemented within WYDOT?
 Full Implementation
 Partial Implementation
 No Implementation

2a) If level of implementation has changed from the phase 1 evaluation, please explain:

3) What is the cost/benefit associated with this project?
 Benefits associated with results of project exceeds costs of project
 Benefits associated with results of project do not exceed costs of project

* Please fill in costs and benefits if possible:
 - Total Project Cost = _____
 - Estimated dollar savings or benefits associated with implementation of the project = _____
 Benefit/Cost Ratio =

Benefits of project cannot be identified

4) Have the results of the project had any impacts on national, regional, or local organizations or agencies?
 Yes
 No

4a) If yes, briefly identify the organization or agency that was impacted, and what affect the research project had on them:

5) Has additional research been pursued or conducted as a result of this project within WYDOT?
 Yes, additional research has been approved.
 No, additional research has not been approved.

5a) If yes, identify the project.

Figure 5-4 Questions on the Phase 2 Performance Evaluation

The same scoring system was used on the phase 2 performance evaluation as discussed earlier for the phase 1 performance evaluation. The phase 2 questions may require some explanation as not all the questions are as simply answered as in phase 1. As shown in Figure 5-4, space was provided for brief explanations. The contribution to WYDOT's mission and actual level of implementation criteria is addressed in the first two questions. Both of these questions are ranked the highest and are of the utmost importance to the WYDOT Research Program. The cost-benefit analysis is included in this phase as the benefits can potentially be identified two years after project completion. It is up to the discretion of the WYDOT Project Sponsor when identifying the total costs and benefits of the research project to be used in the benefit-cost analysis. The project sponsor can either choose if the project's benefits exceed the cost of the project or if the cost of the project exceeded the benefits of the project. The actual cost and benefits can be incorporated into the form, but the benefits may not always be quantifiable. The expertise of the project sponsors is required to make the judgment of whether the project was beneficial or worthwhile for WYDOT. An option for "not applicable" is available as research projects vary and not all projects' benefits can be evaluated with a cost-benefit analysis. If the "not applicable" option is selected no scoring deductions are made. WYDOT does want to know how their research has impacted other agencies, so question 4 addresses the impacts the project may have had on outside agencies. The final question is not used for scoring as not all research projects will have additional research. This question could be useful for identifying related research projects that could be grouped for further evaluation.

Both of the performance evaluation forms can be found in Appendix E and Appendix F for the phase 1 and phase 2 performance evaluations, respectively.

5.4 Testing Performance Evaluation Forms

To obtain the proper weighting and ensure the performance evaluation forms would be effective tools for the WYDOT Research Program, a sample group of projects were tested. A total of 18 projects were identified and used to test the developed performance evaluation forms. The projects that were selected for the testing were identified in conjunction with the WYDOT research program. A complete list of projects that were used for the testing of the performance evaluations can be seen in Appendix A3. The pooled fund studies from the second level analysis were not included as they were not completed, but the performance evaluations can be used to evaluate pooled fund studies.

The State Programming Engineer and the Research Manager from WYDOT both filled out the performance evaluations for the 18 projects identified. The performance evaluations are designed to be filled out by the sponsoring WYDOT employee, but as some sponsoring employees have retired, the state programming engineer and research manager filled out the forms for the test group. Both of these evaluators have in-depth knowledge of all of the research

projects that are conducted within WYDOT and therefore have the appropriate expertise to fill out the performance evaluations.

An initial weighting was assigned to the performance criteria, based on the rankings that were identified by the research program staff. Table 5-1 shows the weights that were given to the rankings.

Table 5-1 Initial Weighting of Performance Evaluation

Ranking	Weighting	Percentage in Phase 1	Percentage in Phase 2
1	30	23%	33%
2	20	15%	22%
3	10	8%	11%
4	0	0%	0%

From the weighting, shown in Table 5-1, scores of all of the projects were then determined. The scoring of the projects was completed on both a numeric scale of 0-100, and a tiered scoring system with the following grades; exceeds expectations, meets expectations and does not meet expectations. The cut offs are at 100-85, 84-70, and 70 and below, respectively for the different tiers. As shown in Figure 5-55 and Figure 5-66, the projects are grouped together in 10 point incremental categories from both of the evaluators.

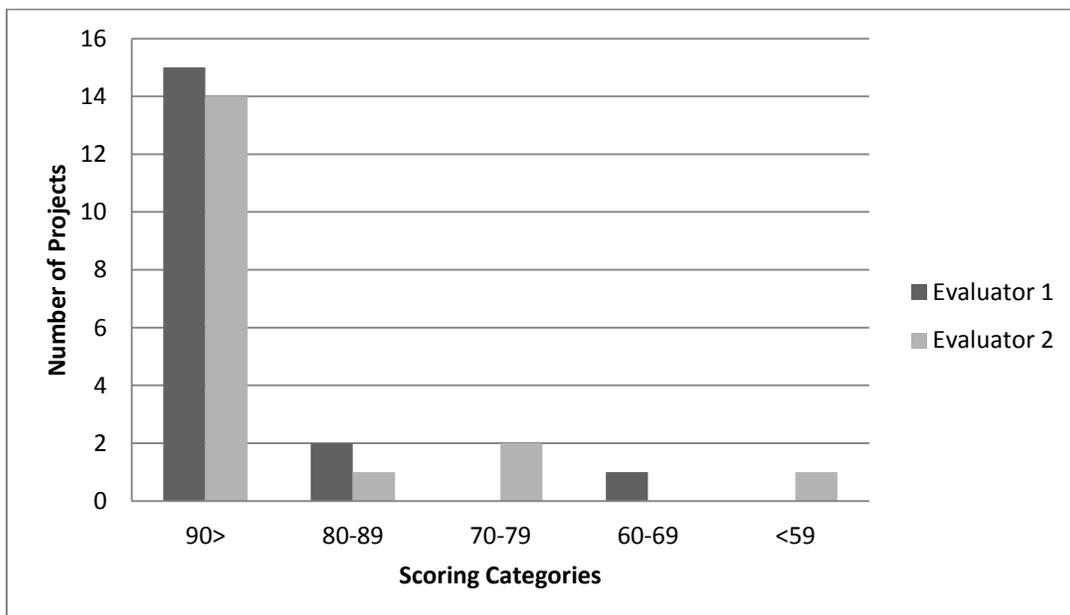


Figure 5-5 Initial Scoring of Phase 1 Research Projects

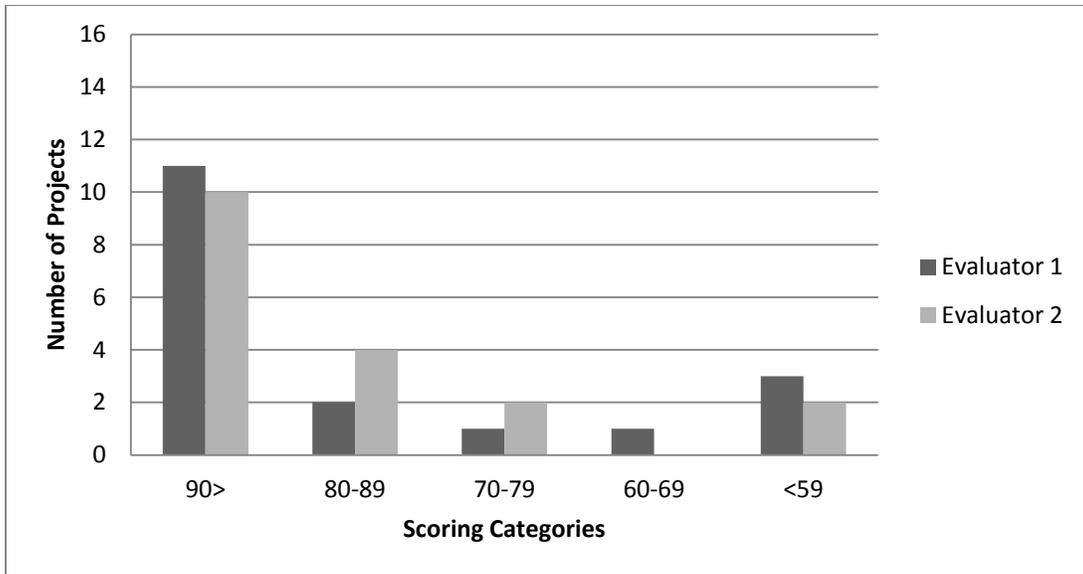


Figure 5-6 Initial Scoring of Phase 2 Research Projects

Both of the evaluators have similar scores for a majority of the projects that were evaluated. Minor discrepancies in the scoring were observed between a few of the projects; these discrepancies are attributed to perceived levels of implementation within WYDOT. Table 5-2 shows the discrepancies with the scoring between both of the evaluators, and as shown most of the projects were scored relatively close by both evaluators.

Table 5-2 Individual Scoring for Each Project for Phase 1 and Phase 2

	Phase 1		Phase 2	
	Evaluator 1	Evaluator 2	Evaluator 1	Evaluator 2
RS06(207)	100%	100%	100%	100%
RS07(209)	100%	100%	100%	89%
RS04(206)	88%	73%	43%	79%
RS01(207)	100%	100%	100%	100%
RS05(207)	100%	100%	100%	100%
RS05(205)	96%	100%	100%	100%
RS02(208)	100%	100%	100%	100%
RS06(206)	100%	100%	100%	100%
RS01(206)	100%	77%	100%	79%
RS06(209)	100%	92%	70%	81%
RS04(207)	69%	54%	0%	0%
RS02(207)	100%	85%	61%	0%
RS05(210)	100%	100%	100%	100%
RS07(206)	88%	100%	85%	100%
RS02(206)	100%	100%	100%	100%
RS10(206)	100%	100%	44%	81%
RS03(205)	92%	92%	85%	85%
RS02(205)	96%	96%	100%	100%
Average	96%	93%	83%	83%
St. Dev.	7.9%	12.8%	29%	31%

As expected, the phase 1 evaluations have overall higher scores than the phase 2 evaluations when the same weights are used. The projects' level of implementation and contributions to WYDOT's mission are heavily weighted in the phase 2 evaluation. After the 2 year period between the phase 1 and phase 2 performance evaluations not all of the projects' results were found to be implemented as expected from the phase 1 performance evaluation. The phase 1 evaluation has a high average as well as a low standard deviation. This is expected as most of the projects were successful at meeting more of the administrative based performance criteria that are encompassed phase 1. The phase 1 evaluation resulted in determining the successful and unsuccessful completion of projects, so the overall score is not as significant. The ability of the phase 1 performance evaluation to single out the unsuccessful research projects will be beneficial for the WYDOT Research Program in identifying the types of projects which do not yield beneficial results for WYDOT.

The phase 2 performance evaluation generates a score that is more significant as a measure, not only for the individual research project, but also for the research program as a whole. Looking at the percentage of projects that meet or exceed expectations is a good indicator of the success of the WYDOT Research Program. Making changes to the program based on the findings of the

phase 2 evaluations will help the program progress by allowing it to fund projects which tend to be more successful and beneficial for WYDOT.

Other weightings for the performance criteria were evaluated in this study. Minor changes were observed with the different weightings but when grouping the projects by the tiered scoring system, no major changes were observed from the “exceeds”, “meets”, or “does not meet expectations” categories. After multiple projects have been evaluated by this process additional analysis may be required.

5.5 Implementing Performance Evaluations for WYDOT

Implementing the performance evaluations for the WYDOT Research Program will ensure the program remains a successful and beneficial entity for WYDOT. Implementing the performance evaluations will be easily completed as they are designed to be simple and quick to fill out. It is recommended that the sponsoring employee of the research project be primarily responsible for the completion of the performance evaluations. It is also recommended that the performance evaluations be handed out in paper form to the sponsoring employee. This will ensure no bias is given by the sponsoring employee with respect to overall scoring, as this scoring can only be accessed from the excel spreadsheet. Also this would provide a paper copy of the evaluation for the completed project file. The WYDOT Research Program should assist in the completion of the performance evaluations, as needed, and will be responsible for the administrative work associated with distribution, collection and analysis of the completed performance evaluations. After the performance evaluations have been collected for projects, it is suggested that the WYDOT Research Program track the success of each project and program through similar methods as shown in this report.

After the performance evaluations have been integrated into the research program for a few years, another study should be completed to confirm that the weighting for the performance criteria is appropriate and possibly refine the evaluation criteria to ensure they are meeting the needs of the program and WYDOT.

The performance evaluations presented in this chapter will ensure the continued success of the WYDOT Research Program by quantifying the results of their completed research projects. Being able to identify successful and unsuccessful projects from the phase 1 performance evaluation will be a great tool that WYDOT can use for future funding by identifying opportunities where certain types of projects can be improved. The phase 2 performance evaluation can be used for determining individual project performance and overall program performance. Tracking the improvements that the WYDOT Research Program will be able to make from year to year will ensure they are meeting the performance and outcome based requirements that future transportation legislation may require.

5.6 Evaluating the Proposed Budgets

During the course of this study it was observed that multiple forms of proposed budgets have been presented to the RAC over the years. This study then looked at budgets that were proposed and accepted from 2005-2011 to develop a standard budget that can be used by all proposed projects. A total of 39 proposed budgets were identified by the Research Program for creating the standardized budget. The list of the projects that were identified for this evaluation is shown in Appendix A4. By having a standardized budget for the proposed projects, this study was able to group the 39 identified project budgets into the following list of budget items:

- I. Direct Costs
 - Total Personnel Costs.
 - Principal Investigator.
 - Other Personnel.
 - Fringe Benefits.
 - Research Travel.
 - Report Generation.
 - Equipment.
 - Others.
- II. Technology Transfer
 - Conferences/ Report Presentation.
 - Miscellaneous Travel.
- III. Indirect Costs
 - Project Administration.
 - Overhead.

The budgetary items are listed with three main categories, Direct Costs, Technology Transfer, and Indirect Costs. Direct Costs comprises total personnel costs, fringe benefits, research travel, report generation, equipment, and others. The total personnel costs include both the principal investigator and other personnel who are involved with the research project. The technology transfer category includes conference and report presentations as well as miscellaneous travel associated with promoting the project. The indirect costs include project administration, including support staff and overhead expenses. Figure 5-7 shows the ranges as a percentage of the overall project cost for each budgetary category selected for WYDOT research projects.

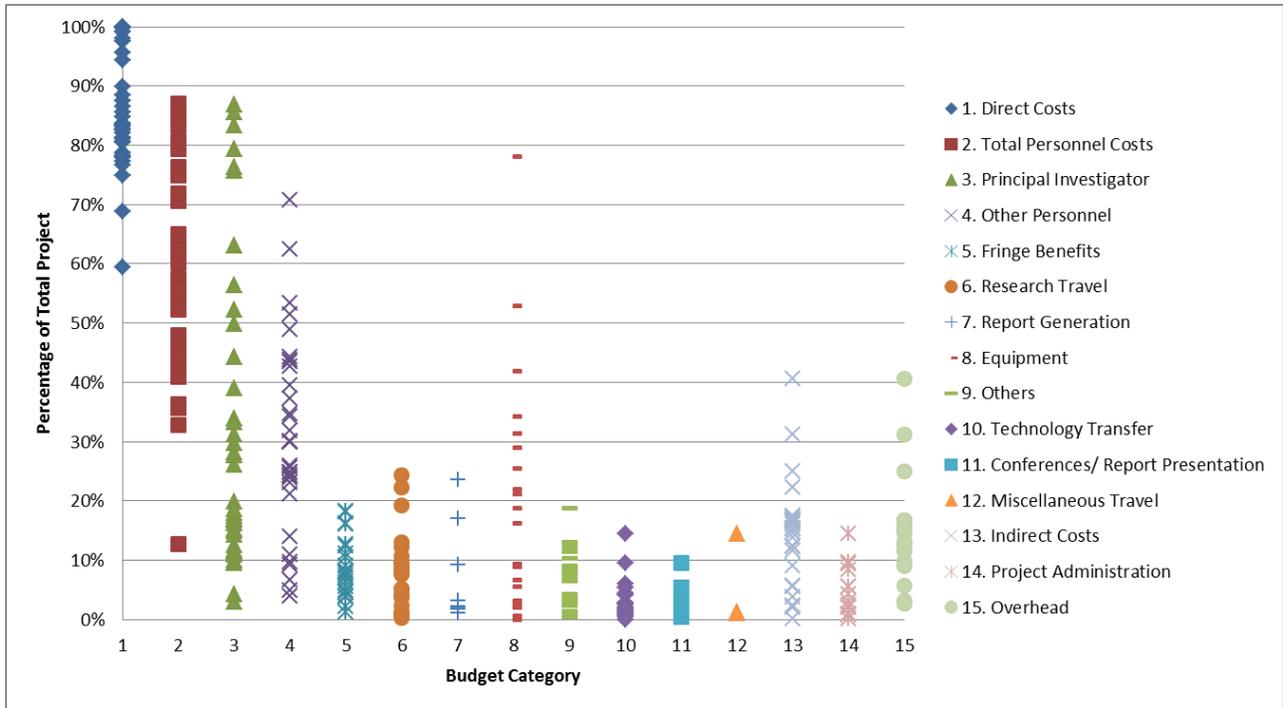


Figure 5-7 Project Budget Category Ranges for WYDOT Research Projects

As research projects tend to be very different from one another, it is expected that a wide range of percentages would be present. The intent of developing a standardized budget was not to limit the amount of money a project may spend on a certain budgetary item, but to give a range that was generally expected for each budgetary item. To accomplish this, the 75th and 25th quartiles were used to find the 50th percentile range for each budgetary item. The ranges the quartiles yielded show where 50 percent of the evaluated projects lie for that specific budgetary category. This method was used as the extreme ends of the range would not be included. Table 5-3 shows the 50th percentile range for each budgetary category.

Table 5-3 50th Percentile Ranges for Budgetary Categories

	25th Percentile	75th Percentile
Direct Costs	81%	96%
Total Personnel Costs	44%	72%
Principal Investigator	12%	46%
Other Personnel	23%	44%
Fringe Benefits	5%	12%
Research Travel	2%	10%
Report Generation	2%	11%
Equipment	3%	30%
Others	2%	9%
Technology Transfer	1%	5%
Conferences/ Report Presentation	1%	3%
Miscellaneous Travel	1%	11%
Indirect Costs	12%	17%
Project Administration	1%	8%
Overhead	12%	17%

As not all projects have similar outcomes, vastly different budget ranges for each budgetary category could exist between the project outcome categories. Therefore analysis looking at different categories based on the outcomes of projects was considered with the following project outcome categories: standards, knowledge and products. Table 5-4 shows the 75th and 25th percentile budget category ranges for each budgetary category for the three identified project outcome categories.

Table 5-4 50th Percentile Ranges for Budgetary Categories by Project Outcome

Budget Categories	Knowledge		Standards		Product	
	25th Percentile	75th Percentile	25th Percentile	75th Percentile	25th Percentile	75th Percentile
Direct Costs	80.5%	97.7%	79.4%	96.8%	76.9%	93.3%
Total Personnel Costs	44.6%	71.6%	54.4%	81.5%	41.0%	69.7%
Principal Investigator	15.0%	38.0%	14.5%	69.9%	9.5%	29.7%
Other Personnel	23.9%	43.5%	11.0%	37.3%	13.9%	51.5%
Frigne Benefits	4.8%	10.2%	6.4%	18.2%	3.8%	11.1%
Research Travel	3.0%	16.2%	4.0%	7.9%	0.8%	9.4%
Report Generation	2.2%	17.0%			1.8%	9.3%
Equipment	3.7%	29.0%	1.9%	41.9%	2.3%	41.3%
Others	3.8%	10.7%	1.0%	7.1%	2.3%	8.1%
Technology Transfer	1.8%	5.4%	0.6%	4.6%	0.7%	2.5%
Conferences/ Report Presnetation	1.4%	4.8%	1.3%	3.8%	0.7%	2.5%
Miscellanous Travel	1.1%	11.1%				
Indirect Costs	10.3%	16.7%	8.4%	16.8%	12.3%	25.0%
Project Administration	2.6%	9.2%	0.2%	9.7%	0.8%	3.8%
Overhead	11.6%	16.7%	15.4%	16.7%	9.9%	25.0%

Table 5-4 shows no major changes among the ranges of the budgetary categories for the project outcomes categories. Also, when the 39 projects get split up by their expected project outcome, the number of projects for each budget category becomes scarce. As there is not a major change between budgetary ranges between the all the projects and projects separated by project outcome, this study suggests the budgetary ranges for all projects be used. Also the ranges are simply references or guides for the RAC to use when evaluating proposed projects.

The Research Project Budget Analysis Form was created for the principal investigators to fill out for the standardized budget for future projects that are to be proposed to WYDOT. This form can be seen in Appendix G. It is suggested that the form be filled out by the principal investigator and then distributed to the RAC for analysis. The form is designed to show the budgetary items that fall outside the 50th percentile range. Table 5-5 shows the portion of the form that is filled out by the principal investigator.

Table 5-5 Example of a Filled Out Research Project Budget Analysis Form

	Projected Project Costs	Percentage of Overall Project Budget	Indicator	Lower Range	Upper Range
Direct Costs	\$63,206	83%		81%	96%
Total Personnel Costs	\$34,108	45%		44%	72%
Principal Investigator	\$15,208	20%		12%	46%
Other Personnel	\$18,900	25%		23%	44%
Frign Benefits	\$6,083	8%		5%	12%
Research Travel		0%	*	2%	10%
Report Generation		0%	*	2%	11%
Equipment	\$16,800	22%		3%	30%
Others	\$6,215	8%		2%	9%
Technology Transfer	\$2,000	3%		1%	5%
Conferences	\$1,000	1%		1%	3%
Miscellaneous Travel	\$1,000	1%		1%	11%
Indirect Costs	\$11,138	15%		12%	17%
Project Administration	\$2,250	3%		1%	8%
Overhead	\$8,888	12%		12%	17%
Total Project Cost	\$76,344				

Only the gray highlighted portion of the table is filled out and the indicators become present as a budgetary items falls outside the 50th percentile range. The indicator column that is shown in Table 5-5 quickly shows which budgetary categories fall outside the 50th percentile range for WYDOT’s research projects. When evaluating these forms, WYDOT’s Research Program and the RAC can easily see which budgetary items fall outside the 50th percentile range by the indicator, but it is noted that not all of the proposed research projects will fit in this standardized budget. For example, some projects may require expensive equipment. Engineering judgment should be used when making decisions based on the standardized budget.

It is suggested that the principal investigators of research projects complete the standardized budget process presented in this report, and in addition, complete an itemized or task based budget. Having both types of budgets will help elevate questions or concerns the RAC may have about proposed projects, budgets, and funding requests.

5.7 Chapter Summary

The performance evaluations that were presented in this chapter will be a valuable tool for the WYDOT Research Program for not only evaluating the individual research projects but the

research program as a whole. The performance evaluations will ensure that the WYDOT Research Program progresses and remains a viable program for WYDOT in the years to come. As the transportation research funding in the United States shifts from an earmark based system to a performance and outcome based system, research programs that have self-evaluations will preserve and possibly increase their allotted funding.

Having the proposed budgets of projects standardized will ensure that the RAC can make proper decisions concerning their budgetary inquiries. The standardized budgets will be an additional tool for the RAC, the research program and the principal investigator to use in determining the funding requirements of projects.

CHAPTER 6 OPPORTUNITIES FOR TECHNOLOGY TRANSFER FOR THE WYDOT RESEARCH PROGRAM

The WYDOT Research Center's website was evaluated on content and overall structure by comparing it to other DOTs Research Centers' websites. The content of any website must be clear and concise to accurately convey information to the user. The website structure needs to be easily navigable so the user can find the content efficiently. This evaluation will show opportunities that WYDOT can implement for their Research Center website that other DOTs are currently using on their research websites. This evaluation focused on the structure and content of the Research Center's website by evaluating the following:

- Research Reports.
- Information for Users.
- Research Program Mission Statement.
- Additional Content for the Website.
- Website Structure.
- Different Avenues of Exposure .

The WYDOT Research Program can be seen through the following link:

- http://www.dot.state.wy.us/wydot/site/wydot/lang/en/planning_projects/studies_plans/research_center_1

The following websites were used as comparisons for evaluating WYDOT's Research Center's website:

- Colorado DOT - <http://www.coloradodot.info/programs/research>
- Idaho Transportation Department - <http://itd.idaho.gov/planning/research/>
- Montana DOT - <http://www.mdt.mt.gov/research/>
- South Dakota DOT – <http://apps.sd.gov/applications/hr19researchprojects/index.htm>
- Utah DOT - <http://www.udot.utah.gov/main/f?p=100:pg:0:::1:T,V:195>
- Minnesota DOT - <http://www.dot.state.mn.us/research/index.html>

6.1 Research Reports

Providing current and past research reports on the research website is crucial for WYDOT to have an effective and efficient tool for their employees and other researchers. Technology transfer is critical for research entities across the country for advancements in their fields.

WYDOT has the opportunity to show the research they have been conducting and offer more efficient technology transfer.

Currently, WYDOT has past research reports dating back just a few years on their current research website. The reports are ordered by the dates on which they were posted to the website, opposed to being ordered by their completion date. If the research reports were ordered by the year of completion in an archival format, users of the website would have an easier time finding the reports of projects. The South Dakota Department of Transportation (SDDOT) utilizes an archival call system for their reports and has reports available from 1989 to recently completed reports. Figure 6-1 shows the manner in which SDDOT displays their final reports for research projects. The report number, report title, and a link to the report are given.

Office of Research

SDDOT / Research / Projects

**South Dakota Department of Transportation
Research Final Reports**

Report #	Report Title	Final Report Link
SD2006-02	SDDOT 2006 Organizational Health Assessment	SD2006-02_Final_Report.pdf
SD2006-02	SDDOT 2006 Organizational Health Assessment	SD2006-02_Executive_Summary.pdf
SD2006-03	SDDOT 2006 Statewide Customer Satisfaction Assessment	SD2006-03_APPX_A.pdf
SD2006-03	SDDOT 2006 Statewide Customer Satisfaction Assessment	SD2006-03_APPX_B.pdf
SD2006-03	SDDOT 2006 Statewide Customer Satisfaction Assessment	SD2006-03_APPX_C.pdf
SD2006-03	SDDOT 2006 Statewide Customer Satisfaction Assessment	SD2006-03_Executive_Summary.pdf
SD2006-03	SDDOT 2006 Statewide Customer Satisfaction Assessment	SD2006-03_APPX_E.pdf
SD2006-03	SDDOT 2006 Statewide Customer Satisfaction Assessment	SD2006-03_APPX_F.pdf
SD2006-03	SDDOT 2006 Statewide Customer Satisfaction Assessment	SD2006-03_APPX_G.pdf
SD2006-03	SDDOT 2006 Statewide Customer Satisfaction Assessment	SD2006-03_APPX_H.pdf
SD2006-03	SDDOT 2006 Statewide Customer Satisfaction Assessment	SD2006-03_APPX_I.pdf
SD2006-03	SDDOT 2006 Statewide Customer Satisfaction Assessment	SD2006-03_Final_Report.pdf
SD2006-05	Review of SDDOT's Pavement Management System	SD2006-05_Final_Report.pdf
SD2006-06	Review of Travel Demand Forecasting Requirements in the SDDOT	SD2006_06_F.pdf
SD2006-06	Review of Travel Demand Forecasting Requirements in the SDDOT	SD2006_06_X.pdf
SD2006-15	International Registration Plan & International Fuel Tax Agreement System Requirements Analysis	SD2006_15_X.pdf
SD2006-15	International Registration Plan & International Fuel Tax Agreement System Requirements Analysis	SD_IRP&FTA_System_Spec.pdf
SD2005-01	Mechanistic-Empirical Pavement Design Guide Implementation Plan	sd2005-01_Final_Report.pdf
SD2005-02	Verify Certain ITE Trip Generation Rate Applications in South Dakota	TripGenFinalReport.pdf
SD2005-02	Verify Certain ITE Trip Generation Rate Applications in South Dakota	TripGenAppendix.pdf
SD2005-03	Use of Wireless Technology for Field Applications	SD2005_03_Executive_Summary.pdf
SD2005-03	Use of Wireless Technology for Field Applications	SD2005_03_Final.pdf

Figure 6-1 SDDOT Research Report Archival System

For older reports that are not in electronic format, hard copy reports are available upon request; these reports are still listed on the website but no link is given. Listings all of the reports that WYDOT has completed over the years would greatly increase interest in past research projects that were previously hard to find.

The Colorado Department of Transportation (CDOT) also lists their research reports on their research program website. Links to the reports are provided for the year that the report was completed. Figure 6-2 shows how this links are presented on their website.

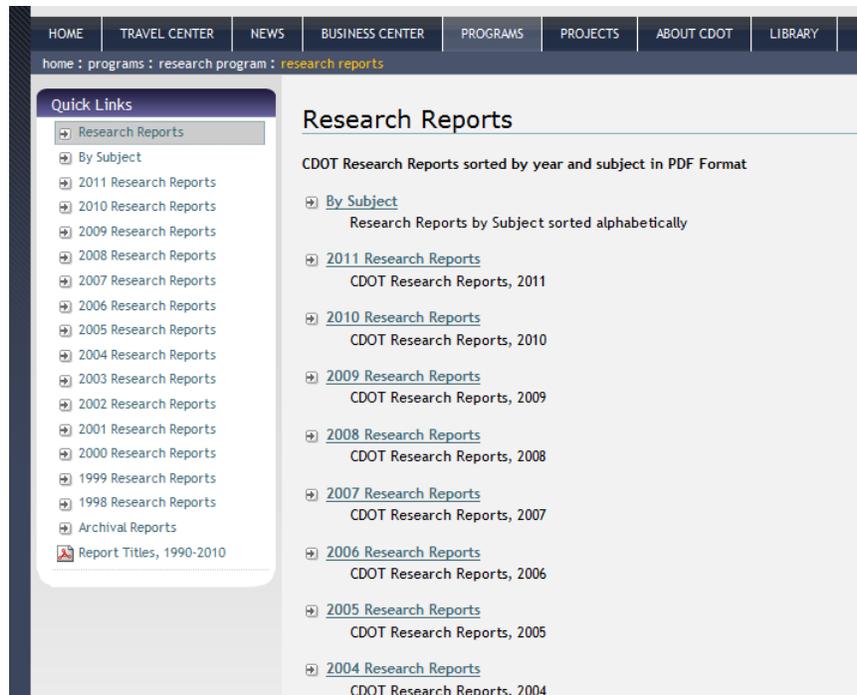


Figure 6-2 CDOT Research Report Presentation

The links allow CDOT to display their research reports in an organized manner; they lead the user to a list of all research reports for that given year. Almost all research reports have links to their final reports in PDF form. Older reports that do not have PDF copies available on the website can be accessed by contacting the CDOT Research Librarian. It is noted that reports from 1998 to present are available in PDF form.

The Idaho Transportation Department (ITD) Research Program uses a very similar organizational system like the CDOT Research Program for presenting their reports on their websites. They have reports available in PDF form from 1956 to 2010. ITD also separates their research reports by division or program, such as the Bridge, Economics/Finance, Maintenance, etc. This organization style allows users many sorting methods when looking for research reports.

All research program host sites offer search engines from their main website that allow users to find research reports. WYDOT also offers a search engine that encompasses the entirety of the website, but neither research reports nor the research center can be found using this search engine. It is suggested that WYDOT include their research reports as well as their research center on their main websites search engine. Including the research reports and the research center on this search engine will greatly increase user efficiency.

If WYDOT could make available all past research reports on their website, WYDOT employees and other researchers would have direct access to a vast information source. Being able to find

these reports in a quick and easy manner is necessary for technology transfer. Giving WYDOT's search engine access to these reports and making the reports available in an archival format such as SDDOT or CDOT will allow for quick and easy access to the research reports.

6.2 Information for Users

The writing guidelines that are currently available on the website are very useful tools for researchers who are writing reports and proposals, and these guidelines give good insight to how research is conducted with in WYDOT. All other Research Centers in this evaluation had similar writing guidelines. Opportunities that WYDOT could benefit from are highlighted in this section, including improving the writing guidelines, updating the delivery method of the contact information for the Research Center, and additional tools for researchers.

The writing guidelines currently are organized into sections that the researcher needs to complete for writing research reports; these sections include progress reports, executive summary, report body, etc. WYDOT could include examples of past research reports after a section is described; a "good" example could be shown to demonstrate to the researcher what is expected of them by WYDOT. The SDDOT utilizes a similar system in which they explain certain components of the research reporting process such as including appendices, figures or tables, writing an abstract, etc. and then show examples from an actual report of how to properly complete each task. Since final research reports are already given on the website and researchers have access to them for reference material, WYDOT could benefit from merely adding accepted proposals and examples of progress reports. Not only would the researchers benefit from knowing what the RAC is looking for in proposals and writing styles, the RAC would have an easier time evaluating proposals that have similar writing structures and styles.

Contact information is given for the Research Manager, but finding this information is not easy and it is recommended to show this information on the main page of the research website. A phone and fax number is listed but other avenues of contact information, including emails or support staff contact information is not listed. The contact information is vital for communication between the research center staff and their customers.

Another common resource given for researchers is links to national and local transportation research entities. As shown in Figure 6-3, the Idaho Transportation Department (ITD) lists many resources for their researchers. These resources include national and local agencies from multiple online research catalogs and databases to the local LTAP center.

Transportation Research Search Tools

The tools listed below can be used to find information about research done nationally and in other states.

- ▼ [Online Research Catalogs and Databases](#)
- ▼ [State DOT Research Programs](#)
- ▼ [Transportation Libraries](#)
- ▼ [Transportation Research Thesaurus](#)
- ▼ [Transportation Research Reports and Journals](#)
- ▼ [Transportation Statistics](#)
- ▼ [Custom Transportation Search Engines](#)

If you need assistance finding research information, please contact the [ITD Research Program](#). The staff can also assist you with interlibrary loan requests.

Technology Transfer

The ITD Research Program oversees funding for the Idaho's Local Technical Assistance Program (LTAP), which provides training for local highway agency staff. Idaho's LTAP Center, the "T2 Center," is operated by the Local Highway Technical Assistance Council (LHTAC) under a contract with ITD.

- [LHTAC](#)
- [Idaho T2 Center](#)

Other Transportation Organizations

The links below can be used to access the websites of national and state transportation agencies involved in research, development, and technology transfer.

- ▼ [National Organizations](#)
- ▼ [State Transportation Agencies](#)
- ▼ [Transportation Pooled Fund Program](#)
- ▼ [State LTAP Centers](#)

Figure 6-3 Idaho Transportation Department Researcher Resources

WYDOT and other state DOTs send their final research reports to national transportation research libraries to archive the research that is completed within these agencies. This technology transfer is crucial for the DOTs and other transportation agencies to maintain and have access to current research records. WYDOT should include similar links on their website to take advantage of these programs and resources they are already a part of. Montana, South Dakota and Utah DOTs all have similar links on their research websites.

6.3 Creating a Mission Statement

A mission statement is needed for any organization to define its purpose for its employees and users. A mission statement for the WYDOT Research Center would enhance the program by directly relating the goals of WYDOT to the goals of the Research Center. As shown in Figure 6-4 through Figure 6-7, many surrounding DOTs have mission statements on the main page of their research Websites.



The screenshot shows the website for the Office of Research within the South Dakota Department of Transportation (SDDOT). The page has a light orange background with a faint image of a laboratory or office setting. At the top, the text "State of South Dakota" is written in a spaced-out font. Below that, "Office of Research" is written in a large, handwritten-style font. The main heading is "SDDOT / Research / About Research". The contact information is: "Becker-Hansen Building - 700 East Broadway Ave. - Pierre, SD 57501-2586" and "Phone: 605.773.3292; Fax: 605.773.4713". The mission statement text reads: "The South Dakota Department of Transportation conducts research to improve transportation technology. Specific goals include evaluation of new materials and methods, development of design and analysis techniques, and study of underlying causes of transportation problems. The research effort addresses topics considered most important to the Department's mission of providing a transportation system for the State of South Dakota." Below this, it lists responsibilities: "The Office of Research's responsibilities include:" followed by a bulleted list: "Developing annual research programs", "Administering contract research", "Conducting in-house research", and "Advising other SDDOT offices". At the bottom, it states: "The Office of Research is staffed by a Research Engineer, a secretary, and other engineers from several disciplines; including chemistry, civil engineering, computer science, electrical engineering, and geotechnical engineering."

Figure 6-4 South Dakota's Office of Research Mission Statement



UDOT Research Division

Engineering the Future

Research is paving the way to the future in Utah. Every year new technologies are tested and implemented to improve transportation, to save lives and reduce transportation costs. The activities within Research are broad, ranging from advancing the science of transportation engineering in emerging areas to implementing the use of new products on a daily basis. The research reach involves planning, design, construction, operations, and maintenance activities. The pages listed below contain the products of research – reports, data, newsletters, and answers – moving transportation into the future.

Figure 6-5 Utah's Research Division Mission Statement

Research Program Mission

- Support research, development, and technology transfer activities addressing the Department's strategic goals and initiatives.
- Enhance ITD's ability to deliver efficient and effective transportation services.
- Offer practical solutions to problems facing the Department.
- Develop new tools/technologies and facilitate their implementation.

Program Responsibilities

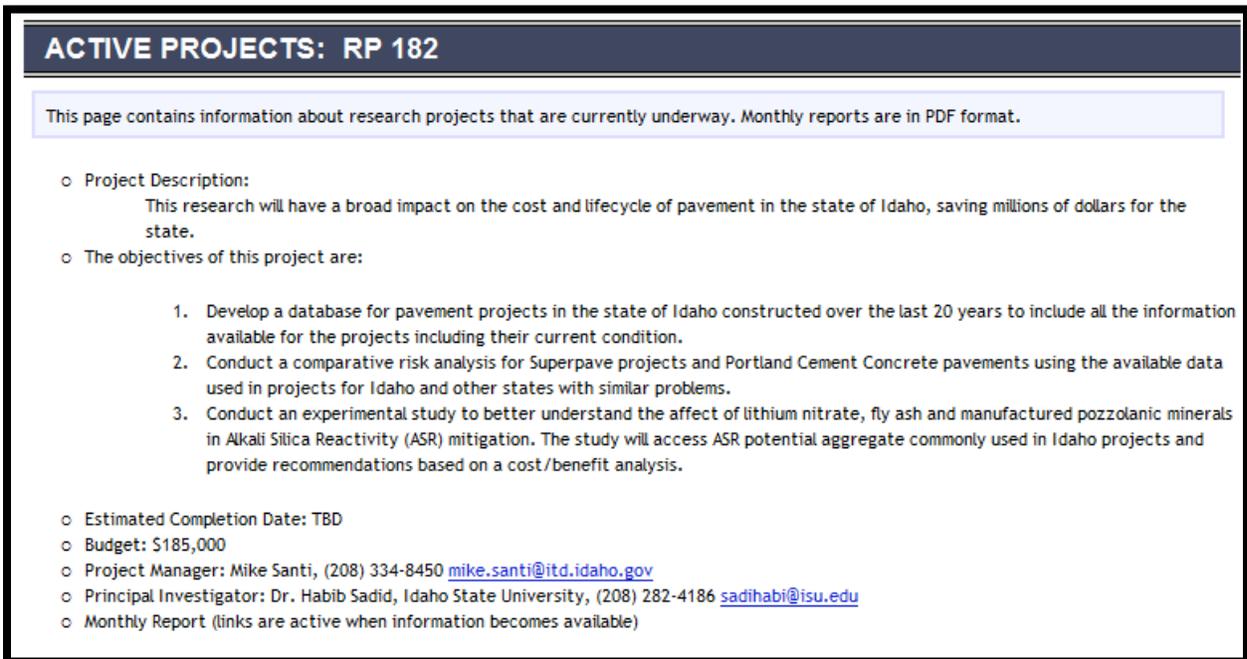
- Administering federal SPR (State Planning & Research) funds for ITD research, development, and technology transfer.
- Coordinating Department involvement in multi-state pooled fund projects.
- Identifying ITD research needs and priorities.
- Helping staff locate transportation research and information.
- Overseeing ITD-funded research performed by universities and consultants.
- Overseeing Idaho Technology Transfer Center (T2 Center) funding.
- Coordinating ITD involvement in national and regional transportation research with TRB, AASHTO, the Northwest Transportation Consortium and others.

Figure 6-6 Idaho's Research Program Mission Statement

6.4 Additional Content for the Website

Including the current research projects and Research Work Program Annual reports would put the WYDOT Research Center on course with their peers. This information would be useful for the RAC members, prospective researchers, and WYDOT employees for staying up to date on the WYDOT's Research Center's activities.

Having a list of the current research projects would allow users to see what research projects WYDOT is currently supporting and may assist potential researchers in choosing a direction for future research. The current research projects could be listed with their proposal, an abstract, and progress reports. The ITD posts their current research projects on their website. Figure 6-8 shows the information ITD posts on their active research projects.



The screenshot shows a webpage titled "ACTIVE PROJECTS: RP 182". Below the title is a blue box with white text: "This page contains information about research projects that are currently underway. Monthly reports are in PDF format." The main content is organized into sections:

- Project Description:
 - This research will have a broad impact on the cost and lifecycle of pavement in the state of Idaho, saving millions of dollars for the state.
- The objectives of this project are:
 1. Develop a database for pavement projects in the state of Idaho constructed over the last 20 years to include all the information available for the projects including their current condition.
 2. Conduct a comparative risk analysis for Superpave projects and Portland Cement Concrete pavements using the available data used in projects for Idaho and other states with similar problems.
 3. Conduct an experimental study to better understand the affect of lithium nitrate, fly ash and manufactured pozzolanic minerals in Alkali Silica Reactivity (ASR) mitigation. The study will access ASR potential aggregate commonly used in Idaho projects and provide recommendations based on a cost/benefit analysis.
- Estimated Completion Date: TBD
- Budget: \$185,000
- Project Manager: Mike Santi, (208) 334-8450 mike.santi@itd.idaho.gov
- Principal Investigator: Dr. Habib Sadid, Idaho State University, (208) 282-4186 sadihabi@isu.edu
- Monthly Report (links are active when information becomes available)

Figure 6-8 ITD's Active Project Information

ITD gives a project description, project objectives, estimated completion dates, budget, contact information for the project manager and investigator, and monthly progress reports. The information needed to create the current research projects portion of the website is readily available in the project proposals.

The Idaho, Montana, and Utah DOTs all include their Annual Research Work Program Reports on their research program websites. Including the Research Work Program Annual Reports would allow users insight into the operations of the WYDOT Research Center with respect to budgetary inquiries and the type of projects WYDOT funds.

6.5 Website Structure

The structure of the current website could benefit from a few changes to its organizational set up. DOTs with easily navigable websites utilize research homepages; these allow users to select from a variety of tabs within the Research Program. Out of the six DOTs in this evaluation, four have a main webpage for their research center containing contact information and mission statements.

Currently, the WYDOT's Research Center's web content lies within the "Planning/Projects/Research" tab off of the main page of the website. Under this tab, the "Studies/Plans/Research" tab can be opened which takes the users to four links titled "Research Center Reports 1-4". These links contain the contact information, writing guides, and recent reports. These links are also not accessible on popular search engines such as Google, nor are they accessible through the search engine on WYDOT's homepage. Having users navigate over four links to find the information they need is not an efficient way to convey information.

Creating a main tab from WYDOT's webpage for the Research Center would greatly improve the efficiency and effectiveness of the website for all users. Ideally, when this tab is opened the user would see the Research Center's mission statement and contact information, as well as tabs leading the user to:

- Research Reports.
- Current Research Projects.
- Resources for Researchers.
 - Writing Guidelines.
 - Links to other Transportation Research Programs (TRB, FHWA, NCHRP, etc.).
- Research Work Program Annual Reports.

6.6 Social Networking Opportunities

In today's internet based world the most popular means by which users acquire desired information are from social networking websites. Some of these websites, including Facebook and Twitter, have upwards of 750 million users, with 50% of those users visiting their respected websites daily. Creating a Facebook and Twitter account for the WYDOT's Research Center would be another avenue for not only getting publicity on their projects, but also for obtaining feedback from interested users. These avenues of communication have the ability to be updated daily, monthly, or how ever often needed. The Minnesota DOT has created both a Facebook page and a Twitter a account for their research center. Figure 6-9 shows the links that MNDOT

has on the main page of their research center website. Figure 6-10 shows MNDOT’s Facebook page, which their research center utilizes.

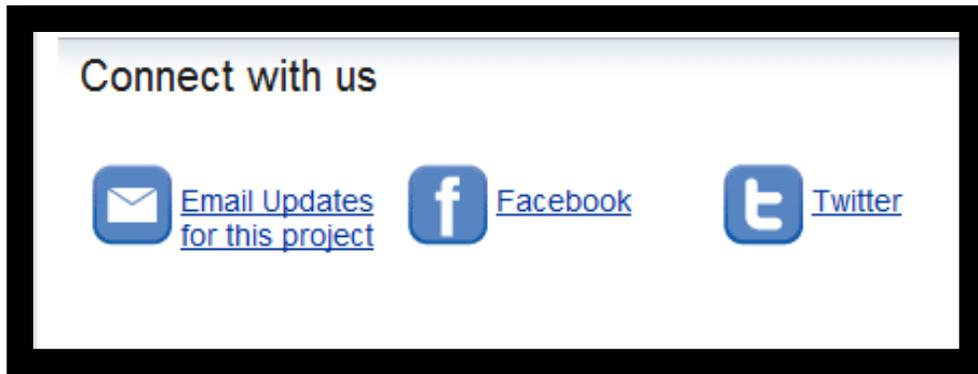


Figure 6-9 MNDOT’s Social Networking Links



Figure 6-10 MNDOT's Facebook Page

Although the Facebook page is used for the entire DOT, updates for their research center can be easily posted to the Facebook page “wall”. WYDOT has a Facebook page, but the research center currently does not make postings to the page. Postings could include announcements for RAC meetings, calls for proposals, and links to recently completed projects. The MNDOT Research Center does have its own Twitter page, as shown in Figure 6-11.



Figure 6-11 MNDOT Research Twitter Page

Their Twitter page contains “tweets” or posts that directly relate to what is happening in the research program. These posts include a variety of information from final reports of research projects to conferences where MNDOT research is presented. Contact information for the research program is also provided on their Twitter page.

The possibilities that these social networking websites could bring to WYDOT are dependent on how involved the research center wants to get in updating and maintaining these pages. It is recommended that a Facebook and Twitter account be created for the WYDOT Research Program, and at the very least contact information and the research center’s mission statement be included on these pages. Additional posts including completion of final reports, conference presentations, and RAC meeting announcements would be good information for the research center to post. The benefits of these social networking websites range from publicity to inquiries for new research, and the WYDOT research center has the flexibility to make these websites as they see fit. Both of these avenues are free options for the WYDOT Research Center and only require updating from the Research Center staff.

6.7 Chapter Summary

By restructuring the content and organizational set up of WYDOT’s Research Center’s website, WYDOT employees will be able to easily access the resources that the research center has available. Departments within WYDOT will be able to find completed projects and technologies that they could potentially implement and utilize. Employees will be able to identify these projects and technologies through the final research reports that will be posted conveniently to the website. The Research Center can also show how important it is to the day to day operations

of WYDOT. Creating news releases for WYDOT's internal news publication, The Interchange, would be a great way to spread the word about all of the great projects, technologies, and improvements the research center has contributed to WYDOT. These news releases would also show interactions that the research center has with other departments within WYDOT and potentially create interest in future research projects.

Creating more awareness internally within WYDOT could be a great avenue for the Research Center to find input for potential future studies, and provide additional direction for the Research Center. Getting the WYDOT community further involved within the Research Center will not only encourage growth but ensure continued success. The improvements recommended by this report include:

- Creating a link to the research center from the main WYDOT page for ease of use.
- Allowing the WYDOT search engine to access the research center and its reports is crucial for technology transfer.
- Posting all of the final research reports to the website.
 - These reports need to be presented in an organized manner to easily convey the information to the users.
- The writing guidelines could include examples of what the research center and the RAC is expecting for proposing projects.
- The contact information for the research center employees needs to be clearly shown on the main page of the research center website, including email addresses.
- Links to research resources that WYDOT is involved with can be added to the website.
- Creating a mission statement will help define the research center, not only for potential researchers, but also for WYDOT employees.
- Adding additional content to the website including the WYDOT Research Work Program and current projects.
- Utilizing some free social networking websites like Facebook and Twitter will give another avenue for users to access information about the research center.

With the recommendations presented in this report the WYDOT Research Center website will be able to easily convey information to WYDOT employees and researchers. The changes made will allow the WYDOT Research Center to stay on the cutting edge of transportation research by maintaining an effective and efficient website.

CHAPTER 7 CONCLUSIONS AND RECOMMENDATIONS

An effective and implementable methodology was presented in this report that can be utilized for evaluating the research program of a transportation agency. The methodology is a two stage analysis that addresses the ten performance measurements which were developed by “A Methodology for Evaluating DOT’s Research Programs, A Case Study: Wyoming DOT.” The first stage analysis addresses eight of the ten performance measurements. The eight performance measurements that are addressed in the stage I methodology include the following:

- Number of projects and amount of funding per project by strategic intent.
- Number of proposals responding to the research program solicitations.
- Number of needs statements submitted by the agency’s programs.
- Outcomes of a project: specifications revised, new methodologies implemented, dollars saved/costs avoided, facilities with extended life, crashes reduced, fatalities reduced, new products evaluated and implemented, policy/legislative impacts, etc.
- Number of research reports completed each year and number of research reports not completed within three years.
- Percentage of administrative costs to overall program funding.
- Funds requested by research community versus funds available.
- Percentage of projects completed on-time and within budget. (Walton et. al., 1999)

These performance measurements address the direction that the research program has been moving towards during the time period analyzed as well as administrative measurements. The direction of the program is measured by looking at the projects for the identified strategic intent categories, the program’s responsiveness to the research needs of the DOT, and what types of outcomes the program’s research is generating. Also, administrative measurements are determined from the stage I methodology, including the research reports that are created each year, the administrative costs of the program, the funding capabilities of the program with respect to the needs of the program, and the percentage of projects that are completed on-time and within their proposed budget. All of these measures are critical for a DOT research program so that it is an effective and relevant asset.

The stage II methodology was developed in this study to focus on quantifying the impacts of individual projects as well as the research program as a whole. The additional two performance measurements that were covered in this methodology, not listed above, include the following:

- Cost-benefit analysis for individual projects.
- Cost-benefit analysis for the program.

As stated in Chapter 3, performance evaluations were created to quantify all research projects that DOT research programs complete. The performance evaluations consist of a two phase analysis that looks at projects immediately and two years after completion. These evaluations can be initiated by the DOT research program, as shown in the methodology, and they will quantify the effectiveness of the completed research projects. After a research project has been through the multi-phase analysis and received a score, the DOT research program managers can make recommendations for future research needs and project selection. The proposed two stage methodology will insure that research programs are fulfilling the emerging needs of DOTs.

7.1 WYDOT Case Study Conclusions

A case study of the WYDOT research program was completed to demonstrate the use and benefits of the developed methodology. The ten performance measurements developed in the proposed two stages were implemented to evaluate the performance of the WYDOT research program. The summaries of the performance measurements provided conclusions about the effectiveness and relevance of the WYDOT research program were developed. The evaluation focused on the research conducted by the WYDOT research program from 2005 to 2010. It was found that the WYDOT Research Center is an effective and productive program. The program is able to fund a variety of projects that benefit the traveling public, its employees, as well as the transportation research community. The organization of the research program allows it to remain flexible and proactive when addressing changing research projects as they evolve throughout their life cycle. The outcomes and results of WYDOT's research projects are beneficial and implementable not only by WYDOT but also by the entire transportation community. The following conclusions were developed after implementing the evaluation methodology on the WYDOT Research Program:

- The WYDOT research program funds research projects that contribute to the overall mission of WYDOT and the program is a valuable asset that helps WYDOT achieve their goals.
- Over 80 percent of the projects that were approved and completed between 2005 and 2010 had either full or partial implementation within WYDOT. The high level of implementation indicates that the Research Program is selecting the appropriate research projects for funding.
- WYDOT employees know the importance of research and know how to utilize their research program to address the needs of their respected WYDOT Program.
 - 60 percent of research projects were initiated by WYDOT employees.

- Eight of the WYDOT programs and two WYDOT districts sponsored research projects between 2005 and 2010.
- The research program funded a significant number of highway safety projects which is consistent with the overall mission of WYDOT.
- Less than 10 percent of the overall research budget is used for administrative costs; this administrative cost is minimal considering the size of the program.
- The WYDOT RAC has been given the unique opportunity to fund any project that could potentially have beneficial impacts on WYDOT.
 - 100% of proposed pooled fund studies, 100% of the proposed in-house research projects, and 85% of proposed contracted research projects were approved and funded by the RAC during the analysis period.
- The WYDOT research program consistently completes projects on time and within their proposed budgets.
 - 100% of contracted and in-house research projects are completed within budget and 88% are completed within their proposed timeline.
- Pooled fund studies are effective research options for WYDOT, but they should be more closely evaluated to determine if the scope and results of these studies will benefit WYDOT directly.
 - Three out of five pooled fund studies evaluated in this study currently have no expected implementation for WYDOT.
 - None of the pooled fund studies have been completed on their proposed timeline and three out of the five pooled fund studies will not be completed within their initial proposed budget.
- The performance evaluations completed on the research projects yielded high overall performance scores.
 - The research projects averaged a score of 96% for the phase 1 performance evaluation, meaning they met the overall administrative and performance requirements set.
 - The research projects averaged a score of 83% for the phase 2 performance evaluation, a slightly lower score was observed for this evaluation as not all research projects met their expected level of implementation.

7.2 Recommendations for the WYDOT Research Program

The following recommendations are proposed based on the analysis performed.

- WYDOT should continue funding research projects that advance the overall goals of their mission statement.
- It is recommended that an inquiry be made about the reasons why three successful pre-proposals pertaining to wildlife studies were not brought back to the RAC as proposals.

- It is recommended that the RAC receive formal presentations about pooled fund studies before voting on budgetary and timeline extensions. To accomplish this, a Pooled Fund Extension Form was created and is shown in Appendix C.
- If discrepancies arise regarding a research project's direction, the principal investigator, WYDOT liaison and the research program need to come together and clearly define what new knowledge, products, or standards WYDOT is hoping to gain from the project.
- Projects resulting in knowledge had an overall lower level of implementation within WYDOT. When such projects are presented to the RAC, it is recommended that the results and outcomes of the projects be identified to ensure implementable results are produced.
- Two out of five WYDOT districts sponsored research projects that were identified by this study. It is recommended that the WYDOT research program encourage research projects to be sponsored from the remaining WYDOT districts.
- It is recommended that the performance evaluations developed in this study, shown in Appendix E and Appendix F, be implemented within the WYDOT research program. Having the ability to quantify and score the completed projects will be a beneficial tool for the WYDOT research program to demonstrate the effectiveness of their research projects.
- It is recommended that the developed standardized budget be used to evaluate proposed research project's budgets. Having a standardized budget will allow the RAC to evaluate proposed project funding needs and make recommendations. The standardized budget is shown in Appendix G.
- This study also suggests that the WYDOT research program revamp its website for greater technology transfer opportunities. The recommendations found in Chapter 6 outline the possible improvements with respect to content and overall structure. Implementing these recommendations will insure that the research program website meets the needs of WYDOT employees and the transportation community.

7.3 Implementing the Methodology for DOT Research Programs

Any other DOTs interested in evaluating their research programs can implement the two stage methodology developed in this study. This methodology provides DOTs with a framework, direction, and specific procedures for evaluating their research program based on their particular needs. The case study presented in this report shows how DOT research programs can gather the necessary information and conduct the evaluation of the research they complete as well as their research program.

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APPENDIX A1: TABLE OF ALL PROJECTS IDENTIFIED FOR THE FIRST LEVEL ANALYSIS

PROPOSAL DATE	WYDOT I.D.	PROJECT TITLE	PROJECT TYPE	PRESENTOR	SPONSORING ORGANIZATION	LEAD STATE- POOLED FUND	WYDOT CHAMPION	PROJECT AREA	REQUESTED FUNDING	ESTIMATED COMPLETION DATE	DECISION
1/5/2005	TPF-5(068)	POOLED FUND: LONG-TERM MAINTENANCE OF LOAD AND RESISTANCE FACTOR DESIGN SPECIFICATIONS	INCREASED FUNDING	SANDRA LARSON	IOWA DOT	IOWA	KEITH FULTON	BRIDGE	\$20,000		FORWARD REQUEST TO EXECUTIVE STAFF FOR APPROVAL
4/12/2005	RS02(205)	FATIGUE TESTING OF WYDOT'S SIGNAL POLE STIFFENED CONNECTION PHASE II.	PROPOSAL	JAY PUCKETT	UNIVERSITY OF WYOMING		GREGG FREDRICK/ PAUL HUCK	BRIDGE	\$192,190	2 YEARS FROM START	FORWARD REQUEST TO EXECUTIVE STAFF FOR APPROVAL
4/12/2005	RS03(205)	FEASIBILITY OF A NEXT-GENERATION, INTERMODAL RAIL-TRUCK TRANSPORT SYSTEM FOR THE WESTERN I-80 CORRIDOR	PROPOSAL	GARY SCHNEIDER	R & S CONSULTING		MARK WINGATE	PLANNING	\$95,700	6 MONTHS FROM START	FORWARD REQUEST TO EXECUTIVE STAFF FOR APPROVAL
7/14/2005	RS04(205)	HIGHWAY RELATED BUSINESS IMPACTS: Phase III EFFORT FOR THE TOWN OF DUBOIS	PROPOSAL	RHONDA YOUNG	UNIVERSITY OF WYOMING		MARK EISENHART	CONSTRUCTION	\$87,972	2.5 YEARS FROM START	FORWARD REQUEST TO EXECUTIVE STAFF FOR APPROVAL
7/14/2005	TPF-5(054)	POOLED FUND: DEVELOPMENT OF MAINTENANCE DECISION SUPPORT SYSTEM	PROPOSAL	DAVE HUFT	SDDOT	SOUTH DAKOTA	JEFF FRAIZER	MAINT.	\$100,000	1 YEAR FROM START	FORWARD REQUEST TO EXECUTIVE STAFF FOR APPROVAL
7/14/2005	RS05(205)	SNOW SUPPORTING STRUCTURES FOR AVALANCHE HAZARD REDUCTION MILEPOST 151 AVALANCHE, HIGHWAY US 89/191, JACKSON, WYOMING	PROPOSAL	RAND DECKER	MSI-FOOTHILL INTERALPINE		JAMES MONTUORO	MAINT.	\$94,689	1.5 YEARS FROM START	FORWARD REQUEST TO EXECUTIVE STAFF FOR APPROVAL
10/12/2005	RS01(206)	CHARACTERIZATION OF WYOMING HOT MIX ASPHALT WITH THE HAMBURG WHEEL-TRACKING DEVICE (HWTD)	PROPOSAL	VICKI BONDS	WYDOT		VICKI BONDS	MATERIALS	\$120,000	2.5 YEARS FROM START	FORWARD REQUEST TO EXECUTIVE STAFF FOR APPROVAL
10/12/2005	RS04(206)	EVALUATION OF TREATMENT OPTIONS FOR ASR-AFFECTED CONCRETE	PROPOSAL	KIM BASHAM	CONCRETE ENG. SPECIALISTS LLC		CHERYL BEAN	AERONAUTICS	\$101,650	6 YEARS FROM START	FORWARD REQUEST TO EXECUTIVE STAFF FOR APPROVAL
10/12/2005	TPF-5(150)	POOLED FUND: EXTENDING THE SEASON FOR CONCRETE CONSTRUCTION AND REPAIR: PHASE III	PROPOSAL	CHARLES KORHONEN	US ARMY CORP OF ENGINEERS		TIM MCDOWELL	PLANNING	\$80,000	2.5 YEARS FROM START	FORWARD REQUEST TO EXECUTIVE STAFF FOR APPROVAL
10/12/2005	TPF-5(193)	POOLED FUND: MIDWEST STATES POOLED FUND CRASH TEST PROGRAM SPR-3(017)	PROPOSAL	AMY STARR	NDOR	NEBRASKA	KEITH FULTON / BILL WILSON	BRIDGE	\$137,500	2.5 YEARS FROM START	FORWARD REQUEST TO EXECUTIVE STAFF FOR APPROVAL
10/12/2005	XXXXXX	RELATING VEHICLE-WILDLIFE CRASH RATES TO ROADWAY IMPROVEMENTS	PROPOSAL	RHONDA YOUNG	UNIVERSITY OF WYOMING			SAFETY	\$38,034	9 MONTHS FROM START	NOT FORWARDED TO EXECUTIVE STAFF FOR APPROVAL
1/11/2006	RS03(206)	A LABORATORY INVESTIGATION OF PRESSURE CONTRACTION SCOUR AT SUBMERGED BRIDGES	PROPOSAL	SUE NIEZGODA	UNIVERSITY OF WYOMING		WILLIAM BAILEY	BRIDGE	\$171,114	3.5 YEARS FROM START	FORWARD REQUEST TO EXECUTIVE STAFF FOR APPROVAL
1/11/2006	RS02(206)	VEHICLE-WILDLIFE CRASH RATES TO ROADWAY IMPROVEMENTS	PROPOSAL	RHONDA YOUNG	UNIVERSITY OF WYOMING		MATT CARLSON	SAFETY	\$50,478	1 YEAR FROM START	FORWARD REQUEST TO EXECUTIVE STAFF FOR APPROVAL
4/12/2006	RS07(206)	EVALUATION OF INTELLIGENT TRANSPORTATION SYSTEM ALTERNATIVES FOR REDUCING THE RISKS OF TRUCK ROLLOVER CRASHES DUE TO HIGH WINDS.	PROPOSAL	GARY SCHNEIDER/ LARRY REDD	R & S Consulting		MIKE GOSTOVICH	SAFETY	\$88,000	1 YEAR FROM START	FORWARD REQUEST TO EXECUTIVE STAFF FOR APPROVAL
4/12/2006	RS06(206)	PRACTICAL OPERATIONAL IMPLEMENTATION AND EVALUATION OF TETON PASS AVALANCHES MONITORING INFRASOUND SYSTEM.	PROPOSAL	ERNIE SCOTT	Inter-Mountain Labs/Sheridan		JAMES MONTUORO	MAINT.	\$86,853	2 YEARS FROM START	FORWARD REQUEST TO EXECUTIVE STAFF FOR APPROVAL
4/12/2006	XXXXXX	SNOW FENCE LIFE CYCLE COST ANALYSIS	PROPOSAL	PAUL MCCARTHY	WYDOT		PAUL MCCARTHY	MAINT.	\$486,000	5 YEARS FROM START	NOT FORWARDED TO EXECUTIVE STAFF FOR APPROVAL
7/6/2006	RS01(207)	A COMPREHENSIVE TRANSPORTATION SAFETY EVALUATION PROGRAM IN THE STATE OF WYOMING	PRE-PROPOSAL	KHALED KSAIBATI	UNIVERSITY OF WYOMING, WY T*2			SAFETY	\$267,384	1.5 YEARS FROM START	APPROVED TO SUBMITT PROPOSAL
7/6/2006	RS10(206)	EFFECTIVENESS OF TRAPPER'S POINT WILDLIFE CROSSING ANIMAL DETECTION SYSTEM	PROPOSAL	RHONDA YOUNG	UNIVERSITY OF WYOMING		MATT CARLSON	SAFETY	\$76,344	2.5 YEARS FROM START	FORWARD REQUEST TO EXECUTIVE STAFF FOR APPROVAL
7/6/2006	RS09(206)	EVALUATING THE RISK OF ALKALI-SILICA REACTION IN WYOMING THROUGH AN INTER-LABORATORY INVESTIGATION OF MULTIPLE ASR EVALUATION METHODS	PROPOSAL	JENNIFER TANNER	UNIVERSITY OF WYOMING		BOB ROTHWELL	MATERIALS	\$228,125	6 YEARS FROM START	FORWARD REQUEST TO EXECUTIVE STAFF FOR APPROVAL
7/6/2006	TPF-5(054)	POOLED FUND TPF-5(054): DEVELOPMENT OF MAINTENANCE DECISION SUPPORT SYSTEM.	INCREASED FUNDING	DAVE HUFT	SDDOT	SOUTH DAKOTA	JEFF FRAIZER	MAINT.	\$50,000	1 YEAR FROM START	FORWARD REQUEST TO EXECUTIVE STAFF FOR APPROVAL
10/11/2006	RS01(207)	A COMPREHENSIVE TRANSPORTATION SAFETY EVALUATION PROGRAM IN THE STATE OF WYOMING	PROPOSAL	KHALED KSAIBATI	UNIVERSITY OF WYOMING, WY T*2		MATT CARLSON	SAFETY	\$158,365	2 YEARS FROM START	FORWARD REQUEST TO EXECUTIVE STAFF FOR APPROVAL

10/11/2006	TPF-5(068)	POOLED FUND TPF-5(068): LONG-TERM MAINTENANCE OF LOAD AND RESISTANCE FACTOR DESIGN SPECIFICATIONS	PROPOSAL	CAROL CULVER	IOWA DOT	IOWA	KEITH FULTON	BRIDGE	\$40,000	3 YEARS FROM START	FORWARD REQUEST TO EXECUTIVE STAFF FOR APPROVAL
10/11/2006	TPF-5(218)	POOLED FUND TPF-5(092): CLEAR ROADS (TEST AND EVALUATION OF MATERIALS, EQUIPMENT AND METHODS FOR WINTER HIGHWAY MAINTENANCE).	PROPOSAL	DEBRA FICK	MnDOT	MINNESOTA	CLIFF SPOONEMORE	CONSTRUCTION	\$20,000	1 YEAR FROM START	FORWARD REQUEST TO EXECUTIVE STAFF FOR APPROVAL
10/11/2006	TPF-5(151)	POOLED FUND: SUBSURFACE DRAINAGE FOR LANDSLIDE AND SLOPE STABILIZATION.	PROPOSAL	TOM BADGER	WSDOT	WASHINGTON	MAK FALT	GEOLOGY	\$30,000	UNKNOWN	FORWARD REQUEST TO EXECUTIVE STAFF FOR APPROVAL
1/10/2007	TPF-5(177)	POOLED FUND: IMPROVING RESILIENT MODULUS TEST PROCEDURES FOR UNBOUND MATERIALS	PROPOSAL	MIKE MORAVEC	FHWA		BOB ROTHWELL	MATERIALS	\$40,000	3 YAERS FROM START	FORWARD REQUEST TO EXECUTIVE STAFF FOR APPROVAL
1/10/2007		SAFETY MANAGEMENT SYSTEM	PRE-PROPOSAL	MARTIN KIDNER	WYDOT		MARTON KIDNER	PLANNING	\$200,000	UNKNOWN	APPROVED TO SUBMITT PROPOSAL
1/10/2007	RS02(207)	SNOW SNAKE PERFORMANCE MONITORING	PROPOSAL	PAUL MCCARTHY	PMPC		CLIFF SPOONEMORE	CONSTRUCTION	\$40,000	10 MONTHS FROM START	FORWARD REQUEST TO EXECUTIVE STAFF FOR APPROVAL
7/11/2007	RS07(207)	EFFECTIVENESS OF USING RECYCLED ASPHALT MATERIALS (RAP) AND OTHER DUST SUPPRESSANTS ON GRAVEL ROADS	PROPOSAL	KHALED KSAIBATI	UNIVERSITY OF WYOMING, WY T ²		DALE McOMIE	MATERIALS	\$95,120	2 YEARS FROM START	FORWARD REQUEST TO EXECUTIVE STAFF FOR APPROVAL
7/11/2007	RS04(207)	I-80 FREIGHT CORRIDOR ANALYSIS	PROPOSAL	GARY SHNEIDER	R & S CONSULTING		MARK WINGATE	PLANNING	\$75,000	7 MONTHS FROM START	FORWARD REQUEST TO EXECUTIVE STAFF FOR APPROVAL
7/11/2007	RS06(207)	ITS SYTEM TO REDUCE HIGH WIND TRUCK CRASHES ON I-25 NEAR BORDEAUX, WY.	PROPOSAL	RHONDA YOUNG	UNIVERSITY OF WYOMING		VINCE GARCIA	ITS	\$166,744	3 YEARS FROM START	FORWARD REQUEST TO EXECUTIVE STAFF FOR APPROVAL
7/11/2007	RS05(207)	VARIABLE SPEED LIMIT SYSTEM FOR I-80 ELK MOUNTAIN CORRIDOR.	PROPOSAL	RHONDA YOUNG	UNIVERSITY OF WYOMING		VINCE GARCIA	ITS	\$390,184	2.5 YEARS FROM START	FORWARD REQUEST TO EXECUTIVE STAFF FOR APPROVAL
10/10/2007	TPF-5(218)	Pooled Fund Update and Additional Funding Request: Clear Roads (Test and Evaluation of Materials, Equipment and Methods for Winer Highway Maintenance).	INCRASED FUNDING	DEBRA FICK	MnDOT	MINNESOTA	CLIFF SPOONEMORE	CONSTRUCTION	\$75,000	3 ADDIONAL YEARS	FORWARD REQUEST TO EXECUTIVE STAFF FOR APPROVAL
10/10/2007	TPF-5(145)	Pooled Fund Update and Additional Funding Request: Western Maintenance Partnership	INCRASED FUNDING	MICHAEL FAZIO	UDOT	UTAH	JEFF FRAZIER	MAINT.	\$7,000		FORWARD REQUEST TO EXECUTIVE STAFF FOR APPROVAL
10/10/2007	RS03(207)	Update and Additional Funding Request: Evaluation of WYDOT's Research Center and Research Program	INCRASED FUNDING	LARRY REDD	R & S CONSULTING		PAT COLLINS	PLANNING	\$10,000	6 ADDITIONAL MONTHS	FORWARD REQUEST TO EXECUTIVE STAFF FOR APPROVAL
1/9/2008	XXXXXX	BAGGS MULE DEER CROSSING PROJECT	PRE-PROPOSAL	TOM WOOLEY				WILDLIFE STUDIES	\$250,000	2 YEARS FROM START	APPROVED TO SUBMITT PROPOSAL
1/9/2008	XXXXXX	PRONGHORN MOVEMENTS ACROSS I-80: CAN WE RE-ESTABLISH HISTORIC MIGRATION PATTERNS IN SOUTH CENTRAL WYOMING?	PRE-PROPOSAL	TOM RYDER				WILDLIFE STUDIES	\$5,000	2 YEARS FROM START	APPROVED TO SUBMITT PROPOSAL
1/9/2008	XXXXXX	REESTABLISHMENT OF WILDLIFE MIGRATION CORRIDORS ACROSS INTERSTATE 80	PRE-PROPOSAL	TERRY CREEKMORE	WYOMING GAME AND FISH			WILDLIFE STUDIES	\$575,000		APPROVED TO SUBMITT PROPOSAL
4/9/2008	TPF-5(193)	POOLED FUND SPR-3(017) ADDITIONAL FUNDING: MIDWEST STATES POOLED FUND CRASH TEST PROGRAM	PROPOSAL	AMY STARR	NDOR	NEBRASKA	BILL WILSON, KEITH FULTON	BRIDGE	\$65,000	3 YAERS FROM START	FORWARD REQUEST TO EXECUTIVE STAFF FOR APPROVAL
4/9/2008	TPF-5(116)	POOLED FUND TPF-5(116) INVESTIGATION OF THE FATIGUE LIFE OF STEEL BASE PLATE TO POLE CONNECTIONS FOR TRAFFIC STRUCTURES.	INCRASED FUNDING	TxDOT	TxDOT	TEXAS	KEITH FULTON	BRIDGE	\$25,000	5 ADDITIONAL MONTHS	FORWARD REQUEST TO EXECUTIVE STAFF FOR APPROVAL
4/9/2008	TPF-5(189)	POOLED FUND: ENHANCEMENT OF WELDED STEEL BRIDGE GIRDERS SUSCEPTIBLE TO DISTORTION- INDUCED FATIGUE	PROPOSAL	RODNEY MONTNEY	KANSAS DOT	KANSAS	KEITH FULTON	BRIDGE	\$75,000	3 YEARS FROM START	FORWARD REQUEST TO EXECUTIVE STAFF FOR APPROVAL
4/9/2008	TPF-5(178)	POOLED FUND: IMPLEMENTATION OF THE SIMPLE PERFORMANCE TESTER (SPT) FOR SUPERPAVE VALIDATION	PROPOSAL	AUDREY COPELAND	FHWA		RICK HARVEY	MATERIALS	\$105,000	3 YEARS FROM START	FORWARD REQUEST TO EXECUTIVE STAFF FOR APPROVAL
4/9/2008	RS02(208)	USE OF TRUCK-MOUNTED CHANGEABLE MESSAGE SIGNS (CMSs) DURING MOBILE OPERATIONS	PROPOSAL	TEXAS TRANSPORTATION INSTITUTE	TEXAS TRANSPORTATION INSTITUTE		MIKE GOSTOVICH	TRAFFIC	\$171,201	1 YEAR FROM START	FORWARD REQUEST TO EXECUTIVE STAFF FOR APPROVAL
6/9/2008	TPF-5(192)	POOLED FUND: LOOP AND LENGTH BASED CLASSIFICATION POOLED FUND	PROPOSAL	SUE LODAHL	MnDOT	MINNESOTA	MARK WINGATE	PLANNING	\$30,000	2.5-3 YEARS FROM START	FORWARD REQUEST TO EXECUTIVE STAFF FOR APPROVAL
10/8/2008	RS01(209)	EVALUATION OF THE EFFECTIVENESS OF MULE DEER CROSSING STRUCTURES IN NUGGET CANYON	PROPOSAL	HALL SAWYER	WESTERN ECOSYST. TECH.		JOHN EDDINS	WILDLIFE STUDIE	\$122,641	AUG. 2011	FORWARD REQUEST TO EXECUTIVE STAFF FOR APPROVAL

10/8/2008	XXXXXX	MAXIMIZING VALUE CREATION AND COST REDUCTION IN ASSET MANAGEMENT	PROPOSAL	LARRY REDD	R & M ANALYTICS			PLANNING	\$172,850	10-12 MONTHS FROM START	NOT FORWARDED TO EXECUTIVE STAFF FOR APPROVAL
10/8/2008	RS05(209)	POOLED FUND: AASHTO DARWIN-ME COOPERATIVE SOFTWARE DEVELOPMENT PROJECT	PROPOSAL	VICKI SCHOFIELD	AASHTO		RICK HARVEY	MATERIALS	\$100,000	18 MONTHS FROM START	FORWARD REQUEST TO EXECUTIVE STAFF FOR APPROVAL
1/7/2009	RS04(209)	BRIDGE DECK EVALUATION USING NON-DESTRUCTIVE TEST METHODS	PROPOSAL	JENNIFER TANNER	UNIVERSITY OF WYOMING		KEITH FULTON	BRIDGE	\$116,210	2 YEARS FROM START	FORWARD REQUEST TO EXECUTIVE STAFF FOR APPROVAL
1/7/2009	RS03(209)	IMPLEMENTATION OF THE MECHANISTIC-EMPIRICAL PAVEMENT DESIGN GUIDE IN THE WYOMING DEPARTMENT OF	PROPOSAL	APPLIED RESEARCH ASSOCIATION	APPLIED RESEARCH ASSOCIATION		VICKI BONDS	MATERIALS	\$218,993	18 MONTHS FROM START	FORWARD REQUEST TO EXECUTIVE STAFF FOR APPROVAL
4/15/2009	RS06(209)	GRAVEL ROADS MANAGEMENT: DEVELOPING A METHODOLOGY	PROPOSAL	KHALED KSAIBATI	UNIVERSIT OF WYOMING, WY T^2		MARTIN KINDER	PLANNING	\$44,851	1 YEAR FROM START	FORWARD REQUEST TO EXECUTIVE STAFF FOR APPROVAL
4/15/2009	RS07(209)	IMPROVING FOUNDATION DESIGN IN ROCK: ANALYSIS OF OSTERBERG CELL LOAD TEST AT BURMA ROAD OVERPASS	PROPOSAL	JOHN TURNER	UNIVERSITY OF WYOMING		MARK FALK	GEOLOGY	\$32,873	6 MONTHS FROM START	FORWARD REQUEST TO EXECUTIVE STAFF FOR APPROVAL
10/14/2009	RS04(209)	BRIDGE DECK EVALUATION USING NON-DESTRUCTIVE TEST METHODS	INCREASED FUNDING	JENNIFER TANNER	UNIVERSITY OF WYOMING		KEITH FULTON	BRIDGE	\$33,500		FORWARD REQUEST TO EXECUTIVE STAFF FOR APPROVAL
10/14/2009	TPF-5(054)	POOLED FUND TPF-5(054): DEVELOPMENT OF A MAINTENANCE DECISION SUPPORT SYSTEM	INCREASED FUNDING	DAVE HUFT	SDDOT	SOUTH DAKOTA	JEFF FRAZIER	MAINT.	\$50,000	SEPT. 2011	FORWARD REQUEST TO EXECUTIVE STAFF FOR APPROVAL
10/14/2009		TREATMENT OPTIONS TO MITIGATE VORTEX SHEDDING IN HIGH-MAST POLE.	PROPOSAL	JAY PUCKETT	UNIVERSITY OF WYOMING			BRIDGE	\$12,000	MAY. 2010	FORWARD REQUEST TO EXECUTIVE STAFF FOR APPROVAL
10/14/2009	RS03(210)	UNDERSTANDING MULE DEER MOVEMENT AND HABITAT USE PATTERN IN RELATION TO ROADWAYS IN NORTHWEST WYOMING	PRE-PROPOSAL	EMBERE HALL	TETON SCIENCE SCHOOL		PETE HALLSTEN	WILDLIFE STUDIES	\$390,294	3 YEARS FROM START	APPROVED TO SUBMITT PROPOSAL
4/14/2010		MANAGING RISKS IN THE PROJECT PIPELINE - MINIMIZING THE IMPACTS OF HIGHWAY FUNDING UNCERTAINTIES	PROPOSAL	LARRY REDD	LARRY REDD, LLC		TIM MCDOWELL	PLANNING	\$58,000	DEC. 31, 2010	NOT FORWARDED TO EXECUTIVE STAFF FOR APPROVAL
4/14/2010	TPF-5(218)	POOLED FUND TPF-5(218): CLEAR ROADS WINTER HIGHWAYS OPERATIONS POOLED FUND	INCREASED FUNDING	DEBRA FICK	MndOT	MINNESOTA	CLIFF SPOONEMORE	CONSTRUCTION	\$75,000	3 YEAR EXTENTION, September 30, 2015	FORWARD REQUEST TO EXECUTIVE STAFF FOR APPROVAL
4/14/2010	RS04(210)	RURAL VARIABLE SPEED LIMIT SYSTEMS: PHASE II	PROPOSAL	RHONDA YOUNG	UNIVERSITY OF WYOMING		VINCE GARCIA	ITS	\$182,403	DEC. 31, 2012	FORWARD REQUEST TO EXECUTIVE STAFF FOR APPROVAL
4/14/2010	RS06(210)	STATEWIDE MESOSCOPIC TRAFFIC SIMULATION FOR WYOMING	PROPOSAL	STEPHEN BOYLES	UNIVERSITY OF WYOMING		LEE ROADIFER	TRAFFIC	\$127,538	APRIL 30, 2012	FORWARD REQUEST TO EXECUTIVE STAFF FOR APPROVAL
4/14/2010	RS03(210)	UNDERSTANDIN MULE DEER MOVEMENT AND HABITAT USE PATTERNS IN RELATION TO ROADWAYS IN NORTHWEST WYOMING	PROPOSAL	EMBERE HALL	TETON SCIENCE SCHOOL		PETE HALLSTEN	WILDLIFE STUDIES	\$310,864	2 YEARS FROM START	FORWARD REQUEST TO EXECUTIVE STAFF FOR APPROVAL
4/14/2010	RS05(210)	WYOMING COUNTY ROAD FUND MANUAL - UPDATED RESEARCH FUNDING PROPOSAL - PHASE I	PROPOSAL	GALEN HESTERBERG	HESTERBERG CONSULTANTS		PAUL BERCIH	PLANNING	\$5,350	JUNE. 30, 2010	FORWARD REQUEST TO EXECUTIVE STAFF FOR APPROVAL
6/14/2010	RS08(210)	COMPARING CRASH TRENDS AND SEVERITY IN THE NORTHERN ROCKY MOUNTAIN REGION	PROPOSAL	KHALED KSAIBATI	UNIVERSITY OF WYOMING, WY T^2		MATT CARLSON	SAFETY	\$47,832	JULY. 31, 2011	FORWARD REQUEST TO EXECUTIVE STAFF FOR APPROVAL
6/14/2010		POOLED FUND - RELATIVE OPERATIONAL PERFORMANCE OF GEOSYNTHETICS USED AS SUBGRADE STABILIZATION	PROPOSAL	JIM COFFIN	WYDOT		JIM COFFIN	GEOLOGY	\$60,000	2 YEARS FROM START	FORWARD REQUEST TO EXECUTIVE STAFF FOR APPROVAL
6/14/2010	RS09(210)	WYOMING COUNTY ROAD FUND MANUAL - UPDATED RESEARCH FUNDING PROPOSAL - PHASE 2	PROPOSAL	GALEN HESTERBERG	HESTERBERG CONSULTANTS		TONY LAIRD	PLANNING	\$45,800	SEPT. 2011	FORWARD REQUEST TO EXECUTIVE STAFF FOR APPROVAL
10/25/2010	RS03(209)	IMPLEMENTATION OF THE MECHANISTIC-EMPIRICAL PAVEMENT DESIGN GUIDE IN THE WYOMING DEPARTMENT OF TRANSPORTATION	INCREASED FUNDING	APPLIED RESEARCH ASSOCIATION	APPLIED RESEARCH ASSOCIATION		VICKI BONDS	MATERIALS	\$150,971	1 ADDITIONAL YEAR	FORWARD REQUEST TO EXECUTIVE STAFF FOR APPROVAL
10/25/2010	SOLICITATION 1266	POOLED FUND SOLICITATION 1265: TESTING UNMANNED AIRCRAFT FOR ROADSIDE AVALANCHE CONTROL	PROPOSAL	CRAIG ABERNATH	MDOT	MONTANA	JIM COFFIN	GEOLOGY	\$15,000	3 YEARS FROM START	FORWARD REQUEST TO EXECUTIVE STAFF FOR APPROVAL

APPENDIX A2: PROJECTS IDENTIFIED FOR THE SECOND LEVEL ANALYSIS

WYDOT IDENTIFICATION	PROJECT TITLE
RS01(206)	CHARACTERIZATION OF WYOMING HOT MIX ASPHALT WITH THE HAMBURG WHEEL-TRACKING DEVICE (HWTD)
RS01(207)	A COMPREHENSIVE TRANSPORTATION SAFETY EVALUATION PROGRAM IN THE STATE OF WYOMING
RS02(206)	VEHICLE-WILDLIFE CRASH RATES TO ROADWAY IMPROVEMENTS
RS02(207)	SNOW SNAKE PERFORMANCE MONITORING
RS02(208)	USE OF TRUCK-MOUNTED CHANGEABLE MESSAGE SIGNS (CMSs) DURING MOBILE OPERATIONS
RS04(206)	EVALUATION OF TREATMENT OPTIONS FOR ASR-AFFECTED CONCRETE
RS04(207)	I-80 FREIGHT CORRIDOR ANALYSIS
RS05(205)	SNOW SUPPORTING STRUCTURES FOR AVALANCHE HAZARD REDUCTION MILEPOST 151 AVALANCHE, HIGHWAY US 89/191, JACKSON, WYOMING
RS05(207)	VARIABLE SPEED LIMIT SYSTEM FOR I-80 ELK MOUNTAIN CORRIDOR.
RS05(210)	WYOMING COUNTY ROAD FUND MANUAL - UPDATED RESEARCH FUNDING PROPOSAL - PHASE I
RS06(206)	PRACTICAL OPERATIONAL IMPLEMENTATION AND EVALUATION OF TETON PASS AVALANCHES MONITORING INFRASOUND SYSTEM.
RS06(207)	ITS SYTEM TO REDUCE HIGH WIND TRUCK CRASHES ON I-25 NEAR BORDEAUX, WY.
RS06(209)	GRAVEL ROADS MANAGEMENT: DEVELOPING A METHODOLOGY
RS07(206)	EVALUATION OF INTELLIGENT TRANSPORTATION SYSTEM ALTERNATIVES FOR REDUCING THE RISKS OF TRUCK ROLLOVER CRASHES DUE TO HIGH WINDS.
RS07(209)	IMPROVING FOUNDATION DESIGN IN ROCK: ANALYSIS OF OSTERBERG CELL LOAD TEST AT BURMA ROAD OVERPASS
RS10(206)	EFFECTIVENESS OF TRAPPER'S POINT WILDLIFE CROSSING ANIMAL DETECTION SYSTEM
TPF-5(054)	POOLED FUND: DEVELOPMENT OF MAINTENANCE DECISION SUPPORT SYSTEM
TPF-5(151)	POOLED FUND: SUBSURFACE DRAINAGE FOR LANDSLIDE AND SLOPE STABILIZATION.
TPF-5(177)	POOLED FUND: IMPROVING RESILIENT MODULUS TEST PROCEDURES FOR UNBOUND MATERIALS
TPF-5(193)	POOLED FUND: MIDWEST STATES POOLED FUND CRASH TEST PROGRAM SPR-3(017)
TPF-5(218)	POOLED FUND TPF-5(092): CLEAR ROADS (TEST AND EVALUATION OF MATERIALS, EQUIPMENT AND METHODS FOR WINTER HIGHWAY MAINTENANCE).

APPENDIX A3: PROJECTS USED FOR TESTING THE PERFORMANCE EVALUATIONS

WYDOT IDENTIFICATION	PROJECT TITLE
RS01(206)	CHARACTERIZATION OF WYOMING HOT MIX ASPHALT WITH THE HAMBURG WHEEL-TRACKING DEVICE (HWTB)
RS01(207)	A COMPREHENSIVE TRANSPORTATION SAFETY EVALUATION PROGRAM IN THE STATE OF WYOMING
RS02(206)	VEHICLE-WILDLIFE CRASH RATES TO ROADWAY IMPROVEMENTS
RS02(207)	SNOW SNAKE PERFORMANCE MONITORING
RS02(208)	USE OF TRUCK-MOUNTED CHANGEABLE MESSAGE SIGNS (CMSs) DURING MOBILE OPERATIONS
RS04(206)	EVALUATION OF TREATMENT OPTIONS FOR ASR-AFFECTED CONCRETE
RS04(207)	I-80 FREIGHT CORRIDOR ANALYSIS
RS05(205)	SNOW SUPPORTING STRUCTURES FOR AVALANCHE HAZARD REDUCTION MILEPOST 151 AVALANCHE, HIGHWAY US 89/191, JACKSON, WYOMING
RS05(207)	VARIABLE SPEED LIMIT SYSTEM FOR I-80 ELK MOUNTAIN CORRIDOR.
RS05(210)	WYOMING COUNTY ROAD FUND MANUAL - UPDATED RESEARCH FUNDING PROPOSAL - PHASE I
RS06(206)	PRACTICAL OPERATIONAL IMPLEMENTATION AND EVALUATION OF TETON PASS AVALANCHES MONITORING INFRASOUND SYSTEM.
RS06(207)	ITS SYTEM TO REDUCE HIGH WIND TRUCK CRASHES ON I-25 NEAR BORDEAUX, WY.
RS06(209)	GRAVEL ROADS MANAGEMENT: DEVELOPING A METHODOLOGY
RS07(206)	EVALUATION OF INTELLIGENT TRANSPORTATION SYSTEM ALTERNATIVES FOR REDUCING THE RISKS OF TRUCK ROLLOVER CRASHES DUE TO HIGH WINDS.
RS07(209)	IMPROVING FOUNDATION DESIGN IN ROCK: ANALYSIS OF OSTERBERG CELL LOAD TEST AT BURMA ROAD OVERPASS
RS10(206)	EFFECTIVENESS OF TRAPPER'S POINT WILDLIFE CROSSING ANIMAL DETECTION SYSTEM
RS03(205)	FEASIBILITY OF A NEXT-GENERATION, INTERMODAL RAIL-TRUCK TRANSPORT SYSTEM FOR THE WESTERN I-80 CORRIDOR
RS02(205)	FATIGUE TESTING OF WYDOT'S SIGNAL POLE STIFFENED CONNECTION PHASE II.

APPENDIX B: PROJECT SUMMARIES FROM THE SECOND LEVEL ANALYSIS

In-House Research Project	RS01(206)
	Characterization of WY Hot Mix Asphalt with the Hamberg Wheel-Tracking Device (HWTD)
Background Information	
Project Category	Standards
Funds Obligated/Expended	\$120,000/\$69,013
WYDOT Program	Materials
WYDOT Sponsor	Vicki Bonds
Started	November, 2005
Completed	October, 2006
Participants	WYDOT
Objectives	
<ul style="list-style-type: none"> • Predict the effects of stripping in asphalt mixes in addition to rutting using the HWTD. • Verify that the results of the Hamberg device are representative of the results observed in the field. • Prepare a formal operating procedure and formulating guidelines for Wyoming Asphalt mixes. 	
Execution and Performance	
<ul style="list-style-type: none"> • The project was able to meet 2 out of 3 objectives using \$69,012.50 of the \$120,000 proposed budget, additional research is on-going. 	
Project Outcomes	
<ul style="list-style-type: none"> • The calibration of field cores and lab mixed samples was inconclusive; replacing the current TSR specifications with the Hamberg specification is premature. • A tentative guideline for future research was developed. 	
Recommendations	
<ul style="list-style-type: none"> • Current testing and further data collection is being conducted internally in the materials office to make recommendations for future specifications. • The HWTD is an effective tool for the WYDOT materials department and further internal and external research with Texas DOT. 	
Implementation	
<ul style="list-style-type: none"> • The Hamberg Wheel-Tracking Device is being used in the WYDOT materials lab to collect further data. Eventually, specifications for the HWTD will be created for WYDOT after sufficient data has been collected and analyzed. 	
Level of Implementation	
<div style="display: flex; justify-content: space-around; width: 100%;"> None Partial Full </div>	

Contract Research Project	RS01(207)
	A Comprehensive Transportation Safety Evaluation Program for Wyoming
Background Information	
Project Category	Standards
Funds Obligated/Expended	\$158,365/\$156,949
WYDOT Program	Safety
WYDOT Sponsor	Matt Carlson
Started	November, 2006
Completed	October, 2009
Participants	University of Wyoming, WY Technology Transfer Center, WYDOT
Objectives	
<ul style="list-style-type: none"> Develop and evaluate transportation safety techniques that can help Wyoming Transportation Agencies in reducing crashes and fatalities on rural roads state wide. 	
Execution and Performance	
<ul style="list-style-type: none"> The project had an advisory committee that was comprised of local, state, and federal transportation officials that were able to come together and direct the project to a successful and beneficial product. 	
Project Outcomes	
<ul style="list-style-type: none"> Developed a procedure for local governments to evaluate safety of rural local roadways in their network. Methodology to identify high risk locations on rural local roads. A procedure to rank and determine the cost/benefit of low cost safety improvements that a transportation agency can implement. 	
Recommendations	
<ul style="list-style-type: none"> The Transportation Safety Evaluation Program created by this study should be used by all local Wyoming Transportation Agencies to assess the safety of their rural local roadway networks. 	
Implementation	
<ul style="list-style-type: none"> Currently, more than half of the counties in Wyoming have implemented the Transportation Safety Evaluation Program developed by this study. 	
Level of Implementation	
<div style="display: flex; justify-content: space-around; margin-bottom: 5px;"> None Partial Full </div>	

Contract Research Project	RS02(206)
	Vehicle-Wildlife Crash rates to Roadway Improvements
Background Information	
Project Category	Knowledge
Funds Obligated/Expended	\$50,478/\$50,478
WYDOT Program	Safety
WYDOT Sponsor	Matt Carlson
Started	January, 2006
Completed	January, 2007
Participants	University of Wyoming, WYDOT
Objectives	
<ul style="list-style-type: none"> Analyze vehicle-wildlife crashes in Wyoming using GIS to look at crash frequencies and crash rates. Correlate reported vehicle-wildlife crashes and the carcass dataset to estimate the underreporting rate for these crashes. Identify major roadway improvements that have occurred in the last ten years in areas prone to vehicle-wildlife crashes and perform before and after analysis controlling for growth in traffic and wildlife populations. Determine the effectiveness of selected vehicle-wildlife crash mitigation measures identified by the WYDOT safety office. 	
Execution and Performance	
<ul style="list-style-type: none"> The project was performed within its proposed timeline and budget. 	
Project Outcomes	
<ul style="list-style-type: none"> No correlations were found between improvements to roadway geometrics and reducing vehicle-wildlife crash rates. 	
Recommendations	
<ul style="list-style-type: none"> To reduce vehicle-wildlife crashes on Wyoming's roadways the posted speed on the roadways would need to be reduced. No significant changes in roadway improvements directly lead to reduced vehicle-wildlife crashes. 	
Implementation	
<ul style="list-style-type: none"> The gained knowledge from the project is used by WYDOT employees. 	
Level of Implementation	
<div style="display: flex; justify-content: space-around; margin-bottom: 5px;"> None Partial Full </div>	

Contract Research Project	RS02(207)						
	Snow Snake Performance Monitoring						
Background Information							
Project Category	Knowledge						
Funds Obligated/Expended	\$40,000/\$40,000						
WYDOT Program	Construction						
WYDOT Sponsor	Cliff Spoonemore						
Started	January, 2007						
Completed	October, 2008						
Participants	PMPC, WYDOT						
Objectives							
<ul style="list-style-type: none"> • Determine if snow snakes are an effective means of improving winter highway safety by controlling blowing snow in the highway right of way. • Determine snow snakes effect, if any, on retaining topsoil and promoting re-vegetation. 							
Execution and Performance							
<ul style="list-style-type: none"> • Due to lack of snow during the first proposed winter season for research, another winter season was needed to complete the research. 							
Project Outcomes							
<ul style="list-style-type: none"> • No conclusive results were obtained due to lack of precipitation with the extended timeline. 							
Recommendations							
<ul style="list-style-type: none"> • The WYDOT Winter Research Program currently monitors snow snake fences as needed but snow snakes are not viewed as effective measures for snow control or re-vegetation. 							
Implementation							
<ul style="list-style-type: none"> • Snow snakes are currently not being pursued by WYDOT. 							
Level of Implementation							
<table style="width: 100%; border-collapse: collapse;"> <tr> <td style="text-align: center; width: 33%;">None</td> <td style="text-align: center; width: 33%;">Partial</td> <td style="text-align: center; width: 33%;">Full</td> </tr> <tr> <td colspan="3" style="text-align: center;"> </td> </tr> </table>		None	Partial	Full			
None	Partial	Full					

Contract Research Project	RS02(208)
	Use of Truck Mounted Changeable Message Signs (CMSs) During Mobile Operations
Background Information	
Project Category	Product
Funds Obligated/Expended	\$171,201/\$164,307
WYDOT Program	Traffic
WYDOT Sponsor	Mike Gostovich
Started	April, 2008
Completed	July, 2009
Participants	Texas Transportation Institute, WYDOT
Objectives	
<ul style="list-style-type: none"> Develop specific guidance for WYDOT, in applicable situations, appropriate messages and the best deployment procedures of truck mounted CMSs during mobile work zone operations. 	
Execution and Performance	
<ul style="list-style-type: none"> The project was completed within its proposed time line and budget. 	
Project Outcomes	
<ul style="list-style-type: none"> Development of recommended messages for the use of truck mounted CMS during mobile operations. The CMS messages developed for stripping, sweeping, and workers out of the vehicle operations. 	
Recommendations	
<ul style="list-style-type: none"> Specific guidelines for designing and displaying messages on truck mounted CMS are given in the final report. These guidelines include sizes of letting, what to include in the message, message length recommendations, etc. for truck mounted CMSs 	
Implementation	
<ul style="list-style-type: none"> Currently, the WYDOT stripping crews have access to these messages and are using the recommended messages in the field. The maintenance crews were also provided with recommended messages and guidelines but currently have not implemented the findings. 	
Level of Implementation	
<div style="display: flex; justify-content: space-around; margin-bottom: 5px;"> None Partial Full </div>	

Contract Research Project	RS04(206)
	Evaluation of Treatment Options for ASR-Affected Concrete
Background Information	
Project Category	Standards
Funds Obligated/Expended	\$101,650/\$82,780
WYDOT Program	Materials
WYDOT Sponsor	Cheryl Bean
Started	November, 2005
Completed	January, 2010
Participants	Concrete Engineering Specialists, WYDOT
Objectives	
<ul style="list-style-type: none"> Evaluate methods to prolong the life of ASR-Affected concrete. Determine the best combination of products to treat existing ASR-affected concrete and prevent damage progression. 	
Execution and Performance	
<ul style="list-style-type: none"> The ASR-Affected concrete used for the research was at the Riverton Airport, six years of testing was to be completed but the airport received funding to replace their concrete facilities and the research timeline was then cut short by 4 years. 	
Project Outcomes	
<ul style="list-style-type: none"> A rating system to determine damage and deterioration for ASR-Affected concrete. Two options for treatment for ASR-Affected concrete. 	
Recommendations	
<ul style="list-style-type: none"> The two treatment options identified by this study are only effective measures at mitigating or reducing further deterioration of ASR-Affected concrete if all moisture pathways are sealed off. This proved difficult to achieve in this study. 	
Implementation	
<ul style="list-style-type: none"> The recommended treatments from this study are not used by WYDOT, but a greater understanding of ASR-Affected concrete was achieved. 	
Level of Implementation	

Contract Research Project	RS04(207)
	I-80 Freight Corridor Analysis
Background Information	
Project Category	Knowledge
Funds Obligated/Expended	\$75,000/\$74,912
WYDOT Program	Planning
WYDOT Sponsor	Mark Wingate
Started	July, 2007
Completed	October, 2009
Participants	R&S Consultants, WYDOT
Objectives	
<ul style="list-style-type: none"> • Provide data and analysis of freight movements and trends in freight movements along the I-80 corridor. • Survey several thousand truckers to collect data on freight movements, type of goods, time sensitivity, etc. • Establish a multi-state coalition to collectively address common factors on freight growth on I-80 and its impact on mobility and safety. 	
Execution and Performance	
<ul style="list-style-type: none"> • The project grew larger than anticipated with additional objectives including looking at operational and financial analysis of a land ferry. Poor communication between the researchers and WYDOT lead to the misdirection of the project. 	
Project Outcomes	
<ul style="list-style-type: none"> • Understanding of freight flows along the I-80 corridor. 	
Recommendations	
<ul style="list-style-type: none"> • A second phase of this study to further analyze future freight volumes through the I-80 corridor, funding for the second phase has been requested but no funds have been approved. 	
Implementation	
<ul style="list-style-type: none"> • WYDOT has not used the findings of this study. 	
Level of Implementation	
<div style="display: flex; justify-content: space-around; margin-bottom: 5px;"> None Partial Full </div>	

Contract Research Project	RS05(205)
	Snow Supporting Structures for Avalanche Hazard Reduction, Snow Rakes and NEPA Review
Background Information	
Project Category	Product
Funds Obligated/Expended	\$106,189/\$106,178
WYDOT Program	Maintenance
WYDOT Sponsor	Tory Thomas
Started	July, 2005
Completed	December, 2008
Participants	MSI-Foothill Inter-alpine, WYDOT
Objectives	
<ul style="list-style-type: none"> • Provide a preliminary design, cost estimate (through installation) and National Environmental Protection Act (NEPA) review to determine if snow supporting structures are warranted, affordable, and acceptable on the 151 Avalanche. 	
Execution and Performance	
<ul style="list-style-type: none"> • An extension on the project was required as permitting through the United States Forrest Service took longer than anticipated. 	
Project Outcomes	
<ul style="list-style-type: none"> • A final design on the new snow supporting structures was developed. 	
Recommendations	
<ul style="list-style-type: none"> • The design developed from this study can be used at other avalanche locations around Wyoming. 	
Implementation	
<ul style="list-style-type: none"> • The design of the snow supporting structures from this study will be constructed in the near future. 	
Level of Implementation	
<div style="display: flex; justify-content: space-around; margin-bottom: 5px;"> None Partial Full </div>	

Contract Research Project	RS05(207)
	Variable Speed Limit for the Elk Mountain Corridor on I-80
Background Information	
Project Category	Product
Funds Obligated/Expended	\$390,189/\$383,526
WYDOT Program	ITS
WYDOT Sponsor	Vince Garcia
Started	July, 2007
Completed	October, 2009
Participants	University of Wyoming, WYDOT
Objectives	
<ul style="list-style-type: none"> Develop a decision support system necessary to effectively and consistently implement the Elk Mountain variable speed limit system. 	
Execution and Performance	
<ul style="list-style-type: none"> The project was set back 6 months due to delays with sign manufacturing. 	
Project Outcomes	
<ul style="list-style-type: none"> Decision support system for the Elk Mountain Corridor on I-80. 	
Recommendations	
<ul style="list-style-type: none"> The benefits associated with the system are being evaluated in a second research phase. 	
Implementation	
<ul style="list-style-type: none"> The decision support system is currently being used by WYDOT to set the speed limit for the Elk Mountain Corridor during adverse weather conditions. Other sections of roadways in Wyoming will implement a variable speed limit similar to the Elk Mountain Corridor system. 	
Level of Implementation	
<div style="display: flex; justify-content: space-around; margin-bottom: 5px;"> None Partial Full </div>	

Contract Research Project	RS05(210) Wyoming County Road Manual Phase 1
Background Information	
Project Category	Knowledge
Funds Obligated/Expended	\$5,350/\$4,800
WYDOT Program	Planning
WYDOT Sponsor	Tony Laird
Started	April, 2010
Completed	July, 2010
Participants	Hesterberg Consultants, WYDOT
Objectives	
<ul style="list-style-type: none"> Gain overall direction for updating the County Road Manual for the Wyoming Road Standards Committee. Develop phase 2 study objectives, study benefits, work plan/scope and deliverables leading to an updated County Road Fund Manual. Gain acceptance for the phase 2 objectives, study benefits, work plan/scope and deliverables from the Wyoming County Road Standards Committee. 	
Execution and Performance	
<ul style="list-style-type: none"> The project was completed within its proposed timeline. 	
Project Outcomes	
<ul style="list-style-type: none"> The objectives, benefits, work plan/scope, and deliverables were accepted by the Wyoming County Road Standards Committee. 	
Recommendations	
<ul style="list-style-type: none"> Phase 2 of the study was accepted by the WYDOT Research Advisory Committee. 	
Implementation	
<ul style="list-style-type: none"> Phase 2 of the Wyoming County Road Manual update is currently underway. 	
Level of Implementation	
<div style="display: flex; justify-content: space-around; margin-bottom: 5px;"> None Partial Full </div>	

Contract Research Project	RS06(206)
	Practical Operational Implementation and Evaluation of Teton Pass Avalanches Monitoring Infrasound System
Background Information	
Project Category	Product
Funds Obligated/Expended	\$86,583/\$86,853
WYDOT Program	Maintenance
WYDOT Sponsor	James Monturo
Started	April, 2006
Completed	December, 2008
Participants	Inter-Mountain Laboratories, WYDOT
Objectives	
<ul style="list-style-type: none"> • Improve the ease of installing and maintaining remote infrasound sensor array monitoring system hardware. • Develop an easy to use software graphical user interface (GUI) that empowers the end user to utilize the technology. • Optimize the Teton Pass system for detection and identification of Twin Slides and Glory Bowl avalanche systems. 	
Execution and Performance	
<ul style="list-style-type: none"> • The project was delayed due to Forest Service permitting that came in later than anticipated. 	
Project Outcomes	
<ul style="list-style-type: none"> • A system that can remotely monitor whether slides could occur or if slides have occurred. 	
Recommendations	
<ul style="list-style-type: none"> • This project was completed to provide another way to monitor avalanche activity in an active slide area, the end result is an effective system that WYDOT is able to monitor and maintain internally. 	
Implementation	
<ul style="list-style-type: none"> • The system is in place in the Jackson, WY area. 	
Level of Implementation	
<div style="display: flex; justify-content: space-around; margin-bottom: 5px;"> None Partial Full </div>	

Contract Research Project	RS06(207)
	ITS System to Reduce High Wind Truck Crashes on I-25 near Bordeaux, WY.
Background Information	
Project Category	Product
Funds Obligated/Expended	\$166,744/ \$166,744
WYDOT Program	ITS
WYDOT Sponsor	Vince Garcia
Started	August, 2007
Completed	October, 2010
Participants	University of Wyoming, WYDOT
Objectives	
<ul style="list-style-type: none"> • Conduct field studies to choose suitable locations for installation of the monitoring equipment. • Confirm relationship between high wind conditions and high risk of truck crashes along corridor. • Analyze crash data to create baseline conditions to monitor the future effectiveness of the system. • Develop final recommendations for the High Wind Warning System. 	
Execution and Performance	
<ul style="list-style-type: none"> • During the course of research it was observed that current theoretical models on truck blow overs due to wind do not always fit field conditions, and further research into the area is needed. 	
Project Outcomes	
<ul style="list-style-type: none"> • High Wind Warning System 	
Recommendations	
<ul style="list-style-type: none"> • Collecting a larger data set of truck weights would allow WYDOT to classify trucks as “Loaded” or “Empty and Lightly Loaded” to better address the safety needs based on the weather conditions associated with blow over risks. • Threshold values for wind hazard and road closures are suggested to be incorporated into the WYDOT Traffic Management Center (TMC). 	
Implementation	
<ul style="list-style-type: none"> • Currently, WYDOT has set in the first phase of the High Wind Warning System in place, but more research is required to fully implement the system. 	
Level of Implementation <div style="display: flex; justify-content: space-around; margin-top: 10px;"> None Partial Full </div> 	

Contract Research Project	RS06(209)
	Gravel Road Management: Developing a Methodology
Background Information	
Project Category	Knowledge
Funds Obligated/Expended	\$88,000/\$75,981
WYDOT Program	Planning
WYDOT Sponsor	Martin Kinder
Started	April, 2009
Completed	October, 2010
Participants	University of Wyoming, Wyoming Technology Transfer Center, WYDOT
Objectives	
<ul style="list-style-type: none"> Address the lack of a widely acceptable methodology for managing unpaved roads, experts in the field will collectively develop a set of criteria for unpaved roads data collection and analysis that will work well for local government agencies with extensive unpaved road networks. Develop a gravel roads component for an asset management software program using the developed methodology. 	
Execution and Performance	
<ul style="list-style-type: none"> Through extensive work with other transportation agencies and officials a better product was achieved. 	
Project Outcomes	
<ul style="list-style-type: none"> Three reports were generated including 1) Methodology, 2) Implementation Guide, and 3) Guidelines for Software Development 	
Recommendations	
<ul style="list-style-type: none"> Software companies have been approached for software development, an additional research phase should be considered to ensure the software is developed. 	
Implementation	
<ul style="list-style-type: none"> The final reports including the Methodology and Implementation Guide are being used by local transportation agencies in Wyoming. The findings of this study have been presented locally, regionally, and at the national level. 	
<p>Level of Implementation</p> <p>None Partial Full</p>	

Contract Research Project	RS07(206)
	ITS Alternatives for Reducing Risks of Truck Blow Overs Due to High Winds
Background Information	
Project Category	Knowledge
Funds Obligated/Expended	\$88,000/\$87,960
WYDOT Program	Safety
WYDOT Sponsor	Mike Gostovich
Started	April, 2006
Completed	January, 2007
Participants	R & S Consultants, WYDOT
Objectives	
<ul style="list-style-type: none"> Design and evaluate the feasibility of an intelligent truck rollover prevention warning system. 	
Execution and Performance	
<ul style="list-style-type: none"> The research was completed within its proposed timeline. 	
Project Outcomes	
<ul style="list-style-type: none"> Initial deployment recommendations for a truck rollover prevention warning system. Safety analysis and benefits associated with the system. Framework for addressing other similar situations. 	
Recommendations	
<ul style="list-style-type: none"> Awareness of the safety concerns related to truck blow overs due to high winds was brought to WYDOT. 	
Implementation	
<ul style="list-style-type: none"> The WYDOT sponsor has since retired, and identifying direct implementations from this project was a challenge. Additional research for high wind warning systems was completed, but no relation between the projects was apparent. 	
Level of Implementation	
<div style="display: flex; justify-content: space-around; margin-bottom: 5px;"> None Partial Full </div>	

Contract Research Project	RS07(209)
	Improving Foundation Design in Rock: Analysis of Osterberg Cell Load Test at Burma Road Overpass
Background Information	
Project Category	Standards
Funds Obligated/Expended	\$32,873/\$32,873
WYDOT Program	Geology
WYDOT Sponsor	Mark Falk
Started	April, 2009
Completed	November, 2009
Participants	University of Wyoming, WYDOT
Objectives	
<ul style="list-style-type: none"> Use the load Osterberg Cell Load Test results to evaluate design equations for side and base resistance in rock (including highly weathered, highly fractured rock) and to apply a model that predicts the axial load-settlement behavior of drilled shafts in rock. 	
Execution and Performance	
<ul style="list-style-type: none"> The project was slightly modified by upsizing the load capacity of the load cell. 	
Project Outcomes	
<ul style="list-style-type: none"> Upgraded design equations for drilled shafts in rock. Introduced Load and Resistance Factor Design (LRFD) into WYDOT's foundation design. Provided analytical model for load settlement behavior in rock. 	
Recommendations	
<ul style="list-style-type: none"> The load test conducted at Burma Road Overpass shows that realistic values of side resistance can be predicted using design equations published in current AASHTO and FHWA publications. 	
Implementation	
<ul style="list-style-type: none"> Analysis from this project will be used in design for future projects with similar foundation characteristics. 	
Level of Implementation	
<div style="display: flex; justify-content: space-around; width: 100%;"> None Partial Full </div>	

Contract Research Project	RS10(206)
	Effectiveness of Trapper’s Point Wildlife Crossing Animal Detection System
Background Information	
Project Category	Knowledge
Funds Obligated/Expended	\$76,344/\$76,344
WYDOT Program	Safety
WYDOT Sponsor	Matt Carlson
Started	July, 2006
Completed	December, 2008
Participants	University of Wyoming, WYDOT
Objectives	
<ul style="list-style-type: none"> Investigate the effectiveness of the Trapper’s Point Animal Detection System. Determine the effect of warning signs with flashing beacons on driver behavior. Determine the success of the system to detect big game in the roadway vicinity and its impact to vehicle-wildlife crashes. 	
Execution and Performance	
<ul style="list-style-type: none"> The project encountered many difficulties with equipment malfunctions and in turn, it was difficult to conduct the research as planned. 	
Project Outcomes	
<ul style="list-style-type: none"> It was determined that the system was not well suited for Wyoming’s climate. The system was found to be not effective at detecting animals and it wasn’t able to warn the driving public in a consistent manor. 	
Recommendations	
<ul style="list-style-type: none"> It was recommended that the system be no longer used. 	
Implementation	
<ul style="list-style-type: none"> The animal detection system at Trapper’s Point is no longer in service. Also, WYDOT looks closely into any sensitive technology being brought forward. 	
Level of Implementation	
<div style="display: flex; justify-content: space-around; margin-bottom: 5px;"> None Partial Full </div>	

Pooled-Fund Research Project	TPF-5(054)
	Development of Maintenance Decision Support System (MDSS)
Background Information	
Project Category	Product
Funds Obligated/Expended	\$100,000/\$200,000
WYDOT Program	Maintenance
WYDOT Sponsor	Jeff Frazier
Started	July, 2005
Completed	Not Completed
Participants	FHWA, CA, CO, IA, ID, IN, KS, KY, MN, ND, NE, NH, NY, PA, SD, VA, WI, WY
Objectives	
<ul style="list-style-type: none"> Assess the need, potential benefit, and receptivity in participating state transportation departments for state and regional MDSS. Define functional and user requirements for an operational MDSS that can assess current road and weather conditions, forecast weather that will affect transportation routes, predict how road conditions will change in response to candidate maintenance treatments, suggest optimal maintenance strategies to maintenance personnel, and evaluate the effectiveness of maintenance treatments that are applied. Build and evaluate an operational MDSS that will meet the defined functional requirements in the participating state transportation departments. Improve the ability to forecast road conditions in response to changing weather and applied maintenance treatments. 	
Execution and Performance	
<ul style="list-style-type: none"> The initial funding was \$100,000 in 2005, additional funding was approved in 2006 for \$50,000 and in 2010 for \$50,000. 	
Project Outcomes	
<ul style="list-style-type: none"> MDSS software program 	
Recommendations	
<ul style="list-style-type: none"> The software program is ready for implementation, and some states, such as CO, have implemented the software. Additions and changes to the software are on-going as long as research dollars are available this project will continue with these additions and changes. 	
Implementation	
<ul style="list-style-type: none"> The MDSS is not currently implemented within WYDOT. 	
Level of Implementation	
<div style="display: flex; justify-content: space-around; margin-bottom: 5px;"> None Partial Full </div>	

Pooled-Fund Research Project	TPF-5(151)
	Subsurface Drainage for Landslide and Slope Stabilization
Background Information	
Project Category	Knowledge
Funds Obligated/Expended	\$30,000/\$30,000
WYDOT Program	Geology
WYDOT Sponsor	Mark Falk
Started	November, 2006
Completed	Not Completed
Participants	BC Hydro, CA, MD, MS, MT, NH, OH, PA, TX, WA, WY
Objectives	
<ul style="list-style-type: none"> • Provide best practices and guidance for subsurface drainage applications for slope stabilization, including subsurface investigation and testing, groundwater-flow characterization, analysis, drain configurations and design, installation methods, monitoring, and maintenance. • Evaluate new applications of existing materials and technologies, such as trenchless technologies (horizontal directional drilling, micro tunneling, guided boring, etc.) and other innovative technologies and materials, for stabilizing slopes using subsurface drainage. 	
Execution and Performance	
<ul style="list-style-type: none"> • The project is expected to be completed within the next two years, the initial timeline was to have this project completed sometime in 2010, but the initial principal investigator left the project. After another principal investigator was found the scope of the project was modified. 	
Project Outcomes	
<ul style="list-style-type: none"> • Design Manual for subsurface drainage. • Training for use of existing software. 	
Recommendations	
<ul style="list-style-type: none"> • The outcomes of this project are needed to help design horizontal drains in Wyoming. Currently, designers rely on the expertise of the contractors installing the systems. 	
Implementation	
<ul style="list-style-type: none"> • Some of the results of this project are expected to be used in Wyoming by designers for subsurface drainage. 	
Level of Implementation	
<div style="display: flex; justify-content: space-around; margin-bottom: 5px;"> None Partial Full </div>	

Pooled-Fund Research Project	TPF-5(193)
	Midwest States Pooled Fund Crash Test Program
Background Information	
Project Category	Knowledge
Funds Obligated/Expended	\$137,500/\$360,000
WYDOT Program	Planning
WYDOT Sponsor	Bill Wilson
Started	October, 2005
Completed	Not Completed
Participants	CA, CT, FL, IA, IL, KS, MN, MO, MT, NE, NJ, NY, OH, SD, TX, WI, WY
Objectives	
<ul style="list-style-type: none"> To crash test highway roadside appurtenances to assure that they meet criteria established nationally. 	
Execution and Performance	
<ul style="list-style-type: none"> This pooled fund study received initial funding of \$55,000 for 3 years in 2006 and was extended for another 3 years in 2009 for \$65,000 annually. 	
Project Outcomes	
<ul style="list-style-type: none"> The Midwest States Pooled Fund Study has tested many new highway safety hardware devices, such as guardrail, and continues to test such equipment. This study also funds other various highway safety research projects. 	
Recommendations	
<ul style="list-style-type: none"> This pooled fund study has many projects presented each year, and WYDOT will continue to participate in this pooled fund study as long as the projects are relevant for WYDOT and Wyoming. 	
Implementation	
<ul style="list-style-type: none"> Many results of the research projects of this pooled fund study have been implemented in Wyoming, including a High Tension Cable Guard Rail. Current projects that the pooled fund study is funding will be implementable for Wyoming, including continued testing and improvements to the High Tension Cable Guard Rail. 	
Level of Implementation	
<div style="display: flex; justify-content: space-around; margin-bottom: 5px;"> None Partial Full </div>	

Pooled-Fund Research Project	TPF-5(218)
	Clear Roads (Test and Evaluation of Materials, Equipment, and Methods for Winter Highway Maintenance)
Background Information	
Project Category	Knowledge
Funds Obligated/Expended	\$25,000/\$125,000
WYDOT Program	Construction
WYDOT Sponsor	Cliff Spoonemore
Started	October, 2006
Completed	Not Completed (Estimated Completion – September 2015)
Participants	CO, IA, ID, IL, KS, MA, ME, MI, MN, MO, ND, NE, NH, NY, OH, PA, UT, VA, WA, WI, WV, WY
Objectives	
<ul style="list-style-type: none"> • Conduct structured field testing and evaluation across a range of winter conditions and different highway maintenance organizational structures to assess the practical effectiveness, ease of use, optimum application rates, barriers to use, durability, safety, environmental impact and cost-effectiveness of innovative materials, equipment and methods for improved winter highway maintenance. • Establish industry standards and develop performance measures for evaluating and utilizing new materials and technologies. • Support technology transfer by developing practical field guides and training curriculum to promote the results of research projects. • Conduct cost-benefit analysis to ensure that new technologies, materials or methods contribute to operational efficiency. • Support the exchange of information and ideas via peer exchanges and collaborative research efforts that provide opportunities for winter maintenance specialists to share experiences related to winter maintenance. • Promote public education and outreach related to winter maintenance and winter driving safety. • Conduct state of the practice surveys to share best practices on current operational issues (for example salt shortages, level of service requirements or other hot button issues). 	
Execution and Performance	
<ul style="list-style-type: none"> • The initial funding was \$25,000 in 2007, additional funding was approved in 2008 for \$25,000, 2009 for \$25,000 and \$75,000 for 2011. 	
Project Outcomes	
<ul style="list-style-type: none"> • Multiple research projects dealing with Winter Maintenance are completed under this pooled fund study. 	

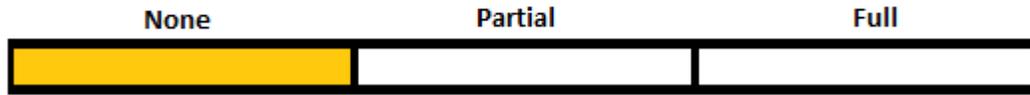
Recommendations

- Currently, 8 projects are being funded by this pooled fund study. In a recent progress report to WYDOT it was reported that 2 of the 8 current projects will be directly related to WYDOT’s winter maintenance needs.

Implementation

- Currently no results from this pooled study are being used by WYDOT.
- Findings of the research projects completed by this pooled fund study have been presented to applicable WYDOT employees, but none of the projects’ results have been implemented.

Level of Implementation



APPENDIX C: POOLED FUND EXTENSION FORM

Request for Additional Funding for Pooled Fund Studies

Project Name:	_____
Project Number:	_____
Lead State:	_____
WYDOT Liaison:	_____
Number of Participating States:	_____



Project History	
Start Date	
Initial Estimated Completion Date	
Initial Funding	
Additional Funding Already Received	
Additional Needs	
Additional Funding Requested	
Additional Time Requested	
New Estimated Completion Date	
Benefits and Implementation for WYDOT	
What products /knowledge /policies /etc. have resulted from this project?	

How have these results been implemented throughout WYDOT?

If these results have not been implemented, what boundaries are being faced?

What are the expected outcomes if additional funding and time are approved?

Is a plan for implementation throughout WYDOT being developed or is developed?

APPENDIX D: RESEARCHER FEEDBACK FORM

Researcher Feedback Form

Researcher: _____
 Organization: _____
 Project Title: _____

 WYDOT Sponsor: _____
 Survey Date: _____



Proposal Process	Rate your satisfaction with the proposal process: <div style="float: right;"> <input type="checkbox"/> Very Satisfied <input type="checkbox"/> Satisfied <input type="checkbox"/> Dissatisfied </div>
	What did you like about the proposal process?
	What did you dislike about the proposal process?
Research Program Staff	Rate your satisfaction with the Research program staff: <div style="float: right;"> <input type="checkbox"/> Very Satisfied <input type="checkbox"/> Satisfied <input type="checkbox"/> Dissatisfied </div>
	As a researcher, what suggestions can you provide to improve the management and administration of the program?

Project Sponsor	Rate your satisfaction with the Research program staff:	<input type="checkbox"/> Very Satisfied <input type="checkbox"/> Satisfied <input type="checkbox"/> Dissatisfied
	What suggestions can you provide to improve the interaction with the program sponsor?	
Lessons Learned	Briefly, what are the three most important and transferrable lessons learned from this project? 1. 2. 3.	
Follow-up Research	Is follow-up research warranted?	<input type="checkbox"/> Yes <input type="checkbox"/> No
	If yes, please explain why:	

Continuous Improvement	Please provide other suggestions to improve the Research program.
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APPENDIX E: PHASE 1 PERFORMANCE EVALUATION



Project Performance Evaluation - Phase 1

Project I.D.: _____

Date: _____ WYDOT Program: _____

Principal Investigator: _____ WYDOT Sponsor: _____

* This form is to be completed immediately at the end of a research project, select one corresponding box for each question.

1) Were all of the proposed objectives of the research project fulfilled?

- All objectives were fulfilled
- Some objectives were fulfilled
- No objectives were fulfilled

2) Expected future level of implementation within WYDOT.

- Full Implementation
- Partial Implementation
- No Implementation
- Results do not recommend implementation

3) External technology transfer.

- Any National, Regional, or Local presentations, publications, etc.
- No external technology transfer

4) Internal technology transfer.

- Presentations created and used by the Research Center or relevant departments within WYDOT
- No internal technology transfer

5) Was a research report created?

- A professional and concise research report was created, meeting WYDOT's expectations
- No research report was created or an inadequate research report was submitted

6) Was the research project completed within its proposed timeline?

- The project was completed within its proposed timeline or within approved extensions
- The project was completed within one month of its proposed timeline
- The project was completed after one month of its proposed timeline
- The project was not completed

7) Was the research project completed within its proposed budget?

- The project was completed within its proposed budget or within an approved funding increase
- The project was not completed within its budget

8) Was the Researcher Feedback Form completed?

- Yes
- No

APPENDIX F: PHASE 1 PERFORMANCE EVALUATION



Project Performance Evaluation - Phase 2

Project I.D.: _____

Date: _____ WYDOT Program: _____

Principal Investigator: _____ WYDOT Sponsor: _____

* This form is to be completed 2 years after a research project has been completed, select one corresponding box for each question or fill in applicable questions.

1) Have the results of this research project contributed to WYDOT's Mission?

- Yes
- No

1a) If yes, Briefly describe which aspects of WYDOT's Mission have been advanced or affected by the results of the research project:

2) Have the results of this research project been implemented within WYDOT?

- Full Implementation
- Partial Implementation
- No Implementation

2a) If level of implementation has changed from the phase 1 evaluation, please explain:

3) **What is the cost/benefit associated with this project?**

- Benefits associated with results of project exceeds costs of project
- Benefits associated with results of project do not exceed costs of project

* Please fill in costs and benefits if possible:

- Total Project Cost = _____

- Estimated dollar savings or benefits associated with implementation of the project = _____

Benefit/Cost Ratio = _____

- Benefits of project cannot be identified

4) **Have the results of the project had any impacts on national, regional, or local organizations or agencies?**

- Yes
- No

4a) **If yes, briefly identify the organization or agency that was impacted, and what affect the research project had on them:**

5) **Has additional research been persued or conducted as a result of this project within WYDOT ?**

- Yes, additional research has been approved.
- No, additional research has not been approved.

5a) **If yes, identify the project.**

APPENDIX G: RESEARCH PROJECT BUDGET ANALYSIS FORM



Research Project Budget Analysis

Project: RS10(206) Effectiveness of Trappers Point Wildlife Crossing

Date: Jan. 9, 2012 WYDOT Department: Safety

Principal Investigator: Dr. Rhonda Young WYDOT Sponsor: Matt Carlson

Instructions

- 1) Fill in the shaded blocks with their corresponding budget items for all applicable categories, not all categories may have budget items.
- 2) Asterisks (*) will appear in categories that lie outside the 50th percentile range.

	Projected Project Costs	Percentage of Overall Project Budget	Indicator	Lower Range	Upper Range
Direct Costs	\$63,206	83%		81%	96%
Total Personnel Costs	\$34,108	45%		44%	72%
Principal Investigator	\$15,208	20%		12%	46%
Other Personnel	\$18,900	25%		23%	44%
Fringe Benefits	\$6,083	8%		5%	12%
Research Travel		0%	*	2%	10%
Report Generation		0%	*	2%	11%
Equipment	\$16,800	22%		3%	30%
Others	\$6,215	8%		2%	9%
Technology Transfer	\$2,000	3%		1%	5%
Conferences	\$1,000	1%		1%	3%
Miscellaneous Travel	\$1,000	1%		1%	11%
Indirect Costs	\$11,138	15%		12%	17%
Project Administration	\$2,250	3%		1%	8%
Overhead	\$8,888	12%		12%	17%
Total Project Cost	\$76,344				