Performance Measurement Tool Box and Reporting System for Research Programs and Projects

DETAILS

0 pages | | PAPERBACK

ISBN 978-0-309-42940-5 | DOI 10.17226/23093

AUTHORS

ACKNOWLEDGMENT

This work was sponsored by the American Association of State Highway and Transportation Officials (AASHTO), in cooperation with the Federal Highway Administration, and was conducted in the National Cooperative Highway Research Program (NCHRP), which is administered by the Transportation Research Board (TRB) of the National Academies.

THE NATIONAL ACADEMIES

Advisers to the Nation on Science, Engineering, and Medicine

The **National Academy of Sciences** is a private, nonprofit, self-perpetuating society of distinguished scholars engaged in scientific and engineering research, dedicated to the furtherance of science and technology and to their use for the general welfare. On the authority of the charter granted to it by the Congress in 1863, the Academy has a mandate that requires it to advise the federal government on scientific and technical matters. Dr. Ralph J. Cicerone is president of the National Academy of Sciences.

The **National Academy of Engineering** was established in 1964, under the charter of the National Academy of Sciences, as a parallel organization of outstanding engineers. It is autonomous in its administration and in the selection of its members, sharing with the National Academy of Sciences the responsibility for advising the federal government. The National Academy of Engineering also sponsors engineering programs aimed at meeting national needs, encourages education and research, and recognizes the superior achievements of engineers. Dr. Charles M. Vest is president of the National Academy of Engineering.

The **Institute of Medicine** was established in 1970 by the National Academy of Sciences to secure the services of eminent members of appropriate professions in the examination of policy matters pertaining to the health of the public. The Institute acts under the responsibility given to the National Academy of Sciences by its congressional charter to be an adviser to the federal government and, on its own initiative, to identify issues of medical care, research, and education. Dr. Harvey V. Fineberg is president of the Institute of Medicine.

The **National Research Council** was organized by the National Academy of Sciences in 1916 to associate the broad community of science and technology with the Academy's purposes of furthering knowledge and advising the federal government. Functioning in accordance with general policies determined by the Academy, the Council has become the principal operating agency of both the National Academy of Sciences and the National Academy of Engineering in providing services to the government, the public, and the scientific and engineering communities. The Council is administered jointly by both the Academies and the Institute of Medicine. Dr. Ralph J. Cicerone and Dr. Charles M. Vest are chair and vice chair, respectively, of the National Research Council.

The **Transportation Research Board** is one of six major divisions of the National Research Council. The mission of the Transportation Research Board is to provide leadership in transportation innovation and progress through research and information exchange, conducted within a setting that is objective, interdisciplinary, and multimodal. The Board's varied activities annually engage about 7,000 engineers, scientists, and other transportation researchers and practitioners from the public and private sectors and academia, all of whom contribute their expertise in the public interest. The program is supported by state transportation departments, federal agencies including the component administrations of the U.S. Department of Transportation, and other organizations and individuals interested in the development of transportation. **www.TRB.org**

www.national-academies.org

ACKNOWLEDGMENTS

The research reported herein was performed under NCHRP Project 20-63 by the Texas Transportation Institute (TTI), a member of the Texas A&M University System. Paul E. Krugler, P.E., research engineer and manager of implementation, was the principal investigator. He is a retired employee of the Texas Department of Transportation, having served his last five years with that agency as their research program director. Melissa Noggle Walden, P.E., associate research scientist, served as the co-principal investigator.

The work was done under the general supervision of Paul Krugler. Other authors of the report include Melissa Walden; Bradley Hoover, lead software applications developer; Yu-ying Diana Lin, systems analyst; and Sandra Tucker, who was the TTI library services manager and is now associate professor at the Texas A&M University Libraries.

The research team would like to gratefully acknowledge the extraordinary level of assistance and guidance provided by the project panel throughout this project. In particular, Richard Long should be recognized. As the panel chairman and also vice chair of the American Association of State Highway and Transportation Officials (AASHTO) Research Advisory Committee (RAC), it was his vision and unrelenting efforts which made this project become reality.

The coordination of the database developed during this project with the Research in Progress database would not have been possible without the greatly appreciated support and assistance of the National Academy of Science.

Finally, the numerous AASHTO RAC members that readily shared their experiences in research performance measurement, including a number of excellent quantitative benefit estimates, were most instrumental in this project and should also be warmly thanked.

NCHRP PROJECT 20-63 PANEL

Area of Special Projects

Richard C. Long, *Florida DOT, Tallahassee, FL* (Chair)
Elizabeth G. Bonini, *Pennsylvania DOT, Harrisburg, PA*
Rick Collins, *Texas DOT, Austin, TX*
O. A. Elrahman, *New York State DOT, Watervliet, NY*
Monique R. Evans, *Ohio DOT, Columbus, OH*
David L. Huft, *South Dakota DOT, Pierre, SD*
Russell Lee, *Oak Ridge National Laboratory, Oak Ridge, TN*
Richard L. McReynolds, *Kansas DOT, Topeka, KS*
Sue Sillick, *Montana DOT, Helena, MT*
Jeffrey H. Smith, *Maryland State Highway Administration, Baltimore, MD*
Loren L. Turner, *California DOT, Sacramento, CA*
Joe Parks, *FHWA Liaison*
Mark R. Norman, *TRB Liaison*

ABSTRACT

This report documents the work performed to gather and analyze available research performance measurement information, select a balanced and broadly applicable set of these performance measures, develop tools to assist practitioners in applying these measures to their research projects and programs, and deliver these products to the community of state research program managers. The selected performance measures and the developed tools were integrated to create the Research Performance Measurement (RPM) System, composed of a web site, RPM-Web, and a complementing CD-ROM tool box, RPM-Tools. The tool set being provided within the system includes PM 101, a narrated research performance measurement tutorial; a wizard to assist in selecting research program performance measures; a compendium of data resource links; a catalog of example research benefit estimations; and automated work sheets for the practitioner to create new benefit estimations. Additional functionalities provided in RPM-Web include historical performance information storage and the capability to generate a suite of performance reports from database information.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

SUMMARY OF FINDINGS

A survey of agencies and available literature revealed growing interest and activity in the measurement of research program and project performance. While representatives from a majority of states indicated an interest and some degree of activity, few had developed comprehensive approaches, there were few tools available, and there was little similarity in methodologies among states. This project selected a standard set of research performance measures, developed tools to assist users employ them, and integrated both the standard performance measures and the tools into the Research Performance Measurement (RPM) System, the primary product of this project. The RPM System has two components, a web site named RPM-Web and a complementing CD-ROM tool box named RPM-Tools.

Thirty performance measures were jointly selected by the research team and the National Cooperative Highway Research Program (NCHRP) project panel for the research performance measurement system to be developed. These standard performance measures fall into five categories: outcome measurements, output measurements, resource allocation measurements, efficiency measurements, and stakeholder measurements. The outcome measurements focus strongly on common missions of state transportation agencies, i.e., to save lives, to reduce crashes, and to provide transportation services at the least possible cost to taxpayers. The consensus of survey responses shows these three to be the most valued performance measures by the American Association of State Highway and Transportation Officials (AASHTO) agency administrators and AASHTO Research Advisory Committee (RAC) members.

A recommendation from this project is that state agencies limit formal research performance measurement to relatively few but critical performance areas. The optimal set of performance measures will likely differ with each state agency, but it is recommended that the three outcome performance measures be strongly considered for measurement in every state.

The RPM System provides the means for agencies to develop individualized and comprehensive research performance measurement programs. The RPM System also provides the opportunity for the AASHTO to compile and analyze the benefits and efficiencies of the nationwide transportation research program being provided through federal funding authorizations.

Interaction with AASHTO RAC members during this project revealed that implementation of the RPM System will likely vary from state to state. It was also clear that one of the major concerns of these program managers was the amount of research staff effort which may be required to implement and sustain a new or more comprehensive research performance measurement program. A recommendation in this regard is that consideration be given to requiring the agency's researching organizations to provide benefit estimates as a final deliverable on their projects. The RPM System has been designed so that each state agency has several options for involving researchers in performance measurement. In addition to the possible distribution of the RPM-Tools CD-ROM to contractors for benefit estimation purposes, each state has the option to grant various levels of access to RPM-Web to its contractors.

CHAPTER 1 - INTRODUCTION AND RESEARCH APPROACH

INTRODUCTION

State transportation agencies are motivated to measure the performance of their research programs for numerous reasons. Monitoring the value and efficiency of this program is of critical importance to both research program managers and agency administrators alike (*1*). While research performance measurement is important for common management purposes such as program justification and early identification of weakening program areas, there is a heightened need for communication of research program performance and value in the current era of rapid turnover in transportation agency administrators. There is also a growing need at the national level for aggregated research program performance information. An assessment of annual, nationwide research impact would be of great value to AASHTO in developing and supporting requests for future federal funding for transportation research.

It was important to the panel that RPM-Web functionality did not duplicate that already available to the national research community in other web sites and databases. As conceptually developed by the panel, the purpose and value of the RPM System substantially differs from that offered by the Research in Progress (RiP) web site and the Transportation Research Information Services (TRIS) web site. While purposes differ, so differ the time frames for use, as depicted on the timeline for a research project shown in Figure 1. The primary value and use of the RiP web site is during the process of new research project development, when it is imperative that research program managers be able to review a comprehensive list of research currently underway. TRIS is of particular value to the research community beginning with the new project development phase and extending through the active research phase. The RPM System will serve the research community at some point beginning near the completion of research projects, when performances of the projects and research program are being assessed. The degree of coordination between RPM-Web and RiP extends to sharing database information so that users who have entered basic project information into RiP at the outset of a research project will not have to re-enter that information into RPM-Web when the performance assessment occurs. This coordination will greatly benefit the state research offices that will enter this information in most cases.

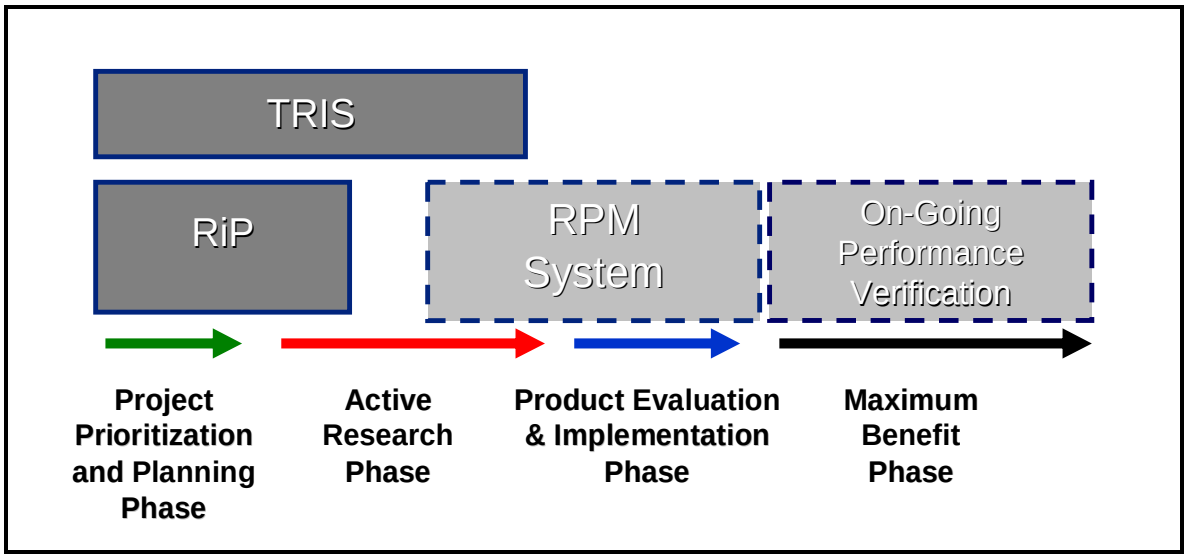


Figure 1. TRIS, RiP, and RPM Usage Timeline

The assistance of the Transportation Research Board (TRB) of the National Academy of Science was crucial to being able to provide this degree of database coordination. It is the intent of TRB to periodically download basic project information from the RiP database to the RPM database.

RESEARCH APPROACH

The research approach for this project included considerable interaction between the research team and the NCHRP panel. This interaction allowed a number of panel ideas and requests to be incorporated, resulting in products better centered on the needs and desires of future users.

The initial task of this project was to determine current state-of-the-practice of research performance measurement. Three nationwide electronic surveys were distributed to gather this information. The targeted audiences included AASHTO RAC members, AASHTO agency administrators, and a group of federal and private industry research managers and executives. These surveys and the information collected are discussed in Chapter 2.

A comprehensive list of research-related performance measures (PMs) was then developed from the survey responses and from information found in literature. After analysis by the research team and discussions at a meeting with the NCHRP panel, 30 performance measures were selected as the standard performance measures for the system to be developed. These performance measures are the subject of Chapter 3.

Commonly used terms were defined to assist in communications during the project. The 30 selected standard performance measures, plus 10 additional ones, are also defined within the RPM System. While imperative for this project, these definitions also may have considerable future value. They have the potential to become the genesis of a nationally accepted set of definitions and methods among the AASHTO member agencies. A glossary of terms is provided in Appendix A.

A systems requirements document describing proposed functionality and programming specifications for the RPM System was delivered to the NCHRP panel as an interim report prior to beginning programming activities. Excerpts of this systems requirements document are provided in Appendix B for the convenience of those desiring more detailed information about the design and architecture of the RPM System. Several refinements to the envisioned system were again made possible by panel suggestions and comments. Detailed descriptions of user roles, access limitations, navigation, design, and functionality are all found in Appendix B. A story board displaying two levels of RPM-Web navigation and associated user access is shown in Figure 2.

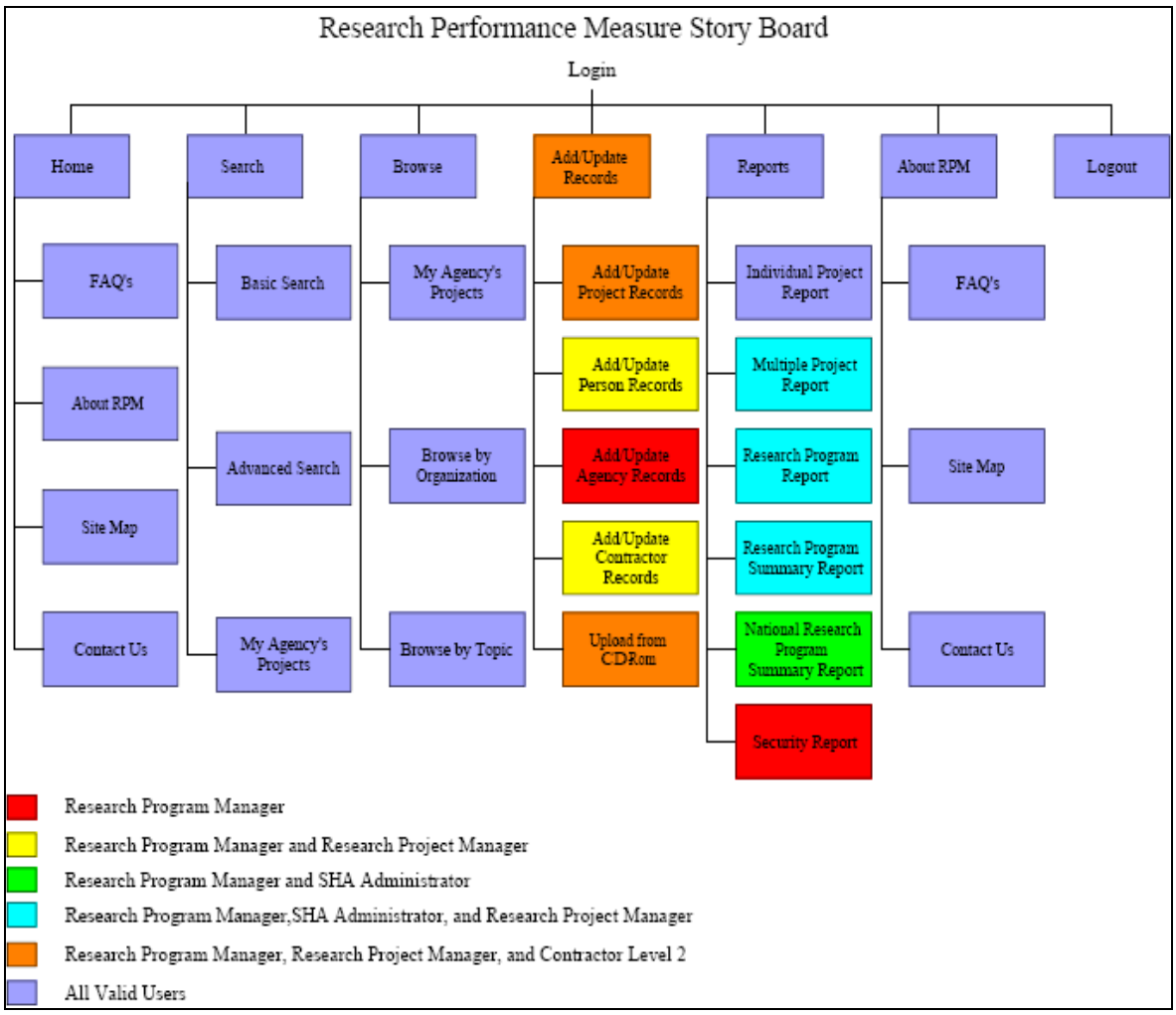


Figure 2. RPM-Web – Navigation Story Board

The welcome screens of RPM-Tools and RPM-Web are shown in Figure 3 and Figure 4, respectively, where the major navigation tabs may also be observed near the top of the screen graphics.

Figure 3. RPM-Tools - Welcome Screen

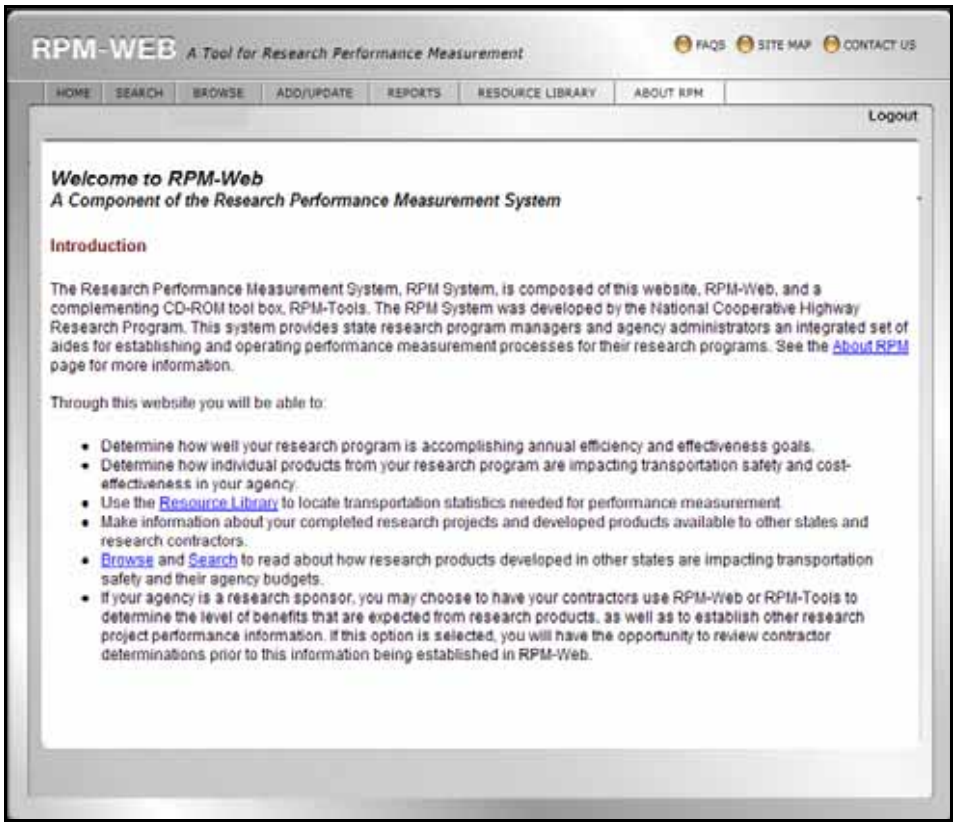


Figure 4. RPM-Web - Welcome Screen

The research team employed two groups of programmers to develop the web site and CD-ROM portions of the RPM System. While development of the two components was parallel, development of the web site generally led that of the CD-ROM for reasons of efficiency and unity in concept.

The panel met with the research team once again when substantial portions of both components were ready for initial viewing and trial. This meeting again provided valuable interaction between the system developers and future users. RPM System development was completed after receiving the comments and input from the panel.

The final requirement of the project was to provide user training to AASHTO RAC members. This training was provided during a one-day workshop held in conjunction with the 2005 National AASHTO RAC Meeting held in Wilmington, North Carolina.

CHAPTER 2 – INFORMATION GATHERING AND ANALYSIS

A significant task of this project was the gathering and analysis of performance measurement information, particularly as it may regard research project and program performance evaluation. Information was gathered from both the literature and a set of three national surveys. The gathered information was critical to the selection of standard performance measures and the tools to be included in the RPM System.

LITERATURE SEARCH

Of the numerous documents obtained and reviewed during the process of this project, of particular note was NCHRP Synthesis 300, *Performance Measures for Research, Development and Technology Programs* (*2*). In this synthesis Sabol captured the state of practice in research performance measurement among state transportation agencies in 2000. One of the noteworthy findings, which may have been a primary motivator for the development of this project, was that there was not yet a commonly accepted set of research performance measures for use by state transportation agencies. Hatry similarly points out the necessity of well-understood and commonly accepted performance measures, and that the first step in being successful in performance measurement is establishing common definitions among the various programs within an agency (*3*). It is logical that if a first and critical step in performance measurement *within* an organization is establishing sound and commonly accepted definitions, then the importance of achieving this goal *between* state transportation agencies in the AASHTO organization will also be critical although undoubtedly more difficult. The definitions and methods provided in this study will hopefully become the basis for more common understanding and coordinated use of research performance measures throughout the member agencies of AASHTO.

Other noteworthy findings of NCHRP Synthesis 300 that this study addresses or incorporates in some manner include:

- research performance measures should have a focus on agency strategic goals,
- a need exists for additional quantitative research performance measures, and
- there is a lack of performance measures monitoring program-level benefits.

Another interesting perspective was found in the 2004 report by the international scanning team which visited Australia, Canada, Japan, and New Zealand to study transportation performance measurement (*4*). While this group did not specifically pursue research-related performance measurement information, some of their observations are quite applicable to this project. The scanning team reported finding examples where performance measurement was much more interwoven into decision making than is usually found in the United States. They also noted greater understanding of the critical difference between outcome and output measures among the transportation officials with whom they met. In Japan, they found that a small core set of measures focused on critically important areas of transportation operations had been identified at the national level, with the prefectures (states) given the ability to create additional measures uniquely desired or needed for their circumstances. In the United States, AASHTO Standing Committee on Research (SCOR) and AASHTO RAC appear to be well positioned to similarly select a “critical few” research performance measures, and then to provide leadership and encouragement to all AASHTO member agencies to utilize them. Another possibility is that a lead states team could be formed to champion research performance measurement and, more importantly, to establish

common language, definitions, and direction for research performance measurement. Without a group to take the lead, much progress may be made in instituting research performance measurement at the state level without the commonality needed in the gathered information to make it of value at the national level when justification and support are needed for federal research funding requests.

A series of information sources acquired and found generally useful in the execution of this project is provided in the bibliography. In addition, the creation of the Resource Collection of statistical information sources, to be discussed in detail later in this report, was a major accomplishment of the literature search efforts during this project.

NATIONAL SURVEYS

One of the important objectives of this project was to assemble a useful and practical collection of research performance measures for the primary use of state transportation agencies. To accomplish this task, it was necessary to assure that recently developed transportation research performance metrics, perhaps not yet documented in the literature, were also identified. The research team developed and distributed three electronic surveys for gathering current information. The survey audiences were AASHTO RAC members, AASHTO agency administrators who are members of the AASHTO Standing Committee on Highways (SCOH), and a group of federal and private industry research managers and executives.

The survey template presented 20 different performance measures which had been identified through a review of literature relevant to transportation research and other associated research areas. These performance measures included outcome, output, efficiency, resource allocation, and stakeholder metrics. Each of the three surveys contained the same list of performance measures, and feedback concerning each of the performance measures was requested. The following is a list of the performance measures presented as part of the surveys:

1. return on investment or benefit-cost ratio;
2. lives saved;
3. construction, maintenance, and operations cost savings;
4. reduction in crashes;
5. reduction in system delays;
6. positive environmental impact;
7. quality of life enhancement;
8. safety enhancement;
9. level of knowledge increased;
10. management tool or policy improvement;
11. public image enhancement;
12. technical practices or standards upgrades;
13. leadership;
14. percent of projects/products implemented;
15. percent of projects completed on time;
16. percent of projects completed within budget;
17. number of contractors;
18. number of contractor partnerships;
19. percent of satisfied customers; and
20. contribution to the overall mission of the department.

The surveys requested information about the organization's experience with each of these research performance measures and the perceived value of each if it were used in their organization. A numerical means for rating the perceived value of individual performance measures was provided in the surveys, thereby allowing a more objective analysis of survey responses. Numerical ratings were on a scale of one to five with one indicating that the respondent believed that the performance measure would offer little value in their environment, while a rating of five indicated that the performance measure would be extremely valuable in their environment. The three survey instruments are provided in Appendix C.

In addition to rating and commenting on the performance measures provided in the surveys, the respondents were encouraged to identify and describe any other research-related performance measures they had utilized in their agencies.

The overall survey response was considered reasonably good. Forty AASHTO RAC members returned the survey, while twenty-four agency administrator responses were obtained from the AASHTO states. A slightly lower response was obtained from the survey of other federal and private industry research managers and executives. Twenty responses were obtained from this group. The organizations surveyed and responding are shown in Appendix D.

After calculating the mean perceived-value rating for each performance measure by each of the surveyed groups, the performance measures were placed in rank order according to these mean scores as shown in Table 1. The performance measures are presented in this table beginning at the top with the measure with the highest average rating under each survey group. The number in the left-hand column, then, represents the ranking for the performance measure listed in that row for each of the three survey groups.

Table 1. Mean Perceived-Value Ratings for Performance Measures, by Survey Group

	RAC Members		Transportation Agency Administrators		Federal & Private Industry Managers	
	Performance Measure	Mean Perceived-Value Rating	Performance Measure	Mean Perceived-Value Rating	Performance Measure	Mean Perceived-Value Rating
1	Construction, maintenance, & operations cost savings	4.37	Lives saved	4.46	Return on investment or benefit-cost ratio	4.05
2	Percent of satisfied customers	4.13	Reduction in crashes	4.45	Reduction in system delays	3.86
3	Reduction in crashes	4.03	Return on investment or benefit-cost ratio	4.36	Construction, maintenance, & operations cost savings	3.81
4	Lives saved	4.00	Construction, maintenance, & operations cost savings	4.07	Reduction in crashes	3.81
5	Return on investment or benefit-cost ratio	3.91	Safety enhancement	3.89	Lives saved	3.67
6	Percent of projects/products implemented	3.68	Reduction in system delays	3.79	Percent of satisfied customers	3.67
7	Contribution to the overall mission of the department	3.68	Technical practices or standards upgraded	3.79	Contribution to the overall mission of the department	3.62
8	Safety enhancement	3.67	Percent of satisfied customers	3.61	Percent of projects completed within budget	3.52
9	Technical practices or standards upgraded	3.67	Positive environmental impact	3.36	Percent of projects/products implemented	3.38
10	Reduction in system delays	3.58	Contribution to the overall mission of the department	3.36	Management & policy improvement	3.33
11	Management & policy improvement	3.47	Management & policy improvement	3.21	Technical practices or standards upgraded	3.24
12	Positive environmental impact	3.35	Percent of projects/products implemented	3.18	Safety enhancement	3.14
13	Leadership	2.91	Public image enhancement	3.07	Leadership	3.00
14	Public image enhancement	2.82	Level of knowledge increased	3.04	Percent of projects completed on time	3.00
15	Level of knowledge increased	2.74	Quality of life enhancement	3.00	Positive environmental impact	2.91
16	Percent of projects completed on time	2.53	Leadership	2.96	Quality of life enhancement	2.71
17	Percent of projects completed within budget	2.42	Percent of projects completed within budget	2.96	Level of knowledge increased	2.67
18	Number of contractor partnerships	2.42	Percent of projects completed on time	2.89	Public image enhancement	2.06
19	Quality of life enhancement	2.28	Number of contractor partnerships	2.18	Number of contractor partnerships	1.95
20	Number of contractors	2.00	Number of contractors	2.11	Number of contractors	1.84

Table 2 compares the performance measure rankings identified in Table 1 for each performance measure included in the three surveys. Table 1 and Table 2 illustrate how the responses from each survey group were summarized for viewing during the process of selecting standard performance measures for the RPM System.

It is interesting to note that three of the four highest perceived-value performance measures are the same for transportation agency administrators and the RAC members who manage their agency's research program. These performance measures are: lives saved; reduction in crashes; and construction, maintenance, and operations cost savings. It is probably not coincidental that these three closely associate with the core mission of state transportation agencies. The importance of outcome measures which monitor the major results sought by an agency is a point made by Hatry, as he states that the mission statement and the primary objectives of an organization should be the starting place for creating outcome performance measures.

Not only did survey respondents provide perceived-value ratings for performance measures, but they often provided optional comments about the performance measures with which they have had experience. This additional information significantly informed the analysis of the results. The comments related to individual performance measures were also summarized, and these are provided in Appendix E.

Table 2. Comparison of Performance Measure Rankings, by Survey Group

Performance Measure	Survey Group and Ranking			Mean Ranking
	RAC Members	Agency Administrators	Federal & Private	
Lives saved	3	1	1	1.7
Reduction in crashes	2	3	3	2.7
Return on investment or cost-benefit ratio	5	2	2	3.0
Construction, maintenance, & operations cost savings	1	4	4	3.0
Safety enhancement	8	5	5	6.0
Percent of satisfied customers	4	8	8	6.7
Reduction in systems delays	9	6	6	7.0
Technical practices/standards upgraded	10	7	7	8.0
Contribution to the overall mission of the department	6	10	10	8.7
Positive environmental impact	12	9	9	10.0
Percent of projects/products implemented	7	12	12	10.3
Management tool or policy improvement	11	11	11	11.0
Level of knowledge increased	14	13	13	13.3
Leadership	13	14	14	13.7
Public image enhancement	15	15	15	15.0
Quality of life enhancement	19	16	16	17.0
Percent of projects completed on time	16	18	18	17.3
Percent of projects completed within budget	18	17	17	17.3
Number of contractor partnerships	17	19	19	18.3
Number of contractors	20	20	20	20.0

CHAPTER 3 – RESEARCH PERFORMANCE MEASURES

The research performance measures gathered from the nationwide surveys were considered in conjunction with performance measure information available in the literature. A comprehensive list of research-related performance measures was compiled from the gathered information, and the perceived value of each metric was considered. The comprehensive list is shown in Appendix F. After analysis, the research team recommended 18 performance measures to the NCHRP panel for inclusion in the system to be developed. At the request of the panel, the research team agreed to expand the number of standard performance measures to be provided to 30. In addition, definitions for an additional 10 performance measures will be included to inform users of other metric possibilities. The panel believed that the larger group of performance measures was needed for the system to adequately address the broad range of needs and desires existing among the states. Finally, it was also decided that users should have the ability to manually incorporate any of these other performance measures, or their own agency's unique performance measures, into performance measure reports available from the system. This utility has been provided in the RPM System. The selected standard performance measures and their definitions are shown in Table 3.

Table 3. Standard Research Performance Measures Included in the RPM System

PM Number	Short Performance Measure Name	Definition	Comment
	Outcome Measurements		
1	**Dollars Saved**	Estimated present value dollar savings in the cost of contract work, cost of agency-purchased materials, and cost of employee labor made possible by research products	A core justification for research budgets. Very important to agency administrators and all funding appropriators.
2	**Lives Saved**	Projected number of lives to be saved based on the number of fatalities associated with the problem prior to the product implementation and the estimated or determined effectiveness of the research products	A core justification for research budgets. Very important to both agency personnel and all elected officials.
3	**Crashes Avoided**	Estimated reduction in number of crashes based on the number of crashes associated with the problem prior to the research product's implementation and the estimated or determined effectiveness of the product	A core justification for research budgets. Very important to both agency personnel and all elected officials.
	Output Measurements		
4	**Technical Products**	Number of types of research products improving design processes, specifications, or technical standards or practices	Each product will either be a technical product, a management product, or a knowledge product. This is a general measure of the impact of the research program on the agency.
5	**Management Products**	Number of types of research products improving the agency's management procedures, policies, and non-technical training	Each product will either be a technical product, a management product, or a knowledge product. This is a general measure of the impact of the research program on the agency.
6	**Knowledge Products**	Number of types of research products improving basic knowledge or understanding in the subject area without creating a specific technical or management product	These are the products of basic research projects. This measure may be used to establish or maintain the desired level of basic research being funded by the agency.
7	**Environmental Products**	Number of types of research products improving or protecting the natural environment	Very important, and can be of primary importance to some state and federal appropriators and others.

Table 3. Standard Research Performance Measures Included in the RPM System (cont.)

8	**Congestion Mitigating Products**	Number of types of research products reducing or eliminating traffic congestion and other transportation system delays	Very important to the general public and all elected officials.
9	**Traveler Comfort Products**	Number of types of research products improving the physical or psychological comfort of the traveler or enhancing the aesthetic quality of the system or improving system security (safety products not included unless traveler comfort or well-being is improved in non-crash situations)	Believed to be one of the most important factors to the traveling public.
10	**Quality of Life Products**	Number of types of research products improving quality of life, which is defined as the total of those product types meeting the criteria for Environmental Products, Congestion Mitigating Products, or Traveler Comfort Products	Important to the traveling public, the most important transportation agency customer.
11	**Safety Products**	Number of types of research products improving design methodologies, traffic management, roadside safety devices, and any other innovation or enhancement for the transportation system which improves safety for anyone on or near the transportation system	Safety is always a top priority. This is an indirect measure of the number of lives saved and reduced crashes made possible by the research program.
12	**Cost-Saving Products**	Number of types of research products reducing the cost of contract work, cost of agency-purchased materials, and cost of employee labor	This is an indirect measure of the amount of cost savings being obtained for the agency by the research project or program.
13	**Research Reports**	Number of published research reports and other technical publications emanating from completed research projects during the evaluation year	This measure combines two measures currently used by agencies: "Number of Papers Written as a Result of Program" and "Number of Research Reports Completed per Year."
14	**Graduate Students**	Total number of graduate students financially supported or otherwise involved in transportation research	The value of the training given to future transportation professionals has been generally understated in the past.
	Resource Allocation Measurements		
15	**Dollar-Saving Projects**	Number of research projects pursuing lowered cost to provide the transportation system	This measure monitors funding balance in the research program and the extent to which agency cost savings are being pursued.

Table 3. Standard Research Performance Measures Included in the RPM System (cont.)

16	**Safety Projects**	Number of research projects pursuing safety enhancements	This measure monitors funding balance in the research program and the extent to which improved transportation safety is being pursued.
17	**Quality of Life Projects**	Number of research projects pursuing improved quality of life	This measure will be obtained by adding the number of projects including environmental products, traveler comfort products, and traffic congestion mitigating products.
18	**Total Contractors**	Number of unique entities with research projects that were active for any length of time during the evaluation period	If proposals are competitively awarded, this is an indirect measure of competitiveness.
19	**Minority Contractors**	Percentage of total research program contract budget that is awarded to minority universities, as defined by the US Department of Education and applicable federal regulations	A federal requirement, reported at least annually.
20	**In-House Percentage**	Percentage of the total funding for research projects being performed by agency personnel	This can be an indicator of growing or declining in-house technical strength.
	Efficiency Measurements		
21	**Benefit-Cost Ratio**	Total present value dollar savings associated with the project(s) compared to either the total present value cost of the project(s) plus implementation effort(s) or to the total present value cost of the fiscal year research program plus related implementation efforts. The system report generator selects the cost basis and enters cost data.	A key efficiency measurement for state and federal budget appropriators.
22	**% Administrative Costs**	Dollar value of program overhead expenses divided by the total program cost	An internal efficiency measurement.
23	**% Requests Funded**	Number of projects funded divided by number of projects requested	A lowering trend indicates probable need for additional research funding.
24	**% Projects Implemented**	Number of projects with at least one product implemented (completely or partially implemented) divided by total number of projects completed during the evaluation period	An indicator of quality in the project selection process and research project execution.

Table 3. Standard Research Performance Measures Included in the RPM System (cont.)

25	**% Projects On Time**	Number of projects completed on/before the scheduled completion date divided by total number of projects to have been completed during the evaluation period	This target should probably be around 80 percent due to the nature of research. A lower percentage can indicate generally poor contractor efforts in creating proposal work schedules.
26	**% Projects within Budget**	Number of projects completed within budget divided by total number of projects completed during the evaluation period	This target should probably be around 80 percent due to the nature of research. A lower percentage can indicate generally poor contractor efforts in creating proposal budget estimates.
27	**% Project with Reports**	Number of projects completed during the evaluation period (FY one year prior) for which all research reports have been submitted within one year of project completion divided by the total number of projects completed during the evaluation period	This is a challenging area for most research programs. Monitoring performance and having a target can be used as a tool for the research manager to encourage or require improved contractor performance.
Stakeholder Measurements			
28	**Customer Satisfaction**	Number of customers reporting satisfied or very satisfied on survey divided by total number of customers surveyed	Variations of surveys were reported on survey responses from several states. It is believed that all stated needs can be addressed by the definition of this PM.
29	**Agency Participation**	Number of agency personnel involved in the program overseeing projects, serving on committees, assisting in project selection, etc.	Most research programs need the participation of large numbers of agency personnel from outside of the research office. There are a number of benefits to the agency derived from this participation. This number should be provided to agency administrators.
30	**Project Needs Statements**	Number of project needs statements submitted by internal customers	This is a key indicator to research program managers for several reasons, particularly in that it shows the degree to which agency personnel understand that research provides solutions to everyday problems.

One of the considerations of the research team was to attempt to select performance measures which would not only meet the needs of state transportation agency administrators and research program managers, but that would also provide for the needs of secondary customers such as contract researchers, stakeholders such as state and federal legislators, and other state-level research professionals. It was not cost effective or practical to include every possible performance measure in the system being developed, but the research team endeavored to provide a set of performance measures which was as comprehensive as possible.

The standard performance measures are divided into five different types in Table 3. The five types of measures are outcome, output, resource allocation, efficiency, and stakeholder. Outcome measures assess the extent to which a research project or a product of a research project achieves a desired result such as cost savings or reducing crashes. Output measures count the number of deliverable units related to a specific attribute, examples being the number of research projects which improve safety and the number of products from projects which positively impact the environment. The third type of measure deals with resource allocation. Resource allocation performance measures primarily capture the deployment of agency dollars, such as the percent of research funding awarded to minority contactors or the number of research projects being funded in attempts to improve transportation safety. In contrast, efficiency measures, the fourth category, are rates or ratios which compare what is accomplished to the effort expended. Examples of this type of measure are the percent of research products being implemented by the agency and the percent of research projects being completed within budget. The final type of performance metric is the stakeholder measure. Stakeholder measures gage the involvement of customers in the research process as well as their level of satisfaction. These performance measures include the percent of satisfied customers, number of participating agency personnel, and the number of project needs statements submitted. By subdividing the performance measures into these five categories, the user is given the opportunity to better balance the selected set of performance measures to be used.

CHAPTER 4 – TOOLS FOR RESEARCH PERFORMANCE MEASUREMENT

The RPM System includes a variety of tools to assist research program managers and other system users in establishing and conducting performance measurement. A number of tools are available in both RPM-Tools and RPM-Web. Exceptions are noted in the following descriptions.

PM 101

PM 101 is a narrated tutorial available only in RPM-Tools. This tutorial is an introduction to performance measurement principles and the application of these principles to research program activities. It also provides an orientation to each of the tools included in the RPM System. The tutorial is composed of the following sections:

- RPM System Overview,
- What Is Performance Measurement?,
- What Makes a Good Performance Measure?,
- How Does Research Performance Measurement Help the Research Program Manager?,
- What Research Performance Measures Are Commonly Used?,
- What Tools Are in the RPM System?,
- How Do I Get Started?,
- Selecting Performance Goals,
- Entering Information into the RPM System,
- Measuring Performance,
- Creating Performance Reports, and
- Performance Measures Listing.

A comprehensive, narrated tutorial was not originally envisioned to be part of the tool box to be developed. However, during a meeting early in the project between the panel members and research team, it became recognized that many RPM System users might benefit greatly from an educational module in the tool box which covered the basics of performance measurement and performance management as they apply to research operations. It was also recognized that a description of the tools included in the tool box would be necessary. The research team developed PM 101 as a narrated tutorial to address these needs. The narration text is included as Appendix G.

One of the most important sections of PM 101 discusses the value of performance measurement. This section helps the user understand how performance measurement can be an effective, practical tool in managing a state transportation research program. In addition to providing an overview of performance measurement and management in general, PM 101 walks the user through the available tools within the RPM System as well as a step-by-step method to get the user started using the system. At the heart of PM 101 is a detailed explanation of the performance measures which have been included in the RPM System.

The 30 standard performance measures which are included in the RPM System are defined and described in detail as part of PM 101. The following information is included in the Performance Measure Listing section of PM 101. The RPM-Tools screen allowing immediate access to information about any of the included performance measures is shown in Figure 5.

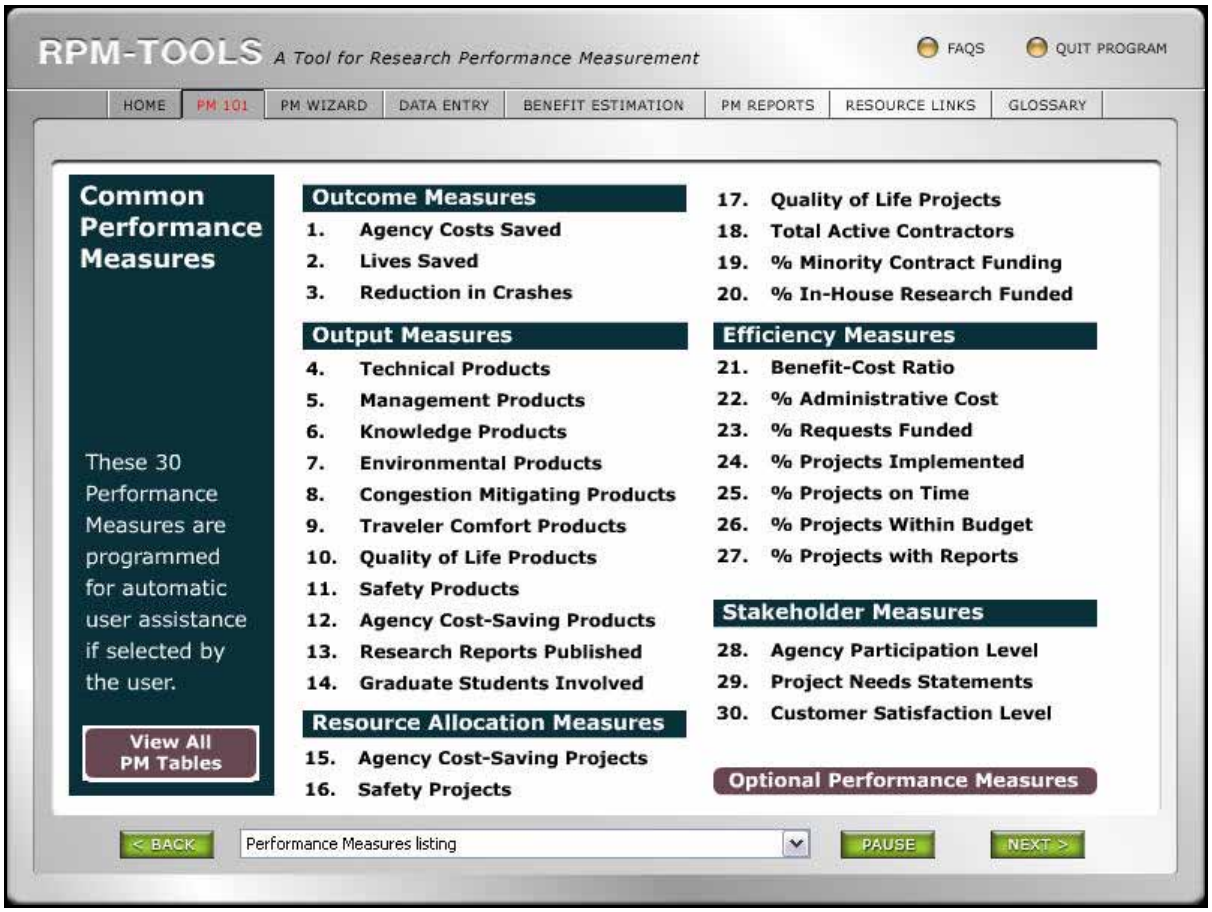


Figure 5. RPM-Tools - Standard Performance Measure Definitions Home Screen

Clicking on any performance measure on this screen will provide the following information about that measure:

- definition;
- type of measure (outcome, output, resource allocation, efficiency, or stakeholder);
- common inputs needed to measure the performance attribute;
- formula for calculating performance;
- reasons to use the performance measure;
- challenges with use of the performance measure; and
- typical target audience for the performance measure.

PM 101 is a unique tool which serves to educate and motivate the user in an area of management which often seems overwhelming and impractical. In order to maximize the learning environment, the research team employed Bloom's taxonomy, which is a common approach for developing curriculum. PM 101 was designed to provide the user with the opportunity to acquire competency in the area of performance measurement at several levels: knowledge, comprehension, application, analysis, synthesis, and evaluation. By taking this approach, the team ensured that the user could initially capture basic knowledge and then could acquire additional competencies or needed information as they were working in other

areas of RPM-Tools. PM 101 is easy to access while the user is working in the other parts of RPM-Tools.

PM SELECTION WIZARD

The PM Selection Wizard is only available in RPM-Tools. It is an analysis tool that offers guidance during the process of selecting research performance measures for an agency.

The wizard is composed of 10 multiple choice questions which, when answered, attribute various point weights to each of the 30 standard performance measures included within the RPM System. The questions, optional answers, and point weighting system are shown in Appendix H. After all questions are answered, the wizard totals the points attributed to each performance measure and, based on these totals, reports each performance measure as strongly recommended, recommended, or as an alternative to be considered for the user's agency. The user then makes an initial selection of performance measures for the organization. The user may consider wizard recommendations but is not constrained in making their selections in any way. The Wizard Recommendations & PM Selection Worksheet screen where the user makes selections is shown as Figure 6.

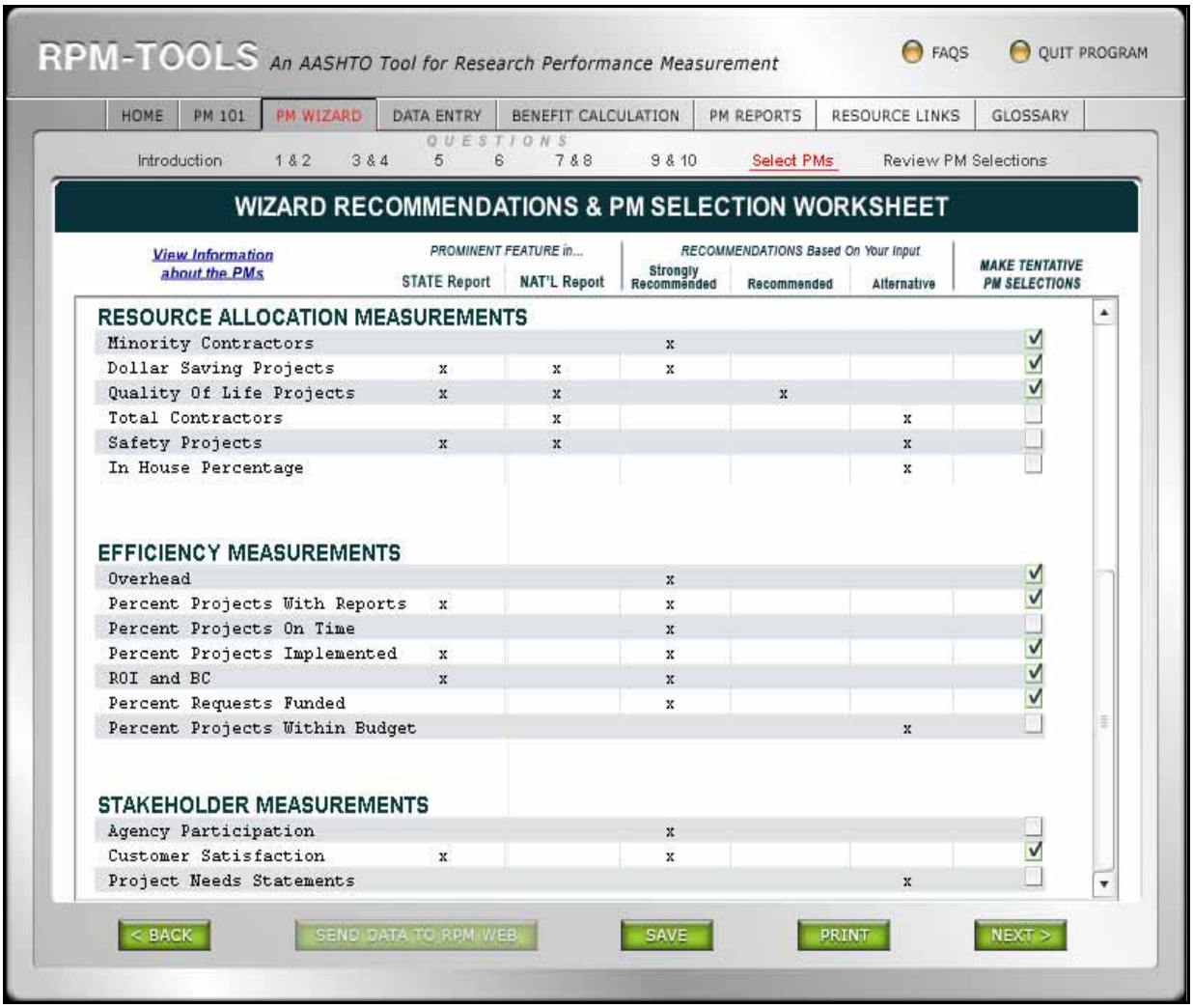


Figure 6. RPM-Tools - Wizard Recommendation & PM Selection Worksheet Screen

Once the user has made a selection of performance measures in the right-hand column, the selections are displayed as a set and the wizard provides comments appropriate to their set of performance measures. The manner in which the selected set and comments are displayed is shown in Figure 7. The user may then modify the set that has been selected if desired.

The wizard questions, the optional answers and associated point weights, and the set of programmed comments which appear when the set of performance measures warrants are based on the opinion of the research team.

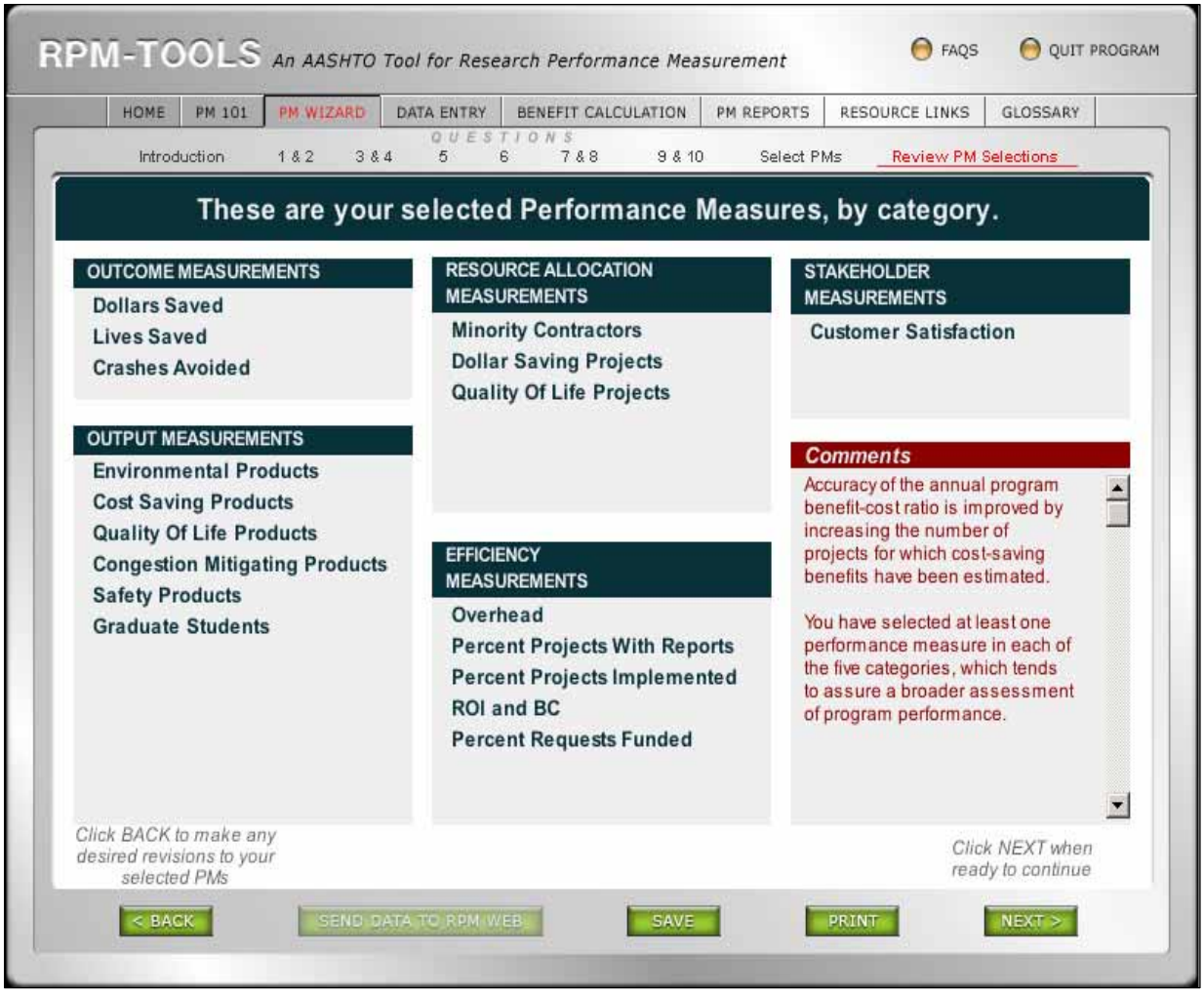


Figure 7. RPM-Tools – Selected Performance Measures with Wizard Commentary

RESOURCE COLLECTION

The Resource Collection is a listing of sources for statistics and other information frequently needed during the process of estimating benefits to be derived from research products. The listing is composed primarily of information sources which may be found on web sites, and URLs are provided for quick access. The Resource Collection contains 87 information sources. These information sources are listed in Appendix I. The resources are categorized by topic as shown in Table 4 to facilitate browsing in both RPM-Tools and RPM-Web. A search capability is also provided with the collection in RPM-Web.

Table 4. Resource Collection Topics and Numbers of References Provided

Resource Topic	Number of Resources Included
Economics and Finance	40
Energy and Environment	10
Freight Transportation	14
Infrastructure	18
Passenger Travel	11
Registered Vehicles and Vehicle Miles Traveled	0
Safety	26

BENEFIT ESTIMATION WORK SHEETS

At the product level, users have the opportunity to estimate benefits using different methodologies, each with associated work sheets to assist the user through the process. The intent of these options is to provide the user as much flexibility as possible to address the wide variety of research products which exist. Automated work sheets are available in the RPM System for each methodology.

Accessing these benefit estimation work sheets within RPM-Web and initiating benefit estimation for a research product require minimal preliminary information entry. If the research project title, start date, and end date are already available in the database, as will be the case if the user has previously entered them into the RiP database, accessing the benefit estimation work sheets requires only that the user enter the name of the research product and check the appropriate box to indicate that the product is or will be implemented.

At the heart of every benefit estimation is the listing of pertinent statistical data and the assumptions which are involved in the estimation. The Resource Collection described above is one source for necessary statistical information. Assumptions that are involved should be obtained from the most knowledgeable individuals within the agency. It is critical to estimation credibility that sources of statistical data and assumptions are documented in the work sheets provided to the user.

RPM-Web offers the user the three methodologies listed below for estimating benefits. RPM-Tools offers the first method.

- Current Minus Future Method. This method requires two determinations of costs, fatalities, and/or numbers of crashes. While this method is almost universally applicable to benefit determination situations, it usually requires more statistical data than the other two methods described below. The user is

first walked through a series of worksheets which establish the currently experienced annual costs, fatalities, and/or numbers of crashes associated with the situation to be improved by the research product. Then, the user is led through similar worksheets to establish the expected annual costs, fatalities, and/or numbers of crashes after agency-wide implementation of the research product. The difference between the two determinations provides an estimate of annual benefits, which is the basis of the total benefits determination calculation embedded in the program. The length of time estimated to achieve agency-wide implementation and the estimated useful life of the research product are other important factors in the determination of total expected benefits.

- Direct Difference Method. This method is particularly well suited for use when the research project provides estimated benefits per application of the research product, or when the expected benefits per application can be estimated after the research project is completed. This method is simpler than the current minus future method because it does not require determinations of agency-wide costs, fatalities, and/or numbers of crashes. Instead, agency-wide annual benefits are estimated by multiplying the expected benefits from each application of the research product by the number of locations or applications where the product will be implemented.
- Percent Improvement Method. This method is ideal when the research project determines a percentage improvement to be expected in costs, fatalities, and/or numbers of crashes, or when a percentage improvement can be estimated after the research project is completed. This method requires the estimator to determine the current annual costs, fatalities, and/or number of crashes associated with the situation to be improved by the research product. Then, the percentage improvement is applied to determine annual expected benefits.

The work sheets of each type lead the user through the process of entering necessary information about the product, entering data and information used in the benefit estimation, and documenting the sources for the data and information being used.

CATALOG OF BENEFIT ESTIMATION EXAMPLES

The Benefit Estimation Catalog provided in both RPM-Tools and RPM-Web was developed primarily from actual estimates of benefits performed and submitted to the research team by state transportation agencies. In addition, several benefit estimations in the catalog of examples were developed for hypothetical products so that a wider variety of examples could be included. The hypothetical products and benefit estimation examples are clearly indicated as such within the catalog. The catalog of example benefit estimations is provided so that the RPM System user may find assistance in determining how to undertake estimating benefits to be obtained from a product at hand. All three of the methods for determining benefits are included among the benefit estimation examples in the catalog.

The RPM-Web screen containing the list of example benefit determinations is shown in Figure 8. One of the 20 standard example estimates is shown in Figure 9. All standard example estimates are included in Appendix J. These examples demonstrate viable approaches to estimating benefits for a variety of types of research products. Should an example estimation be found which is similar in nature to the research product and benefits

to be estimated by the user, work sheets which contain the information from the example may be accessed and modified as necessary to develop the desired product benefit estimation.

Whether a blank work sheet is used or an example is being obtained from the catalog, the user is provided automated work sheets which both assist in the calculations involved and in documenting how the estimation was performed.

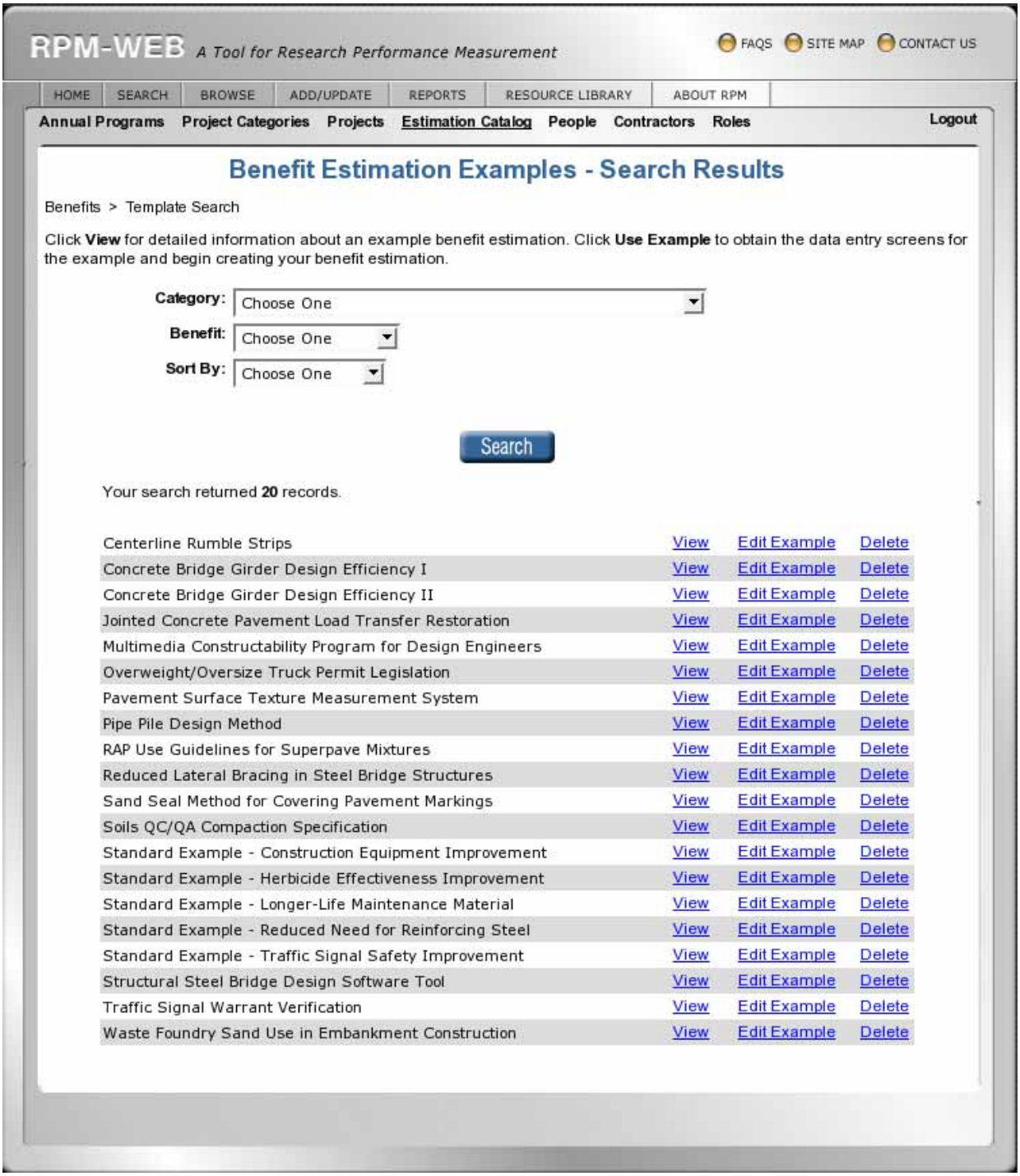


Figure 8. Benefit Estimate Example Catalog

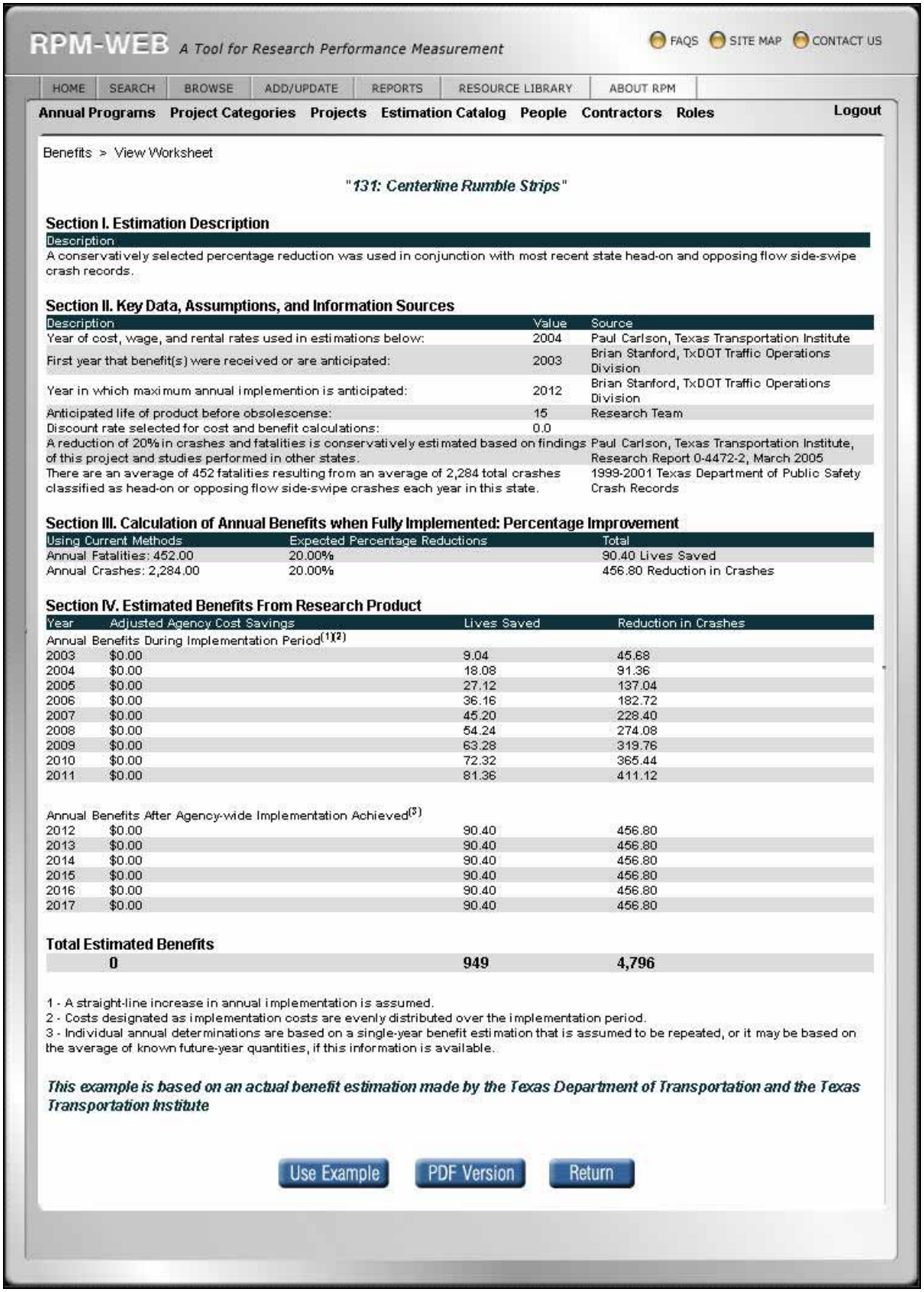


Figure 9. Benefit Estimation Example

AUTOMATED PRESENT VALUE CALCULATION

If the RPM System user enters a discount rate to be used in the dollar cost savings estimation, the system provides automated conversion of research project related costs and cost savings to their present values for the year the research project was completed. Considering the time value of dollars invested in research is important because the period of time from initiating a research project until the implemented products have become obsolete is often fifteen years or longer. Lengths of time of this order make present value handling of dollar values a necessity. Failure to address the time value of invested capital may become a serious credibility issue for consumers of the information being provided.

The discount rate is a percentage used to convert annual dollar costs or benefits occurring in future or earlier years to their values during the desired comparison year. While discount rates used by private businesses usually include the minimum acceptable profit, established by company owners, it is recommended that public agencies' cost to borrow money, or "cost of capital," be used as their discount rate (*5*). These rates have historically ranged from three percent to five percent (*6*). This percentage, or a similarly determined percentage, should be obtained by inquiring with the finance office of the state transportation agency performing the benefits estimate. Useful information about application of discount rates may also be found on the web site for the Office of Management and Budget (OMB).

The benefit estimation work sheets of the RPM System consider and automatically convert three types of dollar transactions into present value quantities. These are the annual research project costs, the annual implementation costs, and the agency's annual cost savings which begin to be realized at the time implementation is initiated. As is customary in economic analyses, the entire cost or cost savings occurring throughout a year is considered transacted on the last day of that year. The cash flow diagram depicted in Figure 10 shows these cash events occurring over time.

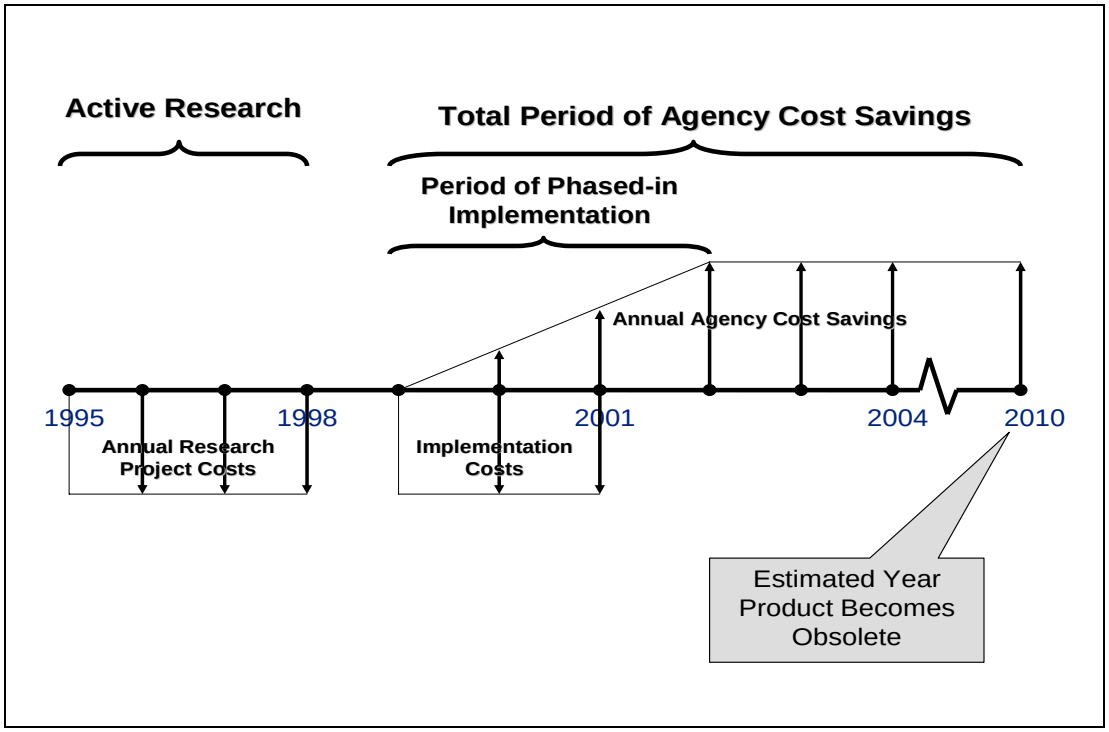


Figure 10. Research Project and Benefit Cash Flow Diagram

Please note several things in the Figure 10 example. First, the research project shown was completed in 1998. So the discount value will convert all annual dollar costs occurring either before or after 1998 to the value of those dollars in 1998. Likewise, the annual cost savings occurring after project termination will be discounted to 1998 value. Note also that in this example that active use of the product did not begin until a year after completion of the research project. While this may not always be the case, periods of product evaluation often do require a year or more.

The implementation period shown in Figure 10 to obtain a statewide, maximum-feasible implementation level for the agency is three years. The RPM System handles all multi-year implementation periods using a straight-line ramped increase for the cost savings over this time period. For implementation costs, the RPM System totals all implementation costs and then averages them and distributes these averages over the years of the implementation period. A ramped distribution is not used because of the greater likelihood of substantial up-front costs to initiate implementation. The decision to ramp and average these two transition period costs was made to simplify calculations in the prototype RPM System.

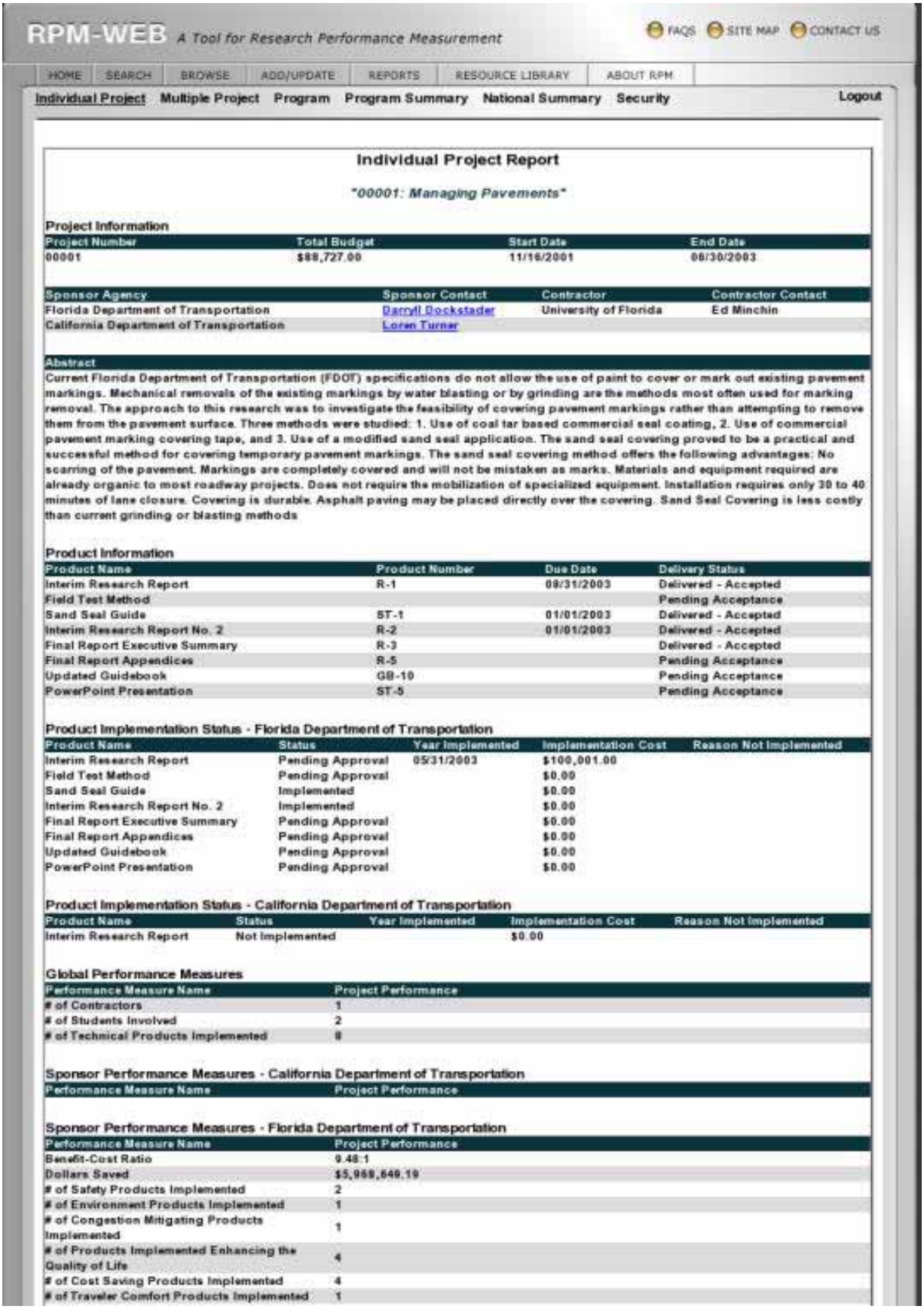
To perform a quantitative estimation of benefits expected from a research product, it is necessary to estimate the length of time that will transpire before the product becomes obsolete and is replaced by later innovations. The anticipated service life of a product before obsolescence is an entry item for the user during benefit estimation. To assist the user in selecting a predicted service life, guidance is provided within the system for a variety of general types of research products. The guidance provided was developed by surveying AASHTO RAC members during the 2004 national RAC meeting in Mystic, Connecticut. Those attending this meeting were provided an opportunity to fill in a form wherein they indicated their opinion on average useful life for 22 different generic research product types. The responses obtained and the guidance being provided within the RPM System derived from them are shown in Appendix K.

PERFORMANCE MEASUREMENT REPORTS

A suite of pre-programmed yet customizable reports is provided in RPM-Web. Performance report types provided include the Individual Project Report, the Multiple Project Report, the Research Program Report, and both a State and a National Research Program Summary Report. In addition, a Security Report is provided to assist the research program manager administer access to the agency's records in RPM-Web. An Individual Product Benefit Estimation Report is available from RPM-Tools.

Customization made available for the RPM-Web reports includes deleting or adding performance measures to create any combination desired. The user may also add the agency's unique performance measures as well as goals and performances for these additional performance measures. Additionally, the user may rename any of the reports and may add a subtitle to the reports. Finally, any of the columns displayed may be deleted from the report being created, if desired. When a desired report format has been created, the user has the option to save that format for later use.

An example of an Individual Project Report in its RPM-Web view is shown in Figure 11. Note that multiple sponsors, when applicable, are displayed along with individual sponsor performance measurement information. When quantitative benefit estimations have been made, those calculations are also displayed as follow-on information to this report.



Individual Project Report

"00001: Managing Pavements"

Project Information

Project Number	Total Budget	Start Date	End Date
00001	$88,727.00	11/16/2001	08/30/2003

Sponsor Agency	Sponsor Contact	Contractor	Contractor Contact
Florida Department of Transportation	Darryll Dockstader	University of Florida	Ed Minchin
California Department of Transportation	Loren Turner		

Abstract

Current Florida Department of Transportation (FDOT) specifications do not allow the use of paint to cover or mark out existing pavement markings. Mechanical removals of the existing markings by water blasting or by grinding are the methods most often used for marking removal. The approach to this research was to investigate the feasibility of covering pavement markings rather than attempting to remove them from the pavement surface. Three methods were studied: 1. Use of coal tar based commercial seal coating, 2. Use of commercial pavement marking covering tape, and 3. Use of a modified sand seal application. The sand seal covering proved to be a practical and successful method for covering temporary pavement markings. The sand seal covering method offers the following advantages: No scarring of the pavement. Markings are completely covered and will not be mistaken as marks. Materials and equipment required are already organic to most roadway projects. Does not require the mobilization of specialized equipment. Installation requires only 30 to 40 minutes of lane closure. Covering is durable. Asphalt paving may be placed directly over the covering. Sand Seal Covering is less costly than current grinding or blasting methods

Product Information

Product Name	Product Number	Due Date	Delivery Status
Interim Research Report	R-1	08/31/2003	Delivered - Accepted
Field Test Method			Pending Acceptance
Sand Seal Guide	ST-1	01/01/2003	Delivered - Accepted
Interim Research Report No. 2	R-2	01/01/2003	Delivered - Accepted
Final Report Executive Summary	R-3		Delivered - Accepted
Final Report Appendices	R-5		Pending Acceptance
Updated Guidebook	GB-10		Pending Acceptance
PowerPoint Presentation	ST-5		Pending Acceptance

Product Implementation Status - Florida Department of Transportation

Product Name	Status	Year Implemented	Implementation Cost	Reason Not Implemented
Interim Research Report	Pending Approval	05/31/2003	$100,001.00	
Field Test Method	Pending Approval		$0.00	
Sand Seal Guide	Implemented		$0.00	
Interim Research Report No. 2	Implemented		$0.00	
Final Report Executive Summary	Pending Approval		$0.00	
Final Report Appendices	Pending Approval		$0.00	
Updated Guidebook	Pending Approval		$0.00	
PowerPoint Presentation	Pending Approval		$0.00	

Product Implementation Status - California Department of Transportation

Product Name	Status	Year Implemented	Implementation Cost	Reason Not Implemented
Interim Research Report	Not Implemented		$0.00	

Global Performance Measures

Performance Measure Name	Project Performance
# of Contractors	1
# of Students Involved	2
# of Technical Products Implemented	8

Sponsor Performance Measures - California Department of Transportation

Performance Measure Name	Project Performance

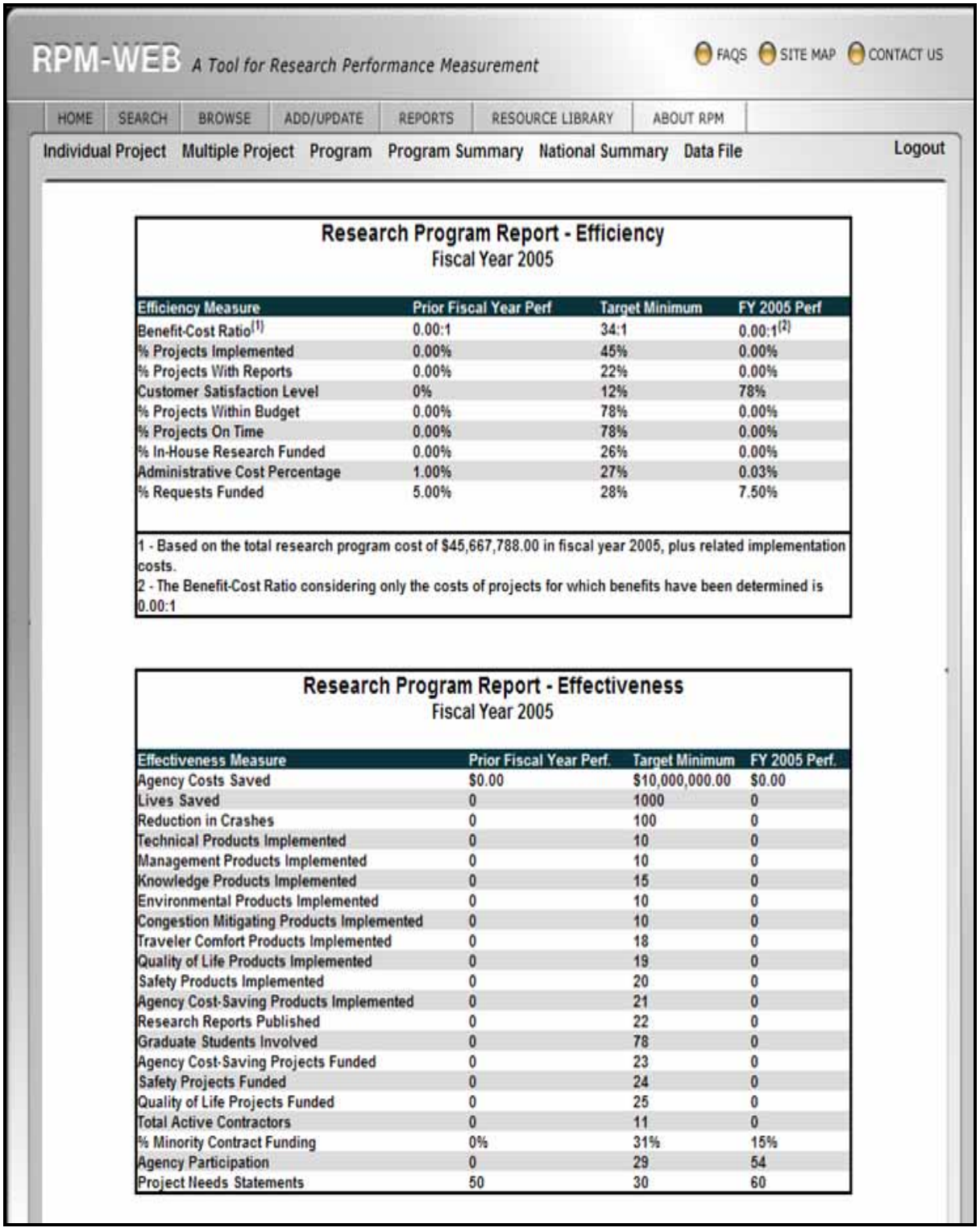
Sponsor Performance Measures - Florida Department of Transportation

Performance Measure Name	Project Performance
Benefit-Cost Ratio	9.48:1
Dollars Saved	$5,969,649.19
# of Safety Products Implemented	2
# of Environment Products Implemented	1
# of Congestion Mitigating Products Implemented	1
# of Products Implemented Enhancing the Quality of Life	4
# of Cost Saving Products Implemented	4
# of Traveler Comfort Products Implemented	1

Figure 11. RPM-Web – Individual Project Report Screen

An example of a Research Program Report in its RPM-Web view is shown in Figure 12. All performance measures are displayed in the Figure 12 example although developers of these reports have the option to show only selected performance measures. The PDF format of the effectiveness portion of the Research Program Report is shown in Figure 13. Each of the RPM-Web reports has a PDF format option.

Guidance in how to generate RPM System reports is provided in the PM 101 tutorial. Although the user can customize all performance measurement reports provided by the RPM System, the standard report formats have been designed to provide an easy alternative for summarizing research performance measurement information.



Research Program Report - Efficiency
Fiscal Year 2005

Efficiency Measure	Prior Fiscal Year Perf	Target Minimum	FY 2005 Perf
Benefit-Cost Ratio[1]	0.00:1	34:1	0.00:1[2]
% Projects Implemented	0.00%	45%	0.00%
% Projects With Reports	0.00%	22%	0.00%
Customer Satisfaction Level	0%	12%	78%
% Projects Within Budget	0.00%	78%	0.00%
% Projects On Time	0.00%	78%	0.00%
% In-House Research Funded	0.00%	26%	0.00%
Administrative Cost Percentage	1.00%	27%	0.03%
% Requests Funded	5.00%	28%	7.50%

1 - Based on the total research program cost of $45,667,788.00 in fiscal year 2005, plus related implementation costs.
2 - The Benefit-Cost Ratio considering only the costs of projects for which benefits have been determined is 0.00:1

Research Program Report - Effectiveness
Fiscal Year 2005

Effectiveness Measure	Prior Fiscal Year Perf.	Target Minimum	FY 2005 Perf.
Agency Costs Saved	$0.00	$10,000,000.00	$0.00
Lives Saved	0	1000	0
Reduction in Crashes	0	100	0
Technical Products Implemented	0	10	0
Management Products Implemented	0	10	0
Knowledge Products Implemented	0	15	0
Environmental Products Implemented	0	10	0
Congestion Mitigating Products Implemented	0	10	0
Traveler Comfort Products Implemented	0	18	0
Quality of Life Products Implemented	0	19	0
Safety Products Implemented	0	20	0
Agency Cost-Saving Products Implemented	0	21	0
Research Reports Published	0	22	0
Graduate Students Involved	0	78	0
Agency Cost-Saving Projects Funded	0	23	0
Safety Projects Funded	0	24	0
Quality of Life Projects Funded	0	25	0
Total Active Contractors	0	11	0
% Minority Contract Funding	0%	31%	15%
Agency Participation	0	29	54
Project Needs Statements	50	30	60

Figure 12. RPM-Web - State Program Report Screen

Research Program Report - Effectiveness
Fiscal Year 2003
Kansas Department of Transportation

Effectiveness Measure	Prior Fiscal Year Performance	Target Minimum	FY 2003 Performance
Agency Costs Saved	$0.00	$40,000.00	$0.00
Lives Saved	0	20	0
Reduction in Crashes	0	50	0
Technical Products Implemented	0	10	0
Management Products Implemented	0	5	0
Knowledge Products Implemented	0	0	0
Environmental Products Implemented	0	10	0
Congestion Mitigating Products Implemented	0	10	0
Traveler Comfort Products Implemented	0	2	0
Quality of Life Products Implemented	0	0	0
Safety Products Implemented	0	10	0
Agency Cost-Saving Products Implemented	0	20	0
Research Reports Published	0	25	0
Graduate Students Involved	0	100	0
Agency Cost-Saving Projects Funded	0	10	0
Safety Projects Funded	0	10	0
Quality of Life Projects Funded	0	10	0
Total Active Contractors	0	40	0
% Minority Contract Funding	%	6%	5.9%
Agency Participation		100	0
Project Needs Statements	52	25	65

Figure 13. RPM-Web - Research Program Effectiveness Portion of the State Program Report in PDF Format

CHAPTER 5 – CONCLUSIONS AND RECOMMENDATIONS

CONCLUSIONS

1. The research performance measures perceived to be of most value among state transportation agency administrators and research program managers are the number of lives saved, the number of crashes avoided, and the amount of dollar cost savings realized from the implementation of research products.

2. Wide variability currently exists among state transportation agencies regarding the monitoring of research program and project performance. There is little consistency in the performance measures being used and few tools exist to provide meaningful assistance during the process.

3. Consensus use of the three outcome measures defined in the RPM System – number of lives saved, number of crashes avoided, and dollar cost savings to the agency – will likely require both coordination and encouragement from AASHTO RAC leadership and the strong support of AASHTO SCOR.

RECOMMENDATIONS TO RPM SYSTEM USERS

1. The three outcome measures defined in the RPM System – number of lives saved, number of crashes avoided, and dollar cost savings to the agency – are recommended for use by every state transportation agency.

2. It is recommended that every state transportation agency seriously consider tracking research project and program performance, even if only on several highly successful research projects each year, and that this information be loaded into the RPM-Web database. While determining research benefits in this manner will provide, at a minimum, strong anecdotal evidence of justification for the program's budget, a compendium of similar entries from a broad number of state transportation agencies will result in meaningful information being derived from the national summary report. Nationwide summary information should prove valuable at the time of the next federal transportation budget re-authorization.

3. Research program and project performance measures should be carefully selected. It is recommended that only research performance measures tracking the highest priority performance areas be officially selected and reported for a given performance period. Other performance metrics may well be monitored, at the discretion of and as needed by the research program manager. Wise and limited selections followed by thorough tracking are believed to compose the formula for success in research performance measurement.

4. Credible determination of estimated research benefits requires three rules to be strictly followed.

   a. Consult top agency experts whenever a factor in the benefit calculation must be an estimate based purely or primarily on an individual's experience.

   b. Document both the sources of information used in the calculation of estimated benefits as well as the method of performing the calculation.

   c. Estimations should always be made on the conservative side of probability. This must be made clear to the experienced personnel asked to provide an estimated factor.

5. Consider requiring that contract researchers provide an estimate of expected benefits for the sponsoring agency if products from the research project are fully implemented by the research sponsor. This would be the final deliverable of the researcher's project. Not only will this provide the state transportation agency an early estimate of benefits, but it is likely that this requirement will also tend to better focus the researcher throughout the project on obtaining the desired benefits.

SUGGESTED RESEARCH

1. A suggested major next step in research performance measurement is the development of one or more additional performance measures focusing on the impact of research on traffic congestion. As traffic congestion and associated travel time delays are a major concern of the traveling public, a performance measure including quantitative means for characterizing reduced traffic congestion would substantially improve the set of available research performance measures. Tools to assist users as well as example benefit estimations will be necessary complements to the new measure or measures.

2. As research office staff resources are usually stretched thinly, it is suggested that an immediate effort be organized to identify and pursue means for facilitating use of the new system in state research offices. Improvements might include development of additional tools, modified screen designs or functionalities, or any other manner of improving system ease of use, intuitiveness, and efficiency. A group of selected states planning early implementation would possibly compose an ideal team to meet, share ideas and brainstorm, and then feed desired or needed changes back to NCHRP, AASHTO, or another body for funding consideration. There may be great value in including several states on this team who have not been involved with the system's development since these states may bring additional perspectives, needs, or ideas which have eluded both the research team and the panel.

REFERENCES

1. Elrahman, O. A., Perry, R. J. and Griffith, R. G., "Measuring Transportation Research Programs: A Conceptual Framework" 9th World Conference on Transportation Research, Seoul, Korea (2001).

2. Sabol, S. A., *NCHRP Synthesis of Highway Practice 300: Performance Measures for Research, Development, and Technology Programs,* Transportation Research Board, National Research Council, Washington, DC (2001) p. 1-2, 38-39.

3. Hatry, H. P., *Performance Measurement: Getting Results.* Urban Institute Press (1999).

4. International Scanning Study Team, *Transportation Performance Measures in Australia, Canada, Japan, and New Zealand.* U.S. Department of Transportation, Federal Highway Administration (2004).

5. Garrison, R. H. and Noreen, E. W., *Managerial Accounting* – Ninth Edition. Irwin McGraw-Hill (2000).

6. U.S. Department of Transportation, Federal Highway Administration, Office of Asset Management, "Economic Analysis Primer." (2003) pp. 668-682.

BIBLIOGRAPHY

2003 Research Peer Exchange, notes from a meeting October 8-9, 2003, Iowa Department of Transportation, Ames, Iowa (2003).

American Association of State Highway and Transportation Officials, "User Benefit Analysis for Highways Manual" (2003).

Arditi, D. and Messiha, H. M. "Life Cycle Cost Analysis (LCCA) in Municipal Organizations." *Journal of Infrastructure Systems, (*March 1999).

Committee on Science, Engineering, and Public Policy, "Implementing the Government Performance and Results Act for Research – A Status Report," National Academy of Sciences, National Academy Press, Washington DC (2001).

Concas, S., Reich, S. L. and Yelds, A. T., "Valuing the Benefits of Transportation Research: A Matrix Approach," *Report No. 2117-463LO,* Center for Urban Transportation Research, University of South Florida (2002).

Deen, T. B. and Harder B. T., *NCHRP Synthesis of Highway Practice 280: Seven Keys to Building a Robust Research Program,* Transportation Research Board, National Research Council, Washington, DC (1999).

Ellis, R. D., Jr., Degner, J., O'Brien, W. and Peasley, G., *Review, Analyze and Develop Benefit Cost/Return on Investment Equations, Guidelines and Variables.* University of Florida - Gainesville, Department of Civil and Coastal Engineering (2003).

Kaplan, R. S. and Norton, D. P., "The Balanced Scorecard – Measures That Drive Performance," *Harvard Business Review,* January – February 1992.

Long, R., Performance Measurements for Research Programs Workshop notes from a meeting of AASHTO RAC members on December 11-13, 2002, Orlando, FL.

McFarland, W. F., "Method for Evaluating the Benefits of Research Projects", *Report No. 1137-1F,* Texas Transportation Institute, College Station, TX (1988).

Minister of Public Works and Government Services, Public Affairs Branch, Treasury Board of Canada, "Program Evaluation Methods: Measurement and Attribution of Program Results, Third Edition."

Osborne, David, "Refining State Technology Programs", *Issues in Science and Technology* 6, No. 4 (1990).

Pickrell, S. and Neumann, L. " Use of Performance Measures in Transportation Decision Making," Conference Proceedings 26, Performance Measures to improve Transportation Systems and Agency Operations, National Academy Press, Washington DC (2001).

Poage, J. L., "Developing Actionable Performance Measures for Government Programs," Volpe National Transportation Systems Center, Cambridge, MA, (2000).

Ruegg, R. and Feller, I. "A Toolkit for Evaluating Public R&D Investment – Models, Methods, and Findings from ATP's First Decade," *NIST GCR 03-857,* U. S. Department of Commerce (2003).

Stockton, W. R., Walton, C. M., Goodin, G. D., Turner, S. M., Martello, M. T., Collier, T. S., Wiles, P. B., Wang, Z., Gupta, A. and Hernandez, Z., "Estimating ITS Benefits: Guidelines for Evaluating ITS Projects, *Research Report 0-1790-5*, Texas Transportation Institute, Texas A&M University, College Station, TX (2003).

TransTech Management, Inc. and AASHTO, "Strategic Performance Measures for State Department of Transportation – A handbook for CEOs and Executives," NCHRP Project No. 20-24(20), American Association of State Highway and Transportation Officials, Washington D. C., (2003).

Trauner Consulting Services, Inc., *NCHRP Research Results Digest 225: Putting Research Into Practice – A Synopsis of Successful Strategies and Case Histories*, Transportation Research Board, National Research Council, (1998).

U. S. General Accounting Office, "HIGHWAY RESEARCH, Systematic Selection and Evaluation Processes Needed for Research Program," Washington DC (2002).

Volpe National Transportation Systems Center, "Cost, Benefit, and Risk Assessment Guidelines for RE&D Investment Portfolio Development," *Report No. WP-43-FA82F-98-1*, Volpe National Transportation Systems Center, Cambridge, MA, (1998).

Volpe National Transportation Systems Center, "Sample Benefit and Cost Assessment with Explanations – Companion Document to Cost, Benefits, and Risk Assessment Guidelines for R,E&D Investment Portfolio Development," *Report No. WP-43-FA82F-98-2*, Volpe National Transportation Systems Center, Cambridge, MA, (1997).

Williams, D. and Hedges, C., *Performance Evaluation Mechanisms for Transportation Research Programs*. Synthesis of Practice No. 4, Ottawa: Transportation Association of Canada, Ottawa (1996).

APPENDIX A - Glossary of Terms

Closed Out – The contract end date has passed and implementation decisions have been made for all products

Contractor/Contracting Agency – The agency contracted by the sponsor to perform the research. This could also be the state itself in the case of in-house research.

Deliverable – A research product or a research report required of the contracting agency in the research contract

Deliverable Completed – A product or report that has been delivered by the contracting agency and accepted by the sponsoring agency as completing the contract requirements

Deliverable Deleted – The requirement for the product or report was removed from the project contract

Deliverable Pending – A product or report which has not been entered into the system as either Completed, Implementing, Not Implementing, or Deleted. This is the default deliverable status.

FY Program Budget – The total of all research project budgets plus the program overhead costs for that fiscal year

Implementation – Use of a research product in a capacity outside of the research project which developed it

Implementation Costs – The cost of implementing a specific research product

Implementing – A product that has been delivered and accepted and that will be or has been used outside of the research project which developed it

Not Implementing – A product that has been delivered and accepted but that will not be implemented by the sponsoring agency

Pending Review – Product or project information entered or uploaded into RPM-Web by the contracting agency and that has not yet been approved by the sponsoring agency and therefore will not yet be included in any RPM-Web report

Product/Research Product – A desired outcome of a research project which justified or helped justify the research project funding (examples: new/improved equipment, procedures, models, training courses or materials, findings, recommendations, software, design methods)

Program – The group of research projects funded by one or more specific sponsoring agencies

Program Budget – The total cost to the agency of all individual research projects plus the agency's program overhead cost

Program Overhead Cost or Program Administrative Cost – The total of all costs to operate an agency's research program which are not specifically assignable to individual projects. The most common costs in this category are the salary and operational costs of the state transportation agency's research office.

Project - A funded endeavor to produce research products

Project Budget – The total cost of the research project as entered by the sponsoring agency into the RiP system. This is normally the total of all direct project costs and does not include a proportionate share of program overhead costs.

Research Performance Measure (RPM) – A method of assessing the effectiveness or efficiency of the activities under a research project or program

Research Report – Written documentation of the research work performed by the contracting agency to provide the research product(s)

RPM Report – One of the pre-formatted reports provided by the RPM System. Most of the report formats have customization options.

RPM System – RPM-Web plus RPM-Tools

RPM-Tools– A CD-ROM containing a performance measurement tutorial; project and product data entry screens; project and product performance measurement calculation capability; and capability to generate a report for a single project

RPM-Web – A web site with backend database containing a catalog of benefit calculation examples; product, project, program, and performance measure data entry screens; product, project and program-level performance measurement value calculation capability; and report generation capability

Sponsor/Sponsoring Agency – The agency funding the research project or program

Wizard – A series of questions to aid and identify in the selection of research performance measures for research programs and projects

APPENDIX B - Systems Requirements Document Excerpts

INTRODUCTION

The Texas Transportation Institute (TTI) has developed systems requirements for the Research Performance Measures (RPM) System to be provided under NCHRP Project 20-63. The RPM System is comprised of a CD-ROM, referred to herein as RPM-Tools, and a web site with a backend database, referred to herein as RPM-Web.

The RPM System is designed to guide and assist research program managers in evaluating the performance of their research programs and individual projects. RPM-Tools is a standalone piece to assist both research program managers and contractors in understanding research performance measurement, selecting performance measures, and in calculating benefits from individual research products. RPM-Web also offers benefit calculation capability, plus a variety of customizable reporting options that include statewide and nationwide reports. Sponsoring agencies also have the option to delegate access to web input screens to their research contractors. A web browser is the only piece of software required.

The RPM database on the web site will be populated with information from the RiP database on a routine basis. Any needed information that cannot be downloaded from RiP will require manual entry by the state agencies or their contractors. This can be accomplished by either manually entering the information using the web site or, in the case of project/product information, the upload from the RPM-Tools CD-ROM. Annual program budget information, state strategic objectives, goals for current fiscal year (FY) performance, and similar program information will require agency entry on an annual basis.

The system includes an automated communication feature. Through the use of database triggers, the RPM System notifies sponsoring agencies via e-mail when an authorized contractor uploads new performance measurement data to the web site.

The web site reporting tool can generate five standard format HTML/PDF reports plus a data file option allowing transfer of information to a user's Excel file. The RPM reports have several customization features, including ability for the research program manager to add performance measures and results which are unique to their state.

This systems requirements document describes in detail the web site, the design of the backend database, and a description of CD-ROM capabilities. Chapter 2 includes a glossary, descriptions of roles, and RPM reports available from the system. Chapter 3 describes tasks that can be accomplished through the CD-ROM. Chapter 4 describes what tasks can be accomplished through the web site, and by whom, and also lists the hierarchy of pages. Chapter 5 is comprised of the entity-relationship diagram as well as tables and field definitions for the database used by the web site.

DEFINITIONS, REPORTS AND ROLES

Glossary for Systems Requirements Document

Data Entry Status

Pending Review – Product or project information entered or uploaded into RPM-Web by the contracting agency and that has not yet been approved by the sponsoring agency and therefore will not yet be included in any RPM-Web report

Deliverable Status

Completed – A product or report that has been delivered by the contracting agency and accepted by the sponsoring agency as completing the contract requirements

Deleted – The requirement for the product or report was removed from the project contract

Implementing – A product that has been delivered and accepted and that will be or has been used outside of the research project which developed it

Not Implementing – A product that has been delivered and accepted but that will not be implemented by the sponsoring agency

Pending – A product or report which has not been entered into the system as either Completed, Implementing, Not Implementing, or Deleted. This is the default deliverable status.

Project Status

Closed Out – The contract end date has passed and implementation decisions have been made for all products

General Codes

Deliverable Types: Report
Product

Person Roles: Principal Investigator
Project Manager

RPM System Report Descriptions & Functionality

Individual Project Report – The default format of this report contains all project and product information available in the database for a selected research project. See the sample report shown in Figure 4-2 – Individual Project Report.

The primary purpose for this customizable report is to provide the Research Program Manager one or more report formats suitable either for internal research office use in

research project management or to meet the information needs of individuals or organizations external to the research office. A unique feature of this report is that it includes documentation of the method of benefit calculation.

A user belonging to the agency sponsoring the research project may customize the default report format by eliminating rows or columns of information. The sponsoring agency user may also add one or more unique performance measures and results concerning this project in free form text fields. The title of the report may also be customized. The Research Program Manager has the option to save this customized report configuration on RPM-Web to make it available to other system users within his or her own agency. Upon opening a saved report configuration, an authorized user obtains up to the minute information pertinent to that report. The Research Program Manager may also save a report to their computer for attaching to e-mails, preserving data reflecting that report date, or otherwise handling. Users from another agency will only be able to access the default format of the Individual Project Report. The default format of this report is the report available from RPM-Tools**.**

Multiple Project Report – The default format of this report contains most project and product information available in the database for each research project sponsored by the requestor's agency. See the sample report shown in Figure 4-3 – Multiple Project Report.

The primary purpose for this customizable report is to provide the Research Program Manager one or more report formats suitable either for internal research office use in program management or for providing information to individuals or organizations external to the research office.

An authorized user may customize this report by eliminating rows or columns of information. This report may also be customized to include only projects associated with one or more agency strategic objectives, agency-defined categories, funding type, or national standard categories from the fiscal year being reported. The title of this report may be customized. As with the Individual Project Report, the Research Program Manager may save a configuration of this report on RPM-Web, to make it available to other system users within his or her own agency, or he or she may save the specific report to their computer.

State Research Program Performance Report – The default format of this report contains two tables of information describing the performance of the agency's entire research program for the requested fiscal year. The first table includes program efficiency information; and the second table includes program effectiveness information. See the sample report shown in Figure 4-4 – State Research Program Performance Report.

The primary purpose for this customizable report is to provide the Research Program Manager one or more report formats suitable for either internal research office use in monitoring program performance or for reporting program performance to agency administrators.

The report for a given agency is available only to system users belonging to that agency. The prior fiscal year's performance is displayed along with the requested fiscal year's

targeted and actual performance. A user may customize the default report format by eliminating rows or columns of information. The sponsoring agency user may add one or more unique performance measures and results in free form text fields. The title of the report may also be customized. The Research Program Manager has the option to save this customized report configuration on RPM-Web, to make it available to other system users within his or her own agency, or he or she may save the specific report to their computer.

State Research Program Impact Report – The default format of this report provides information about an agency's research program that is pertinent to three common and primary research program objectives: to save lives, to reduce costs of providing transportation, and to improve quality of life. See the sample report shown in Figure 4-5 – State Research Program Impact Report. The default report includes an indication of the amount of research being performed toward each objective, the outputs and outcomes which resulted, and indicators of the efficiency of the agency's entire research program.

This primary purpose for this report is to succinctly provide information needed by decision-makers responsible for requesting or approving an agency's research program funding level.

The report for a given agency is available only to system users belonging to that agency. A user may customize the default report format by eliminating rows or columns of information. The title of the report may also be customized. The Research Program Manager may save this customized report configuration on RPM-Web, to make it available to other system users within his or her own agency, or he or she may save the specific report to their computer.

National Research Program Impact Report – The default format of this report provides information about the effect of the combined state research programs. See the sample report shown in Figure 4-6 – National Research Program Impact Report. Like the similar agency-level report, this report focuses on three common and primary objectives of every research program: to save lives, to reduce costs of providing transportation, and to improve quality of life. The default report includes an indication of the amount of research being performed nationally toward each objective, the outputs and outcomes which resulted, and indicators of the efficiency of the nationwide research program.

The primary purpose for this report is to succinctly provide information needed by the Standing Committee on Research (SCOR) and other national decision-makers responsible for requesting or approving research program funding levels during federal transportation program reauthorization deliberations.

A user may customize the default report format by eliminating rows or columns of information. The title of the report may also be customized. An authorized user may save the created report to their computer. The Research Program Manager may save a customized report configuration on RPM-Web to make it available to other system users within their agency authorized to view this report.

Agency Comprehensive Database File – This option allows the Research Program Manager to download a file containing all research project information for a given fiscal year of their agency's research program to an Excel file.

The primary purpose for this option is to provide the Research Program Manager the capability of creating any report, chart, or graph that may be desired using database information.

RPM-Web User Roles

All users must "login" to the web site before being granted access to any area. The valid roles that can be granted to users are shown below.

General User - this basic information access level is envisioned to be broadly granted within state transportation agencies, to FHWA, and other public and private organizations within the transportation research community

SHA Administrator - primarily envisioned for SCOH Members and other state transportation agency administrators

Research Program Manager - primarily envisioned for the state transportation agency RAC Member

Research Project Manager - primarily envisioned for research office staff use or optionally to be granted to state transportation agency personnel located outside of the research office

Principal Investigator – the lead researcher responsible for a specific project

Contract Administrator – the research contract office of the Principal Investigator's agency

Webmaster – manages the database, creates new agencies, and assigns Research Program Manager system user roles

PERFORMANCE MEASURES CD-ROM (RPM-Tools)

The industry-standard multimedia authoring program Macromedia Director MX 2004 will be used to assemble and create the CD-ROM. This authoring tool will accommodate creation of all the features described in this document, including interactive formulas and saving data to the computer's hard drive.

The CD will be a multi-platform "hybrid" CD-ROM. It will support versions of Microsoft Windows from Windows 98 to the present, and Macintosh operating systems.

RPM-Tools provides three major components to the RPM System:

PM 101: A self-paced introduction to research performance measurement, featuring an overview of the value of research performance measurement and providing the user with specific assistance in selecting appropriate performance measures. The material is targeted for those with no prior experience with research performance measurement.

Benefit Calculation Tools: A set of benefit calculation tools, incorporating all of the standard performance measurement options, for determining the benefits resulting from specific research products. Approximately 25 benefit calculation examples, each with active formulas to allow users to modify the calculation to fit their specific need, are included in this section.

Project/Product Data File Creation: A file of the information created during a work session can be saved for transmitting to the sponsoring agency or the data can be uploaded if the project file exists within RPM-Web.

Access to the RPM-Tools CD-ROM will be unrestricted, although only Research Program Managers or others authorized within RPM-Web security may upload information from the CD-ROM to the web-based system. The CD-ROM does not include a database and will not be directly linked to the web-based system.

The primary navigation bar will be anchored across the top of the screen, with section-specific secondary navigation down the side.

Project identification information and benefit calculation data entered by users of the benefit calculation tools can be saved in three ways:

a. Save data to the local hard drive.

b. Create an individual project report for saving or printing which lists all work performed concerning the product currently being analyzed.

c. Create a “data upload” file, which in turn may be either saved for transfer to the sponsoring agency or directly uploaded to the RPM web site if the user has authorized web site access for this capability.

Users will be able to save a session of work for completion during a later session.

Only an individual project report may be generated from the RPM-Tools CD-ROM. The format of the report is identical to that produced by the web-based component, as illustrated later in this document.

The self-paced instructional section will use on-screen text, voice-over narration, and supplementary diagrams to introduce the concepts central to understanding the value of research performance measurement. A software “Wizard” approach will be used to lead users through a series of questions to aid in identifying the performance measures most applicable to specific research programs.

Additionally, a resource section will provide all users with links to a variety of related web-based data sources. Use of this section will require the CD-ROM user to have an active web connection.

PERFORMANCE MEASURES WEB SITE (RPM-Web)

This chapter will discuss the roles, access, navigation, design, and functionality of the RPM web site.

Roles and Access

Table 4-1 describes access to reports and screens for data entry on the RPM web site. The roles are listed in the left-hand column; the types of access are indicated in the remaining columns. The Research Program Manager and the Webmaster have access to the greatest number of reports and input screens. Principal Investigators and Contract Administrators have access to fewer reports and screens. The General User has access only to Individual Project Reports.

The Research Program Manager may specify one of two levels of access for Contractor employees (Principal Investigators and Contract Administrators). Level 1 access allows Contractor personnel to generate multiple project reports containing the projects they performed. Level 2 access allows the Contractor to also add/update/delete product and project data for the projects with which the Contractor is associated.

Contractor access level is specified by each sponsoring agency. A Contractor that works for more than one agency could, for example, be assigned Level 1 access by one agency and Level 2 access by another. All Researchers and Contract Administrators inherit the access level provided to the Contractor for whom they work.

Navigation

Figure 4-1, a story board of web site navigation, shows authorized user access throughout RPM-Web navigation. Navigation within the web site will be controlled by a primary and secondary navigation. The primary navigation will be across the top which will contain the main sections of the site. The secondary navigation will be down the side and will change depending on what section the user has selected.

The list below shows the main navigational elements (bold print), their purposes, and their secondary navigational elements.

- **Home**: Welcome Message
  - FAQs: A helpful list of FAQs
  - About RPM: Description/Purpose of site
  - Site Map
  - Contact Us: Page for submitting e-mail to the webmaster

- **Search**: A search page for finding projects
  - Basic Search: Keyword Search (default)
  - Advanced Search: Allow searches based on PI, PD, or Agency
  - My Agency's Projects: A list of projects involving the user's agency

- **Browse**: A page that allows for browsing of projects based on several various categories.
  - My Agency's Projects: A list of projects associated with the user's "Home Agency" is displayed.
  - Browse by Organization: Display an alphabetical list of agencies. When the user selects one, a list of projects for that agency is displayed.
  - Browse by Topic: Display an alphabetical list of topics. When the user selects one, a list of projects associated with that topic is displayed.

- **Add/Update Record**s: A page that allows the user to add or update various types of records.
  - Add/Update Project Records: A new project link and a list of projects.
    - Add/Update Product is embedded in the project screen.
  - Add/Update Person: A new person link and a list of people in the system.
  - Update Agency Record: A page that contains a list of various aspects of agency information that can be edited.
  - Add/Update Contractor Records: A new contractor link and a list of contractors the user has permission to update.
  - Upload from CD-ROM: A page that lists projects the user has permission to update. When the user selects one they are taken to a page where they can tie a file on their hard drive to a project.

	Access to Reports						Access to Add/Update Screens										
Role or Access Level	Individual Project Report	Multiple Project Report	State Research Program Performance Report	State Research Program Impact Report	National Research Program Impact Report	Comprehensive Database File (Data Export)	Project and Product Information	Contractor Information	Upload from RPM-Tools	People Information	Product and Project Closeout	Approve Contractor Level 2 Input	Select Performance Measures to Show on Reports	Free Form Text Box Entry & Save Report Option	Program Data (FY budget overhead data, PM Targets, etc.)	Assign Roles Except Research Program Manager	Add Agency and Assign Research Program Manager Role
General User	Nation-wide Access																
Research Program Manager	Nation-wide Access	All of Their State's Projects	Their State	Their State	Yes	Their State's Data	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
Research Project Manager	Nation-wide Access	Their Projects Only	Their State	Their State		Their State's Data	Yes	Yes	Yes	Yes	Yes	Yes	Yes				
SHA Administrator	Nation-wide Access	All of Their State's Projects	Their State	Their State	Yes												
Principal Investigator (Contractor is Level 1)	Nation-wide Access	Their Projects Only															
Principal Investigator (Contractor is Level 2)	Nation-wide Access	Their Projects Only					Yes	Yes	Yes								
Contract Administrator (Contractor is Level 1)	Nation-wide Access	All of Their Organization's Projects Only															
Contract Administrator (Contractor is Level 2)	Nation-wide Access	All of Their Organization's Projects Only				Their Organization's Projects Only	Yes	Yes	Yes								
Webmaster	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table 4-1: Roles and Capabilities of Web Site Users

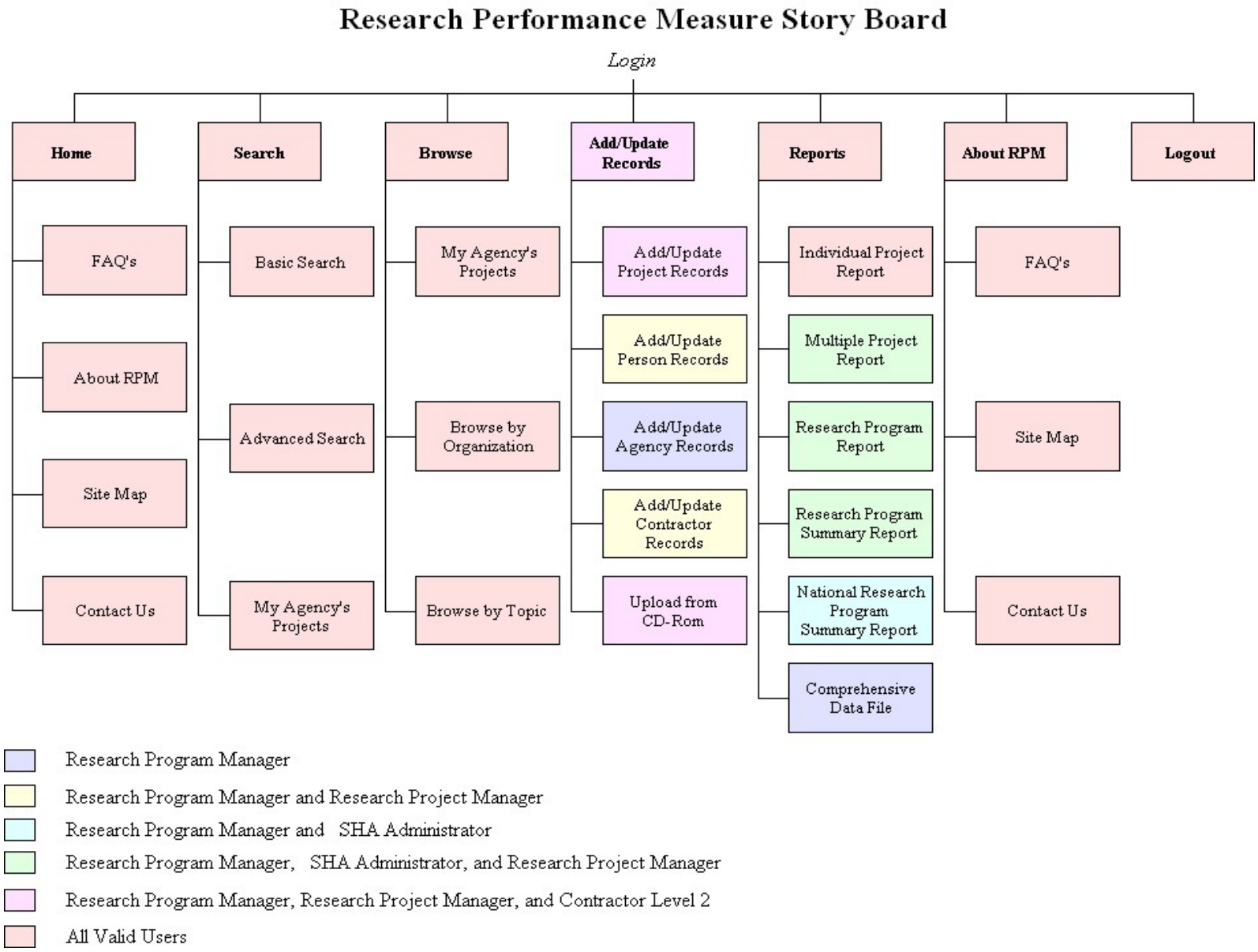


Figure 4-1: Web Site Navigation Story Board

- **Reports**: A page that allows the user to select and generate various reports, depending on their roles within the system. (see Table 4-1)

  - Individual Project Report: The user can search for projects based on any combination of National Technical Area, Title, Start Date, End Date, Project Number, Sponsor or Person. The user then can select a single project and generate this report. Report customization options are offered as described in Chapter 2, RPM Report Descriptions & Functionality.

  - Multiple Project Report: The user selects a FY for the report to be generated. The default is to the current FY. After selecting the FY, a search screen based on National Category, Research Committee, State Subject Area, Funding Type, and Strategic Objective is displayed. The user can further limit the projects to be included in the report by selecting one or more of these categories. Additional report customization options are offered as described in Chapter 2, RPM Report Descriptions & Functionality.

  - State Research Program Performance Report: The user selects a FY for the report to be generated. The current FY is the default. After selecting the FY, a search screen based on National Category, Research Committee, State Subject Area, Funding Type, and Strategic Objective is displayed where the user can further limit the projects to have information included on the requested report. Additional report customization options are offered as described in Chapter 2, RPM Report Descriptions & Functionality.

  - State Research Program Impact Report: The user selects a FY for the report to be generated. The default is the current FY. After selecting the FY, a search screen based on National Category, Research Committee, State Subject Area, Funding Type, and Strategic Objective is displayed where the user can further limit the projects to have information included on the requested report. Additional report customization options are offered as described in Chapter 2, RPM Report Descriptions & Functionality.

  - National Research Program Impact Report: The user selects a FY for the report to be generated. The default is the current FY. Report customization options are offered as described in Chapter 2, RPM Report Descriptions & Functionality.

- **About RPM**: Description/Purpose of Site
  - FAQs: Helpful list of FAQs
  - Site Map
  - Contact Us: Page for submitting e-mail to the webmaster.

- **Logout**: A page that logs the user out of the system.

Add/Update Records

Due to the complexities of the Add/Update Records section, the following is a more detailed discussion of what occurs in this section.

Add/Update Project

When the user clicks the "New Project" link on the "Add/Update Project" page, the system prompts the user with four check boxes before creating the project to determine if the project impacts any of the following:

- Safety-crashes, injuries, fatalities, work zones, etc
- Operational Costs-construction, maintenance, engineering, etc.
- Environmental-recycling, air quality, etc.
- Traveler Comfort-security, traffic congestion, etc.

Based on the user's response, the appropriate indicator variables in the RPM_PROJECT_SPONSOR_PM table will be set. The system then displays the Project Edit page which contains

- Sponsoring agency (If user is a contractor, the system limits the selection of Sponsoring Agencies to those for agencies that have assigned Level 2 security to this contractor. If the user is not a contractor, then the sponsoring agency field will default to the user's agency.)
- Project title
- Abstract
- Start/end date
- Contract number
- RAC national categories
- State specific categories
- Project completed on time
- Project completed in budget
- Paper submitted for publication
- Number of grad students
- Project cost
- Contractors
- Assign people to roles for this project
- Product link
- Objectives link

Based on the Sponsoring Agency selected by the user, the system will update the list of available Study Codes for this project based on the Sponsoring Agency's study codes. If the user is a contractor the Pending Indicator check box is disabled and automatically set to "Y". Once the contractor finishes with the record an e-mail is sent to the Project Director notifying him/her of the pending status.

When the user clicks the Objectives link, the system allows the user to map this project to the Strategic Objectives of the Sponsoring Agency.

When the user clicks the Product link, the system displays the list of Products defined for that project and a "New Product" link. If the user selects an existing Product, the system displays the Product Edit page. If the user clicks the "New Product" link, the system prompts the user with seven check boxes before creating the product to get information about the product and determine its expected impacts.

- Type (Report or Product)
- Does this product effect Technical aspects for the agency
- Does this product effect Management aspects for the agency
- Does this product effect Basic Knowledge of the agency
- Is the product a Report Only
- Does implementing this product contribute to State's environmental initiatives
- Does implementing this product enhance safety

Based on the user's response, the appropriate indicator variables in the RPM_PRODUCT and RPM PRODUCT SPONSOR_PM tables will be set. The system then displays the Product Edit page which contains

- Implemented indicator (Y/N)
- Date implemented
- Implementation cost
- Description
- Title
- Reason not implemented (If not implemented)
- Completed indicator (Y/N)
- Product due date
- Number of crashes reduced
- Number of fatalities reduced
- Reduce operating costs indicator
- Operating cost reduction
- Enhance traveler comfort indicator (Y/N)
- Traveler comfort comments
- Environment comments
- Pending indicator (If contractor this is set to Y until the agency set's it to N)
- Benefit formula link

If the user is a contractor, the Pending Indicator check box is disabled and automatically set to "Y". Once the contractor finishes with the record, an e-mail is sent to the Research Program Manager and Research Project Manager to notify them of a pending status. When the user selects the benefit formula link, the system displays the benefit formula calculation page. The page contains the following:

- Total benefit
- Benefit type

- Begin year of benefit
- Year full benefit realized
- Max benefit
- Number of years of max benefit
- Compute total benefit link
- Example calculation links

When the user calculates the benefit for a quantitative performance measure, the methodology for determining the benefits is stored in the database in extensible markup language (XML). This is done so that when an Individual Project Report is generated, the report can display how the benefit calculation was done.

When the user clicks the compute total benefit link, the system makes sure begin year of benefit, year full benefit realized, max benefit, and number of years of max benefit fields have been completed and then computes the total benefit based on the formula Max Benefit * ((Year Full Benefit Realized – Begin Year of Benefit)/2 + Number of Years of Max Benefit) and updates the total benefit and the appropriate field in the RPM_PRODUCT_SPONSOR_PM table based on the benefit type. The user can also put their own formula into the system and calculate the benefit their own way, which in turn will be stored in XML format, for reporting at a later date.

Add/Update Person

The Edit Person Page contains the following:

- Last name
- First name
- Middle name
- Prefix
- Suffix
- Home agency
- Home contractor
- Phone
- E-mail
- Role security

The Role security shows which roles the Person has been assigned.

Add/Update Contractor

The Edit Contractor page contains the following

- Name
- Minority indicator
- Contractor web site universal resource locator (URL)
- Role security

The Role security shows which roles the Contractor has been assigned. These roles can only be assigned by the research program manager or research project manager only.

Add/Update Agency Records

This page contains the following

- Name
- Agency web site URL
- Year/strategic objectives matrix
- Subject category link
- Annual link

An authorized user can add or update any agency record, with one exception. Only the Webmaster can add a new agency or update the agency name.

When the user clicks the subject category link, the user is given the option to edit or delete existing categories or add new ones.

When the user clicks the annual link, the system displays the Agency Annual Edit page with the following:

- Fiscal Year
- FY Start Date
- FY End Date
- Agency Cost
- Overhead Cost
- Number of Problem Statements Submitted
- Number of Problem Statements Funded
- Percent Customer Satisfaction
- Number of Agency Personnel involved
- Target Benefit/Cost Ratio
- Target Percent Projects Implemented
- Target Percent Projects Completed
- Target Percent Customers Satisfied
- Target Percent Projects on Time
- Target Percent Projects in Budget
- Target Number of Graduate Students
- Target Number of Active Contractors

Upload from CD-ROM

Uploading from the CD-ROM toolbox is a multiple step process. The CD-ROM toolbox will produce an XML file on the user's local computer. This is a special type of

text file which the user can either upload to the web site, if they have access to do so, or e-mail the file to someone else in order for them to upload the file to the web site. If this is a new Project, for the upload process to proceed, the Research Program Manager must first have created the project record in the web site. This feature will help eliminate the possibility of duplicate names/projects that could otherwise be caused from loading directly from the CD-ROM. To upload the information, the user will select the correct Project from a web site list. The user then selects the file containing the output from the CD-ROM application for upload. He/she then matches products in the existing project with those from the CD-ROM upload. For products that do not match up, the user can choose to add these remaining products to the web site or ignore the remaining products. If the user's agency has been assigned the contractor Level 2 role by the sponsoring agency, then the pending indicator is set to "Y" for all data uploaded in that project, and an e-mail is sent to the research manager notifying him/her of the uploaded data. The research project manager can then choose to accept/modify or reject the data.

Technologies Used (Web Site)

The technologies being used by the web site portion of the project include hosting to be provided by a web server powered by RedHat Advanced Server 3.0 running the Apache 2 web server. PHP will be utilized as the programming language and XML/XSLT will be used for displaying the web site as well as for transforming the uploaded data.

DATABASE TABLES AND FIELD DEFINITONS

RPM-Web stores information about programs, projects, products, and the related performance measure information in an Oracle database. RPM-Web provides access to the database, and all interactions with the database are performed through this web interface.

When the RPM web site becomes available on the Internet, the RPM database will already contain information about a large number of current and past research projects extracted from RiP. Most of the RiP records include at least a title, a list of subjects, and information about the contractor and sponsor agency; many records include more details.

To develop an initial list of sponsoring agency contacts, TTI will load information from the table of authorized users of the Pooled Fund system.

Eventually, the RPM database will contain a centralized repository of information about performance measurement as applied to research projects and research programs nationwide.

It is anticipated that when the RPM web site first becomes available for use, many records of existing studies will contain only partial information. TTI will work to add all additional information provided by organizations participating in the rpm process. As new records of studies are created through the RPM web site, a higher proportion of records will contain complete information.

Table 5-1 presents a simplified description of the database, listing the primary entities, their attributes, and their relationships to each other. The persons and contractors are separate from the projects, making it possible to update in one place. Agency subject categories, RAC national categories, and agency annual strategic objectives can be assigned to projects so that they can be matched to user interests. Sponsor performance measure on project-level, or product-level are separate from the projects, or products making it possible for the pooled-fund projects with multiple sponsor agencies.

Entity	Attribute	Related to
Agency [RPM_AGENCY]	Name, web site URL.	Agency subject category, Agency annual performance measure, Agency annual strategic objectives, Sponsored-related project performance measure (Project-level, and product-level) Contractor security
Project [RPM_PROJECT]	Title, Abstract, Start date, End date, Contract/project number, Sponsor-unrelated project-level performance measure.	Person (Project Manager, Principal Investigator), Agency (Sponsor agency), Agency annual strategic objectives, Contractor, RAC national subject category, Agency subject category, Sponsor-related project-level performance measure, Product.
Product [RPM_PRODUCT]	Description, Product number, Type, Product due date, Sponsor-unrelated product-level performance measure.	Project, Sponsor-related product-level performance measure.
Contractor [RPM_CONTRACTOR]	Contractor Name, Web site URL, Minority contractor indicator.	Contractor security, Project.
Person [RPM_PERSON]	Last name, First name, Middle name, Prefix (Dr. Mr., etc.). Suffix (Jr. III etc), Phone, e-mail address	Agency, Contractor, Project, User Account
RAC National Subject [RPM_SUBJECT]	Subject code, Subject description.	Project
Agency Subject Category [RPM_AGENCY_SUBJECT_CATEGORY]	Subject category, subject description	Agency Project
Agency Annual Strategic Objectives [RPM_AGENCY_ANNUAL_STR_OBJ]	Year, Strategic objectives	Agency, Project
Agency Annual Performance Measure	Fiscal year, fiscal year	Agency

Entity	Attribute	Related to
[RPM_AGENCY_ANNUAL_PM]	start date, fiscal year end date, agency-level performance measure data.	
Sponsor-Related Project-Level Performance Measure [RPM_PROJECT_SPONSOR_PM]	Performance measure data	Agency, Project
Sponsor-Related Product-Level Performance Measure [RPM_PRODUCT_SPONSOR_PM]	Performance measure data	Agency, Product
User Account [RPM_USER_ACCOUNT]	Role assigned to the account, Contact e-mail, contact phone number	Person

Table 5-1: Entities, Attributes and Relationships

An Entity Relationship (ER) Diagram as shown Figure 5-1 is a graphic interpretation of RPM database design describing the relationships among the tables. The definition of each table and field in the ER diagram is listed within Figure 5-2.

ER Diagram

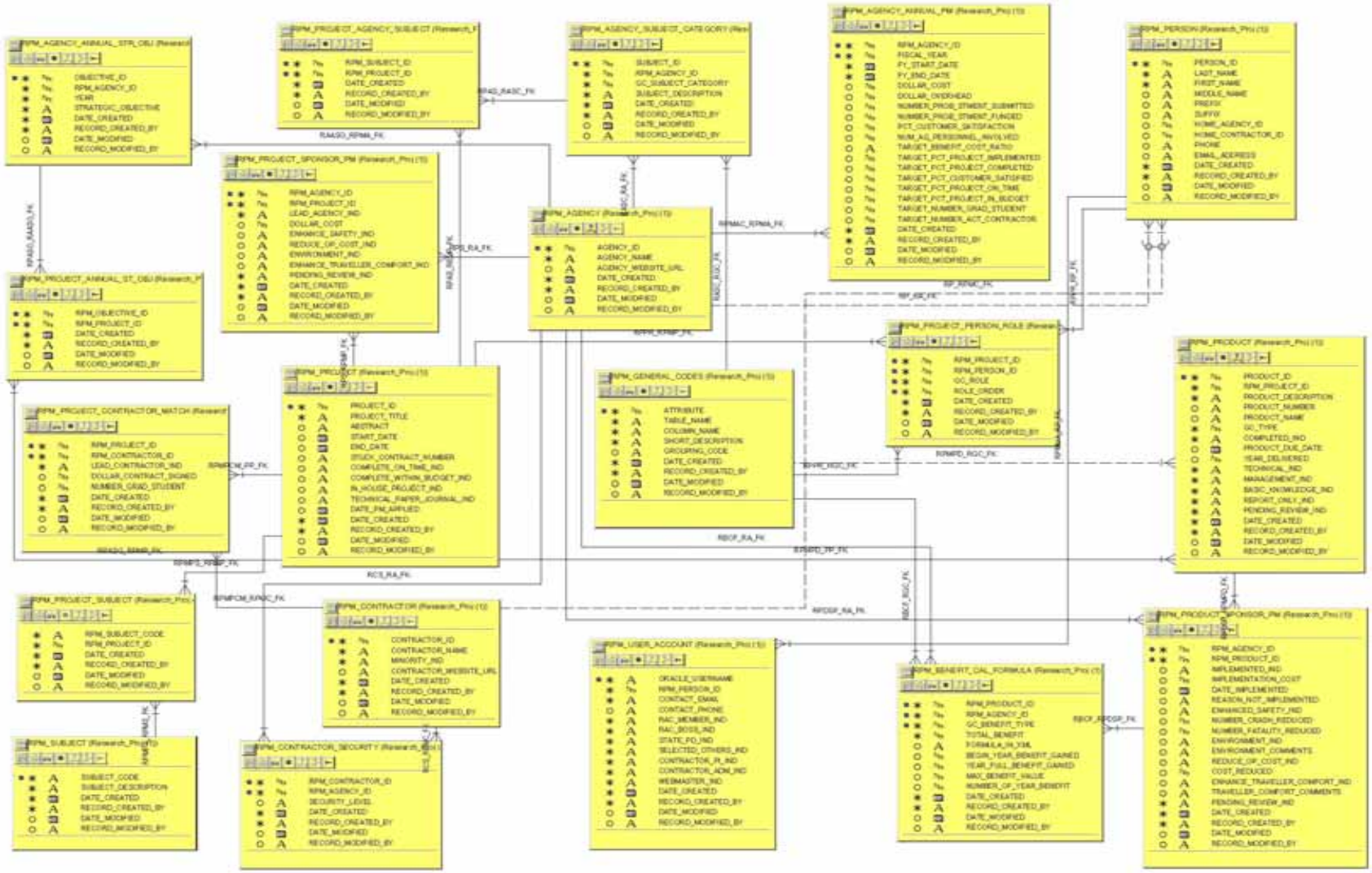


Figure 5-1: Entity Relationship Diagram

09-SEP-04 01:29 PM

Module: Research Performance Measure Database System

Table: RPM_AGENCY

Table Description: Information about State Agencies.

Column Name	Data Type	Length	Nullable	Column Description
AGENCY_ID	NUMBER	22	N	Unique agency identifier.
AGENCY_NAME	VARCHAR2	250	N	Agency Name.
AGENCY_WEBSITE_URL	VARCHAR2	100	Y	Agency website URL.
DATE_CREATED	DATE	7	N	Date the record was created to the database.
DATE_MODIFIED	DATE	7	Y	Date the record was last modified.
RECORD_CREATED_BY	VARCHAR2	30	N	Username who first created the record.
RECORD_MODIFIED_BY	VARCHAR2	30	Y	Username who last modified the record.

Table: RPM_AGENCY_ANNUAL_PM

Table Description: Information about the state agency's annual set up information with agency performance measure.

Column Name	Data Type	Length	Nullable	Column Description
DATE_CREATED	DATE	7	N	Date the record was created to the database.
DATE_MODIFIED	DATE	7	Y	Date the record was last modified.
DOLLAR_COST	NUMBER	22	Y	Entire Cost of the research projects of the fiscal year.
DOLLAR_OVERHEAD	NUMBER	22	Y	Overhead cost of the research projects of the fiscal year.
FISCAL_YEAR	NUMBER	22	N	Fiscal year.
FY_END_DATE	DATE	7	N	End date of the fiscal year.
FY_START_DATE	DATE	7	N	Start date of the fiscal year.
NUMBER_PROB_STMENT_FUNDED	NUMBER	22	Y	Number of problem statement funded for the fiscal year.
NUMBER_PROB_STMENT_SUBMITTED	NUMBER	22	Y	Number of problem statement submitted of the fiscal year.
NUM_AG_PERSONNEL_INVOLVED	NUMBER	22	Y	Number of the agency personnel involved in the fiscal year.
PCT_CUSTOMER_SATISFACTION	NUMBER	22	Y	Percent of satisfied customers of the fiscal year.
RECORD_CREATED_BY	VARCHAR2	30	N	Username who first created the record.
RECORD_MODIFIED_BY	VARCHAR2	30	Y	Username who last modified the record.
RPM_AGENCY_ID	NUMBER	22	N	Agency record identifier for the state agency.
TARGET_BENEFIT_COST_RATIO	VARCHAR2	20	Y	Target of the benefit cost ratio of the fiscal year.
TARGET_NUMBER_ACT_CONTRACTOR	NUMBER	22	Y	Target number of active contractors in the fiscal year.
TARGET_NUMBER_GRAD_STUDENT	NUMBER	22	Y	Target of the number of grad students involvement in this fiscal year.
TARGET_PCT_CUSTOMER_SATISFIED	NUMBER	22	Y	Target of the percentage of the satisfied customers of the fiscal year.
TARGET_PCT_PROJECT_COMPLETED	NUMBER	22	Y	Target of the percentage of the projects that will be completed in the fiscal year.
TARGET_PCT_PROJECT_IMPLEMENTED	NUMBER	22	Y	Target of the percentage of the projects that will be impleted for the fiscal year.
TARGET_PCT_PROJECT_IN_BUDGET	NUMBER	22	Y	Target of the percentage of the projects that will be within the budget in the fiscal year.
TARGET_PCT_PROJECT_ON_TIME	NUMBER	22	Y	Target of the percentage of the projects that will be completed on time in the fiscal year.

Figure 5-2: Definitions of ER Diagram Tables and Fields

09-SEP-04 01:29 PM

Module: **Research Performance Measure Database System**

Table: **RPM_AGENCY_ANNUAL_STR_OBJ**

Table Description: Information about the state agency's annual strategic objectives.

Column Name	Data Type	Length	Nullable	Column Description
DATE_CREATED	DATE	7	N	Date the record was created to the database.
DATE_MODIFIED	DATE	7	Y	Date the record was last modified.
OBJECTIVE_ID	NUMBER	22	N	Unique agency strategic objective identifier.
RECORD_CREATED_BY	VARCHAR2	30	N	Username who first created the record.
RECORD_MODIFIED_BY	VARCHAR2	30	Y	Username who last modified the record.
RPM_AGENCY_ID	NUMBER	22	N	Agency record identifier
STRATEGIC_OBJECTIVE	VARCHAR2	500	N	Strategic objective description.
YEAR	NUMBER	22	N	Fiscal year.

Table: **RPM_AGENCY_SUBJECT_CATEGORY**

Table Description: Information about the state agency's subject categories as the user defined categories in Research Committees, State Technical Areas and Funding Types.

Column Name	Data Type	Length	Nullable	Column Description
DATE_CREATED	DATE	7	N	Date the record was created to the database.
DATE_MODIFIED	DATE	7	Y	Date the record was last modified.
GC_SUBJECT_CATEGORY	NUMBER	22	N	Subject catetory type for the state agency from general_codes table, such as Research Committees, State Technical Areas, and Funding Types.
RECORD_CREATED_BY	VARCHAR2	30	N	Username who first created the record.
RECORD_MODIFIED_BY	VARCHAR2	30	Y	Username who last modified the record.
RPM_AGENCY_ID	NUMBER	22	N	Agency record identifier for the state agency.
SUBJECT_DESCRIPTION	VARCHAR2	500	N	Subject category description.
SUBJECT_ID	NUMBER	22	N	Unique record identifier for the state subject category.

Figure 5-2: Definitions of ER Diagram Tables and Fields (Continued)

09-SEP-04 01:29 PM

Module: **Research Performance Measure Database System**

Table: **RPM_BENEFIT_CAL_FORMULA**

Table Description: Information about the product benefit calculation formula detail.

Column Name	Data Type	Length	Nullable	Column Description
BEGIN_YEAR_BENEFIT_GAINED	NUMBER	22	Y	Beginning year that the benefit started to gain.
DATE_CREATED	DATE	7	N	Date the record was created to the database.
DATE_MODIFIED	DATE	7	Y	Date the record was last modified.
FORMULA_IN_XML	VARCHAR2	1000	Y	Calculation formula stored in XML format.
GC_BENEFIT_TYPE	NUMBER	22	N	Calculation benefit type for the product from general_codes table such as lives saved, crashes reduced, cost saved, etc.
MAX_BENEFIT_VALUE	NUMBER	22	Y	Maximum value of the benefit.
NUMBER_OF_YEAR_BENEFIT	NUMBER	22	Y	Number of year that benefit will be calculated.
RECORD_CREATED_BY	VARCHAR2	30	N	Username who first created the record.
RECORD_MODIFIED_BY	VARCHAR2	30	Y	Username who last modified the record.
RPM_AGENCY_ID	NUMBER	22	N	Agency record identifier for the state agency.
RPM_PRODUCT_ID	NUMBER	22	N	Product record identifier.
TOTAL_BENEFIT	NUMBER	22	N	Total benefit.
YEAR_FULL_BENEFIT_GAINED	NUMBER	22	Y	Year that the full benefit gained.

Table: **RPM_CONTRACTOR**

Table Description: Information about the Contractors.

Column Name	Data Type	Length	Nullable	Column Description
CONTRACTOR_ID	NUMBER	22	N	Unique contractor identifier.
CONTRACTOR_NAME	VARCHAR2	500	N	Contractor name.
CONTRACTOR_WEBSITE_URL	VARCHAR2	100	Y	Contractor website URL
DATE_CREATED	DATE	7	N	Date the record was created to the database.
DATE_MODIFIED	DATE	7	Y	Date the record was last modified.
MINORITY_IND	VARCHAR2	1	N	Indicator if the contractor is a minority contractor.
RECORD_CREATED_BY	VARCHAR2	30	N	Username who first created the record.
RECORD_MODIFIED_BY	VARCHAR2	30	Y	Username who last modified the record.

Figure 5-2: Definitions of ER Diagram Tables and Fields (Continued)

09-SEP-04 01:29 PM

Module: **Research Performance Measure Database System**

Table: **RPM_CONTRACTOR_SECURITY**

Table Description: Information about the security level that the state agency assigned to the contractor.

Column Name	Data Type	Length	Nullable	Column Description
DATE_CREATED	DATE	7	N	Date the record was created to the database.
DATE_MODIFIED	DATE	7	Y	Date the record was last modified.
RECORD_CREATED_BY	VARCHAR2	30	N	Username who first created the record.
RECORD_MODIFIED_BY	VARCHAR2	30	Y	Username who last modified the record.
RPM_AGENCY_ID	NUMBER	22	N	Unique agency identifier.
RPM_CONTRACTOR_ID	NUMBER	22	N	Unique contractor identifier.
SECURITY_LEVEL	VARCHAR2	10	Y	Security level that the state agency assigned to the contractor.

Table: **RPM_GENERAL_CODES**

Table Description: Information about the various lists of values used throughout the research performance measure database systems.

Column Name	Data Type	Length	Nullable	Column Description
ATTRIBUTE	NUMBER	22	N	Unique identifier for code.
COLUMN_NAME	VARCHAR2	30	N	Oracle column name of the list of values.
DATE_CREATED	DATE	7	N	Date the record was created to the database.
DATE_MODIFIED	DATE	7	Y	Date the record was last modified.
GROUPING_CODE	VARCHAR2	10	Y	Grouping code for the general codes.
RECORD_CREATED_BY	VARCHAR2	30	N	Username who first created the record.
RECORD_MODIFIED_BY	VARCHAR2	30	Y	Username who last modified the record.
SHORT_DESCRIPTION	VARCHAR2	100	N	Short description of the general codes
TABLE_NAME	VARCHAR2	30	N	Oracle table name of the list of values.

Figure 5-2: Definitions of ER Diagram Tables and Fields (Continued)

09-SEP-04 01:29 PM

Module: **Research Performance Measure Database System**

Table: **RPM_PERSON**

Table Description: Information about Person.

Column Name	Data Type	Length	Nullable	Column Description
DATE_CREATED	DATE	7	N	Date the record was created to the database.
DATE_MODIFIED	DATE	7	Y	Date the record was last modified.
EMAIL_ADDRESS	VARCHAR2	100	Y	Email address
FIRST_NAME	VARCHAR2	50	N	First name
HOME_AGENCY_ID	NUMBER	22	Y	Home agency record identifier.
HOME_CONTRACTOR_ID	NUMBER	22	Y	Home contractor record identifier.
LAST_NAME	VARCHAR2	50	N	Last name
MIDDLE_NAME	VARCHAR2	50	Y	Middle name
PERSON_ID	NUMBER	22	N	Unique person record identifier.
PHONE	VARCHAR2	20	Y	Contact phone number
PREFIX	VARCHAR2	25	Y	Prefix
RECORD_CREATED_BY	VARCHAR2	30	N	Username who first created the record.
RECORD_MODIFIED_BY	VARCHAR2	30	Y	Username who last modified the record.
SUFFIX	VARCHAR2	25	Y	Suffix

Figure 5-2: Definitions of ER Diagram Tables and Fields (Continued)

09-SEP-04 01:29 PM

Module: **Research Performance Measure Database System**

Table: **RPM_PRODUCT**

Table Description: Information about the product of research projects.

Column Name	Data Type	Length	Nullable	Column Description
BASIC_KNOWLEDGE_IND	VARCHAR2	1	N	Indicator if the product is a basic knowledge product.
COMPLETED_IND	VARCHAR2	1	N	Indicator if the product is completed.
DATE_CREATED	DATE	7	N	Date the record was created to the database.
DATE_MODIFIED	DATE	7	Y	Date the record was last modified.
GC_TYPE	NUMBER	22	N	Type of the product from general_codes table, such as, report, or product.
MANAGEMENT_IND	VARCHAR2	1	N	Indicator if the product is a management product.
PENDING_REVIEW_IND	VARCHAR2	1	N	Indicator if the product is uploaded by the contractor and pending review by the state DOT.
PRODUCT_DESCRIPTION	VARCHAR2	2000	N	Product description
PRODUCT_DUE_DATE	DATE	7	Y	Due date of the product
PRODUCT_ID	NUMBER	22	N	Unique product record identifier.
PRODUCT_NAME	VARCHAR2	500	Y	Product name
PRODUCT_NUMBER	VARCHAR2	50	Y	Product number
RECORD_CREATED_BY	VARCHAR2	30	N	Username who first created the record.
RECORD_MODIFIED_BY	VARCHAR2	30	Y	Username who last modified the record.
REPORT_ONLY_IND	VARCHAR2	1	N	Indicator if the product is a report-only product.
RPM_PROJECT_ID	NUMBER	22	N	Project record identifier.
TECHNICAL_IND	VARCHAR2	1	N	Indicator if the product is a technical product.
YEAR_DELIVERED	NUMBER	22	Y	Year of the product is delivered.

Figure 5-2: Definitions of ER Diagram Tables and Fields (Continued)

09-SEP-04 01:29 PM

Module: **Research Performance Measure Database System**

Table: **RPM_PRODUCT_SPONSOR_PM**

Table Description: Information about the performance measure of the product by the sponsor state agency.

Column Name	Data Type	Length	Nullable	Column Description
COST_REDUCED	NUMBER	22	Y	Operation cost reduced.
DATE_CREATED	DATE	7	N	Date the record was created to the database.
DATE_IMPLEMENTED	DATE	7	Y	Date of the product that is implemented.
DATE_MODIFIED	DATE	7	Y	Date the record was last modified.
ENHANCED_SAFETY_IND	VARCHAR2	1	Y	Indicator of the product enhance safety
ENHANCE_TRAVELLER_COMFORT_IND	VARCHAR2	1	Y	Indicator if the product can enhance traveller comfort.
ENVIRONMENT_COMMENTS	VARCHAR2	2000	Y	Comments of the product that is environment related.
ENVIRONMENT_IND	VARCHAR2	1	Y	Indicator if the product is environment related.
IMPLEMENTATION_COST	NUMBER	22	Y	Cost of the implementation if it is implemented.
IMPLEMENTED_IND	VARCHAR2	1	Y	Indicator if the product is implemented.
NUMBER_CRASH_REDUCED	NUMBER	22	Y	Number of crash reduced.
NUMBER_FATALITY_REDUCED	NUMBER	22	Y	Number of fatality reduced.
PENDING_REVIEW_IND	VARCHAR2	1	N	Indicator if the performance measure is uploaded by the contractor and pending review by the state agency.
REASON_NOT_IMPLEMENTED	VARCHAR2	2000	Y	Reason why the product is not implemented.
RECORD_CREATED_BY	VARCHAR2	30	N	Username who first created the record.
RECORD_MODIFIED_BY	VARCHAR2	30	Y	Username who last modified the record.
REDUCE_OP_COST_IND	VARCHAR2	1	Y	Indicator if the product reduce operation cost.
RPM_AGENCY_ID	NUMBER	22	N	Agency record identifier.
RPM_PRODUCT_ID	NUMBER	22	N	Product record identifier.
TRAVELLER_COMFORT_COMMENTS	VARCHAR2	2000	Y	Comments of the product that can enhance travellers' comfort.

Figure 5-2: Definitions of ER Diagram Tables and Fields (Continued)

09-SEP-04 01:29 PM

Module: **Research Performance Measure Database System**

Table: **RPM_PROJECT**

Table Description: Information about the project.

Column Name	Data Type	Length	Nullable	Column Description
ABSTRACT	VARCHAR2	4000	Y	Project abstract
COMPLETE_ON_TIME_IND	VARCHAR2	1	Y	Indicator if the project is completed on time.
COMPLETE_WITHIN_BUDGET_IND	VARCHAR2	1	Y	Indicator if the project is completed within budget.
DATE_CREATED	DATE	7	N	Date the record was created to the database.
DATE_MODIFIED	DATE	7	Y	Date the record was last modified.
DATE_PM_APPLIED	DATE	7	Y	Date that the performance measure applies.
END_DATE	DATE	7	Y	End date of the project.
IN_HOUSE_PROJECT_IND	VARCHAR2	1	Y	Indicator if the project is an in-house project.
PROJECT_ID	NUMBER	22	N	Unique project record identifier.
PROJECT_TITLE	VARCHAR2	500	N	Project title
RECORD_CREATED_BY	VARCHAR2	30	N	Username who first created the record.
RECORD_MODIFIED_BY	VARCHAR2	30	Y	Username who last modified the record.
START_DATE	DATE	7	Y	Start date of the project.
STUDY_CONTRACT_NUMBER	VARCHAR2	50	Y	Study contract number
TECHNICAL_PAPER_JOURNAL_IND	VARCHAR2	1	Y	Indicator if the project has technical paper published in journal.

Table: **RPM_PROJECT_AGENCY_SUBJECT**

Table Description: Information about the association of the project and the sponsor state agency subject categories.

Column Name	Data Type	Length	Nullable	Column Description
DATE_CREATED	DATE	7	N	Date the record was created to the database.
DATE_MODIFIED	DATE	7	Y	Date the record was last modified.
RECORD_CREATED_BY	VARCHAR2	30	N	Username who first created the record.
RECORD_MODIFIED_BY	VARCHAR2	30	Y	Username who last modified the record.
RPM_PROJECT_ID	NUMBER	22	N	Project record identifier.
RPM_SUBJECT_ID	NUMBER	22	N	Sponsor state subject category record identifier.

Figure 5-2: Definitions of ER Diagram Tables and Fields (Continued)

09-SEP-04 01:29 PM

Module: Research Performance Measure Database System

Table: RPM_PROJECT_ANNUAL_ST_OBJ

Table Description: Information about the association of the project and the sponsor agency's annual strategic objectives.

Column Name	Data Type	Length	Nullable	Column Description
DATE_CREATED	DATE	7	N	Date the record was created to the database.
DATE_MODIFIED	DATE	7	Y	Date the record was last modified.
RECORD_CREATED_BY	VARCHAR2	30	N	Username who first created the record.
RECORD_MODIFIED_BY	VARCHAR2	30	Y	Username who last modified the record.
RPM_OBJECTIVE_ID	NUMBER	22	N	State agency annual strategic objective record identifier.
RPM_PROJECT_ID	NUMBER	22	N	Project record identifier.

Table: RPM_PROJECT_CONTRACTOR_MATCH

Table Description: Information about the association of the project and the contractor.

Column Name	Data Type	Length	Nullable	Column Description
DATE_CREATED	DATE	7	N	Date the record was created to the database.
DATE_MODIFIED	DATE	7	Y	Date the record was last modified.
DOLLAR_CONTRACT_SIGNED	NUMBER	22	Y	Contract amount signed for the contractor.
LEAD_CONTRACTOR_IND	VARCHAR2	1	N	Indicator if the contractor is a lead contractor.
NUMBER_GRAD_STUDENT	NUMBER	22	Y	Number of graduate students participate the project in this contractor.
RECORD_CREATED_BY	VARCHAR2	30	N	Username who first created the record.
RECORD_MODIFIED_BY	VARCHAR2	30	Y	Username who last modified the record.
RPM_CONTRACTOR_ID	NUMBER	22	N	Contractor record identifer.
RPM_PROJECT_ID	NUMBER	22	N	Project record identifier.

Table: RPM_PROJECT_PERSON_ROLE

Table Description: Information about the association between project and person, such as Principal Investigators, Project Managers, etc.

Column Name	Data Type	Length	Nullable	Column Description
DATE_CREATED	DATE	7	N	Date the record was created to the database.
DATE_MODIFIED	DATE	7	Y	Date the record was last modified.
GC_ROLE	NUMBER	22	N	Role type of the person to the project from general_codes table, such as Principal investigator, project manager, etc.
RECORD_CREATED_BY	VARCHAR2	30	N	Username who first created the record.
RECORD_MODIFIED_BY	VARCHAR2	30	Y	Username who last modified the record.
ROLE_ORDER	NUMBER	22	N	Role order.
RPM_PERSON_ID	NUMBER	22	N	Person record identifier.
RPM_PROJECT_ID	NUMBER	22	N	Project record identifier.

Figure 5-2: Definitions of ER Diagram Tables and Fields (Continued)

09-SEP-04 01:29 PM

Module: Research Performance Measure Database System

Table: RPM_PROJECT_SPONSOR_PM

Table Description: Information of the project and the sponsor agency, and the performance measure at the project level.

Column Name	Data Type	Length	Nullable	Column Description
DATE_CREATED	DATE	7	N	Date the record was created to the database.
DATE_MODIFIED	DATE	7	Y	Date the record was last modified.
DOLLAR_COST	NUMBER	22	Y	Amount that the sponsor agency provides.
ENHANCE_SAFETY_IND	VARCHAR2	1	Y	Indicator if the project enhances safety.
ENHANCE_TRAVELLER_COMFORT_IND	VARCHAR2	1	Y	Indicator if the project enhances travellers' comfort.
ENVIRONMENT_IND	VARCHAR2	1	Y	Indicator if the project is environmental related.
LEAD_AGENCY_IND	VARCHAR2	1	N	Indicator if the state agency is a lead agency.
PENDING_REVIEW_IND	VARCHAR2	1	N	Indicator of the performance measure is uploaded by the contractor and pending review by the sponsor agency.
RECORD_CREATED_BY	VARCHAR2	30	N	Username who first created the record.
RECORD_MODIFIED_BY	VARCHAR2	30	Y	Username who last modified the record.
REDUCE_OP_COST_IND	VARCHAR2	1	Y	Indicator if the project reduce operational cost
RPM_AGENCY_ID	NUMBER	22	N	Agency record identifier.
RPM_PROJECT_ID	NUMBER	22	N	Project record identifier.

Table: RPM_PROJECT_SUBJECT

Table Description: Information of the association with the project and the national subject categories.

Column Name	Data Type	Length	Nullable	Column Description
DATE_CREATED	DATE	7	N	Date the record was created to the database.
DATE_MODIFIED	DATE	7	Y	Date the record was last modified.
RECORD_CREATED_BY	VARCHAR2	30	N	Username who first created the record.
RECORD_MODIFIED_BY	VARCHAR2	30	Y	Username who last modified the record.
RPM_PROJECT_ID	NUMBER	22	N	Project record identifier.
RPM_SUBJECT_CODE	VARCHAR2	5	N	Unique subject category code.

Table: RPM_SUBJECT

Table Description: Labels and description for subject categories.

Column Name	Data Type	Length	Nullable	Column Description
DATE_CREATED	DATE	7	N	Date the record was created to the database.
DATE_MODIFIED	DATE	7	Y	Date the record was last modified.
RECORD_CREATED_BY	VARCHAR2	30	N	Username who first created the record.
RECORD_MODIFIED_BY	VARCHAR2	30	Y	Username who last modified the record.
SUBJECT_CODE	VARCHAR2	5	N	Unique subject category code.
SUBJECT_DESCRIPTION	VARCHAR2	100	N	Subject category name.

Figure 5-2: Definitions of ER Diagram Tables and Fields (Continued)

09-SEP-04 01:29 PM

Module: **Research Performance Measure Database System**

Table: **RPM_USER_ACCOUNT**

Table Description: Information about the user account.

Column Name	Data Type	Length	Nullable	Column Description
CONTACT_EMAIL	VARCHAR2	100	N	Contact email address of the account holder.
CONTACT_PHONE	VARCHAR2	20	Y	Contact phone number of the account holder.
CONTRACTOR_ADM_IND	VARCHAR2	1	N	Indicator if the account holder is an administration personnel with a contractor.
CONTRACTOR_PI_IND	VARCHAR2	1	N	Indicator if the account holder is a PI with a contractor.
DATE_CREATED	DATE	7	N	Date the record was created to the database.
DATE_MODIFIED	DATE	7	Y	Date the record was last modified.
ORACLE_USERNAME	VARCHAR2	30	N	Oracle user account.
RAC_BOSS_IND	VARCHAR2	1	N	Indicator if the account holder is the State Administrator, i.e. the supervisor of the RAC member.
RAC_MEMBER_IND	VARCHAR2	1	N	Indicator if the account holder is a RAC member.
RECORD_CREATED_BY	VARCHAR2	30	N	Username who first created the record.
RECORD_MODIFIED_BY	VARCHAR2	30	Y	Username who last modified the record.
RPM_PERSON_ID	NUMBER	22	N	Person record identifier to indicate the person of the user account.
SELECTED_OTHERS_IND	VARCHAR2	1	N	Indicator of the account holder is a reasearch associate.
STATE_PD_IND	VARCHAR2	1	N	Indicator if the account holder a state DOT project director.
WEBMASTER_IND	VARCHAR2	1	N	Indicator if the account holder is a webmaster.

Figure 5-2: Definitions of ER Diagram Tables and Fields (Continued)

APPENDIX C – Survey Instruments

AASHTO RAC WEB SURVEY INSTRUMENT

NCHRP 20-63: RAC Survey

RAC Performance Measure and Tool Survey for NCHRP Project 20-63:
Performance Measurement Tool Box and Reporting System for Research Programs and Projects

Purpose of this Survey

The ability to credibly show the benefits derived from state transportation agency (STA) research projects/programs is critical to justifying state and federal funding for these programs. The primary purpose of this NCHRP project is to provide a performance measurement (PM) tool box that you may use to determine the benefits that your program is providing to your state. A second product will be a website which will provide an easy-to-use input model and allow state-level information to be aggregated to determine the national impact of STA research programs, thereby supporting the continuation and future increase in State Planning and Research (SPR) funding. The possibility of providing automated annual/biennial SPR program reports from the new database will also be explored.

You have been asked to participate in this survey because of your involvement in transportation research. The survey will provide information relative to the assessment of performance measurement techniques which are applied to transportation research programs at the state level. There are more than 150 individuals who have been invited to provide input to this project and the responses will be summarized and included as part of the project's final report. Your participation in this survey will be critical to helping the project team to design a tool box which is relevant to your state and credible to your program's stakeholders.

Every effort has been made to make this survey easy to complete and as brief as possible. Follow-up contact with individual RAC members will be made as needed to further explore the input provided through this survey. If you have any questions regarding this survey, please contact Paul Krugler, (512) 467-0946 or p-krugler@ttimail.tamu.edu, or Melissa Vittrup, (979) 845-8514 or mvittrup@tamu.edu. Thank you in advance for your valuable contributions.

Please complete this survey and provide supporting documents by: April 23, 2004.

Start Survey >>

Note:
This research study has been reviewed and approved by the Institutional Review Board-Human Subjects in Research, Texas A&M University. For research-related problems or questions regarding subjects' rights, the Institutional Review Board may be contacted through the IRB Coordinator, Office of Vice President for Research and Associate Provost for Graduate Studies at (979) 845-1811.

NCHRP 20-63: RAC Survey

RAC Performance Measure and Tool Survey for NCHRP Project 20-63:
Performance Measurement Tool Box and Reporting System for Research Programs and Projects

Contact Information

*Agency:
*Name:
*Position Title:
For purposes of follow-up, please provide the following:
*Telephone:
Fax:
*E-mail:

<< Prev Page Next Page >>

RAC Performance Measure and Tool Survey for NCHRP Project 20-63:
Performance Measurement Tool Box and Reporting System for Research Programs and Projects

Performance Measures. Please provide your input concerning twenty research-related performance measures (PMs) that the literature indicates are currently used by various state transportation agencies (STAs) or that seem to have high potential value for that use.

- **Frequency of Use:** Select one of the three provided responses to indicate whether/how often your state uses the same or a similar research-related PM.
- **Rating:** Provide your perspective on probable effectiveness (value) of every listed PM, whether or not you currently use it as a PM in your state. Please indicate your rating of 1 (little value) to 5 (extremely valuable).
- **Comments:** When appropriate, provide brief comments in the area provided. Please include how your state's version of that PM varies notably from the description shown.

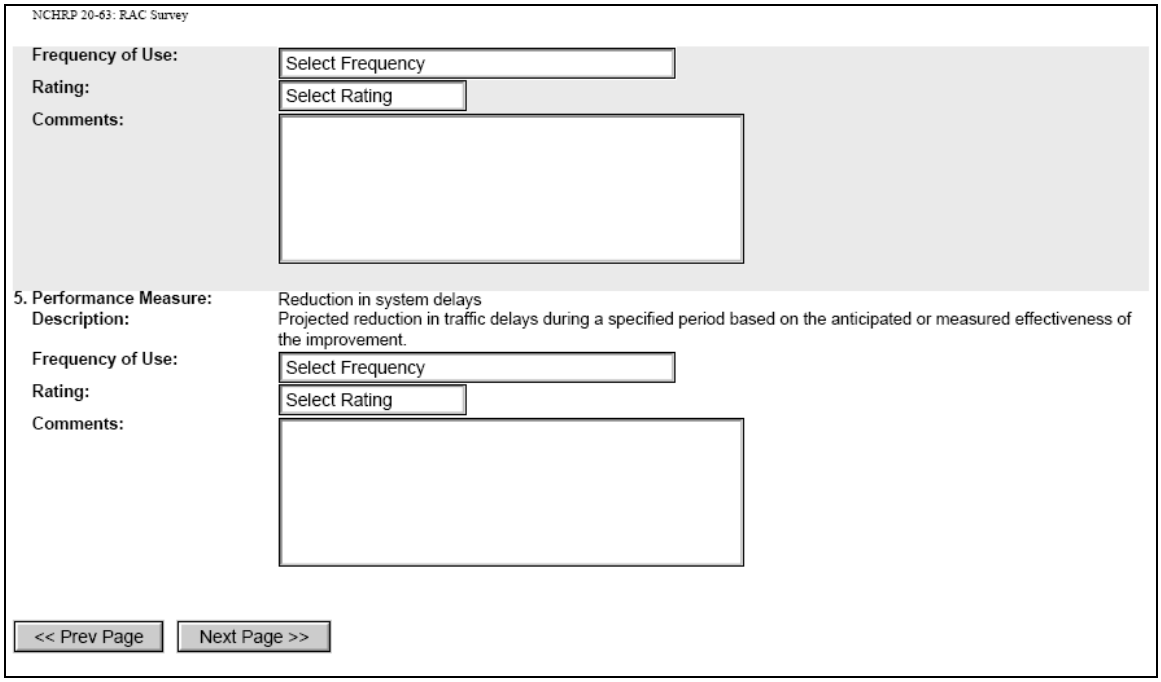
---

1. Performance Measure: Return on Investment or Benefit vs. Cost Ratio
Description: Total dollar savings associated with the project (based on STA's standard benefit/payback period (example-10 years)) versus total cost of the project (including implementation, tangible, recurring, & sunk costs).
Frequency of Use: Select Frequency
Rating: Select Rating
Comments:

2. Performance Measure: Lives saved
Description: Projected number of lives saved during a standard payback period based on the anticipated effectiveness of the improvement and the number of fatalities associated with the problem prior to the project/product implementation.
Frequency of Use: Select Frequency
Rating: Select Rating
Comments:

3. Performance Measure: Construction, maintenance & operations savings
Description: Total dollar savings in the cost of contracts and agency materials & labor costs (reduction or avoidance of costs) during a specified payback period.
Frequency of Use: Select Frequency
Rating: Select Rating
Comments:

4. Performance Measure: Reduction in crashes
Description: Projected reduction in number of crashes during a specified payback period based on the anticipated or measured effectiveness of the improvement and the total number of crashes attributed to problem prior to the project/product implementation.



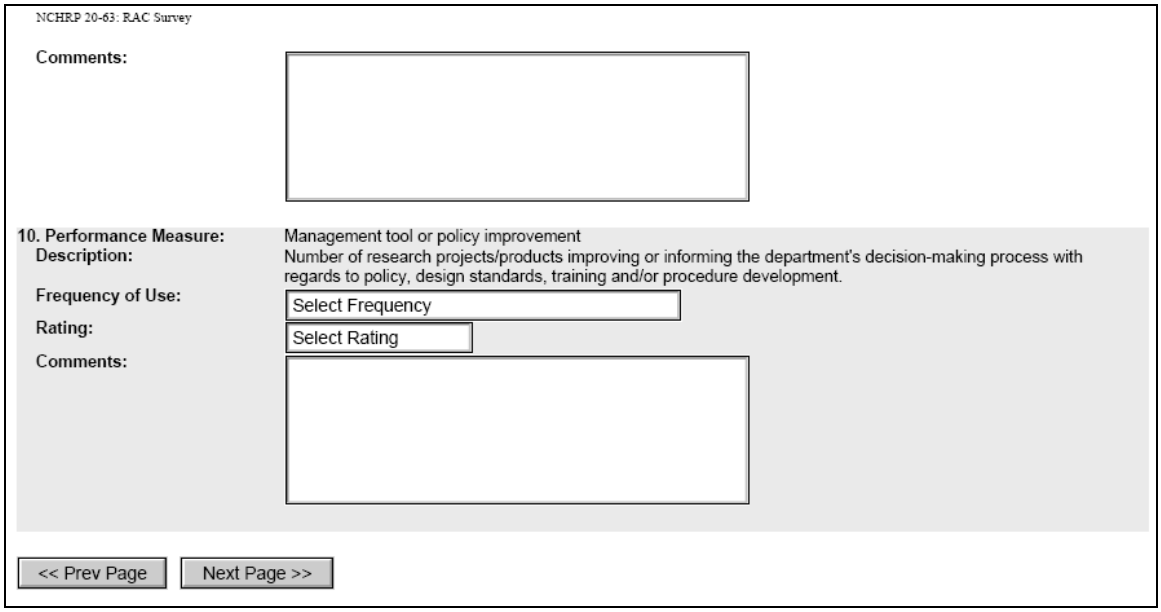
RAC Performance Measure and Tool Survey for NCHRP Project 20-63:
Performance Measurement Tool Box and Reporting System for Research Programs and Projects

Performance Measures (cont.). Please provide your input concerning twenty research-related performance measures (PMs) that the literature indicates are currently used by various state transportation agencies (STAs) or that seem to have high potential value for that use.

- **Frequency of Use:** Select one of the three provided responses to indicate whether/how often your state uses the same or a similar research-related PM.
- **Rating:** Provide your perspective on probable effectiveness (value) of every listed PM, whether or not you currently use it as a PM in your state. Please indicate your rating of 1 (little value) to 5 (extremely valuable).
- **Comments:** When appropriate, provide brief comments in the area provided. Please include how your state's version of that PM varies notably from the description shown.

---

6. Performance Measure:	Positive environmental impact
Description:	Number of research projects/products improving or protecting the natural environment.
Frequency of Use:	Select Frequency
Rating:	Select Rating
Comments:	
7. Performance Measure:	Quality of life enhancement
Description:	Number of research projects/products improving the psychological or physical comfort of the user or enhancing the aesthetic quality of the system or system security.
Frequency of Use:	Select Frequency
Rating:	Select Rating
Comments:	
8. Performance Measure:	Safety enhancement
Description:	Number of research projects/products improving design methodologies in regards to safety or the perception of the transportation system safety.
Frequency of Use:	Select Frequency
Rating:	Select Rating
Comments:	
9. Performance Measure:	Level of knowledge increased
Description:	Number of research projects/products improving the body of knowledge in a specific area(s) or our decision-making processes.
Frequency of Use:	Select Frequency
Rating:	Select Rating



RAC Performance Measure and Tool Survey for NCHRP Project 20-63:
Performance Measurement Tool Box and Reporting System for Research Programs and Projects

Performance Measures (cont.). Please provide your input concerning twenty research-related performance measures (PMs) that the literature indicates are currently used by various state transportation agencies (STAs) or that seem to have high potential value for that use.

- **Frequency of Use:** Select one of the three provided responses to indicate whether/how often your state uses the same or a similar research-related PM.
- **Rating:** Provide your perspective on probable effectiveness (value) of every listed PM, whether or not you currently use it as a PM in your state. Please indicate your rating of 1 (little value) to 5 (extremely valuable).
- **Comments:** When appropriate, provide brief comments in the area provided. Please include how your state's version of that PM varies notably from the description shown.

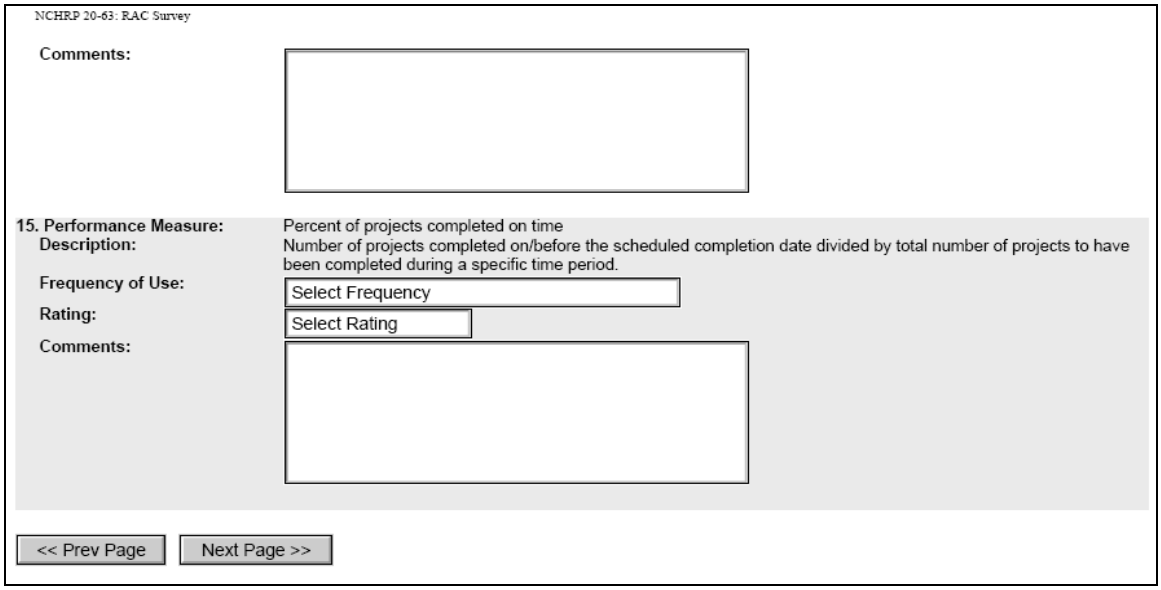
---

11. Performance Measure: Public image enhancement
Description: Number of research projects/products enhancing the public image of the STA.
Frequency of Use: Select Frequency
Rating: Select Rating
Comments:

12. Performance Measure: Technical practices or standards upgraded
Description: Number of research projects/products improving the design processes or contributing new information to technical standards or practices.
Frequency of Use: Select Frequency
Rating: Select Rating
Comments:

13. Performance Measure: Leadership
Description: Number of research projects/products providing a pro-active solution or adding to scientific or technological knowledge in the field.
Frequency of Use: Select Frequency
Rating: Select Rating
Comments:

14. Performance Measure: Percent of projects/products implemented
Description: Number of projects/products implemented (completely or partially) divided by total number of projects/products during a specific period (according to state standard).
Frequency of Use: Select Frequency
Rating: Select Rating



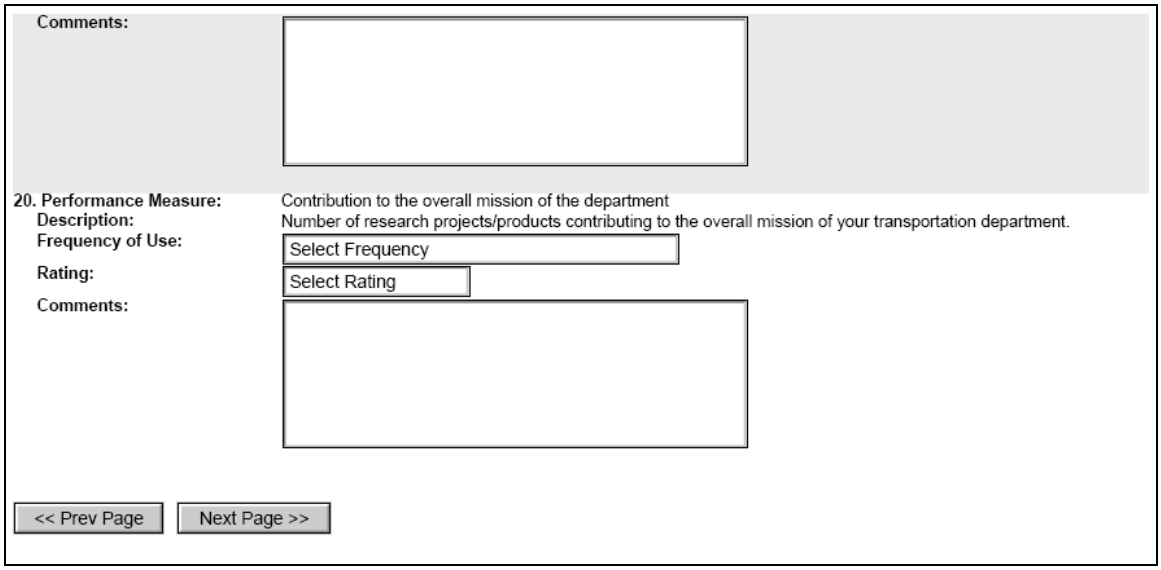
NCHRP 20-63: RAC Survey

RAC Performance Measure and Tool Survey for NCHRP Project 20-63:
Performance Measurement Tool Box and Reporting System for Research Programs and Projects

Performance Measures (cont.). Please provide your input concerning twenty research-related performance measures (PMs) that the literature indicates are currently used by various state transportation agencies (STAs) or that seem to have high potential value for that use.

- **Frequency of Use:** Select one of the three provided responses to indicate whether/how often your state uses the same or a similar research-related PM.
- **Rating:** Provide your perspective on probable effectiveness (value) of every listed PM, whether or not you currently use it as a PM in your state. Please indicate your rating of 1 (little value) to 5 (extremely valuable).
- **Comments:** When appropriate, provide brief comments in the area provided. Please include how your state's version of that PM varies notably from the description shown.

16. Performance Measure:	Percent of projects completed within budget
Description:	Number of projects completed within budget divided by total number of projects completed during a specific time period.
Frequency of Use:	Select Frequency
Rating:	Select Rating
Comments:	
17. Performance Measure:	Number of contractors
Description:	Number of unique entities with active research projects during a specific time period.
Frequency of Use:	Select Frequency
Rating:	Select Rating
Comments:	
18. Performance Measure:	Number of contractor partnerships
Description:	Number of partnerships formed between researching entities.
Frequency of Use:	Select Frequency
Rating:	Select Rating
Comments:	
19. Performance Measure:	Percent of satisfied customers
Description:	Number of customers reporting satisfied or very satisfied on survey divided by total number of customers surveyed.
Frequency of Use:	Select Frequency
Rating:	Select Rating



NCHRP 20-63: RAC Survey

RAC Performance Measure and Tool Survey for NCHRP Project 20-63:
Performance Measurement Tool Box and Reporting System for Research Programs and Projects

Additional Performance Measures. There are undoubtedly other research-related Performance Measures (PMs) used by individual states, some of which may be exceptionally good for all states to consider using. Please provide the requested information on all other research-related PMs used by your state that are not already addressed among the PMs in the first section. The comment area may be used to further describe the PM, if necessary. Your evaluation of frequency and effectiveness for each of these is also very important to the purpose of this survey.

---

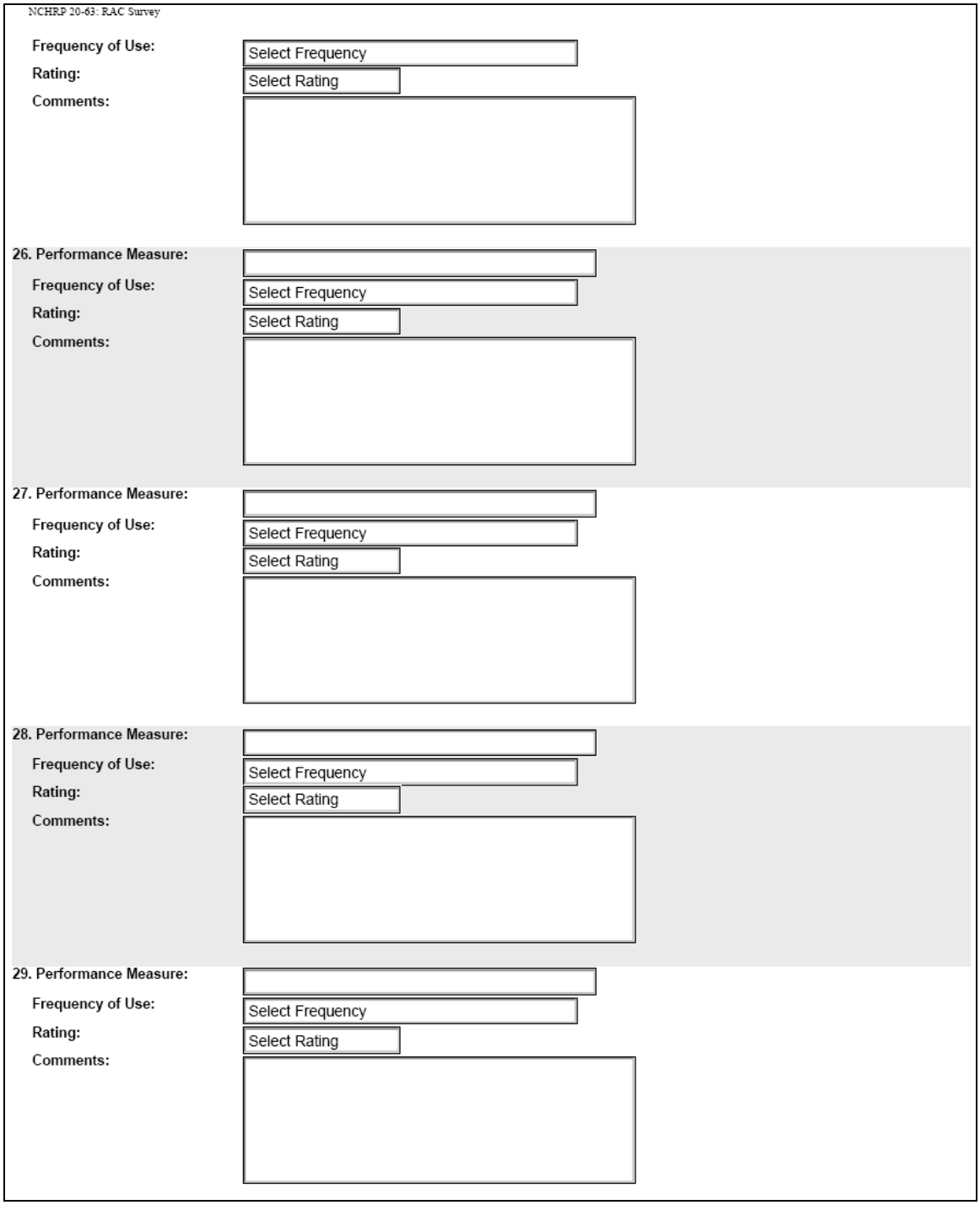
21. Performance Measure:
Frequency of Use: Select Frequency
Rating: Select Rating
Comments:

22. Performance Measure:
Frequency of Use: Select Frequency
Rating: Select Rating
Comments:

23. Performance Measure:
Frequency of Use: Select Frequency
Rating: Select Rating
Comments:

24. Performance Measure:
Frequency of Use: Select Frequency
Rating: Select Rating
Comments:

25. Performance Measure:



NCHRP 20-63: RAC Survey

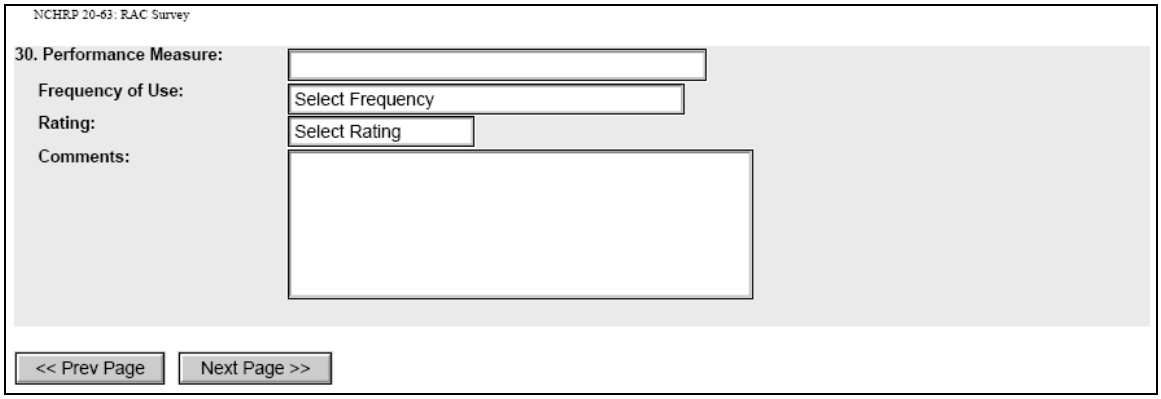
Frequency of Use: Select Frequency
Rating: Select Rating
Comments:

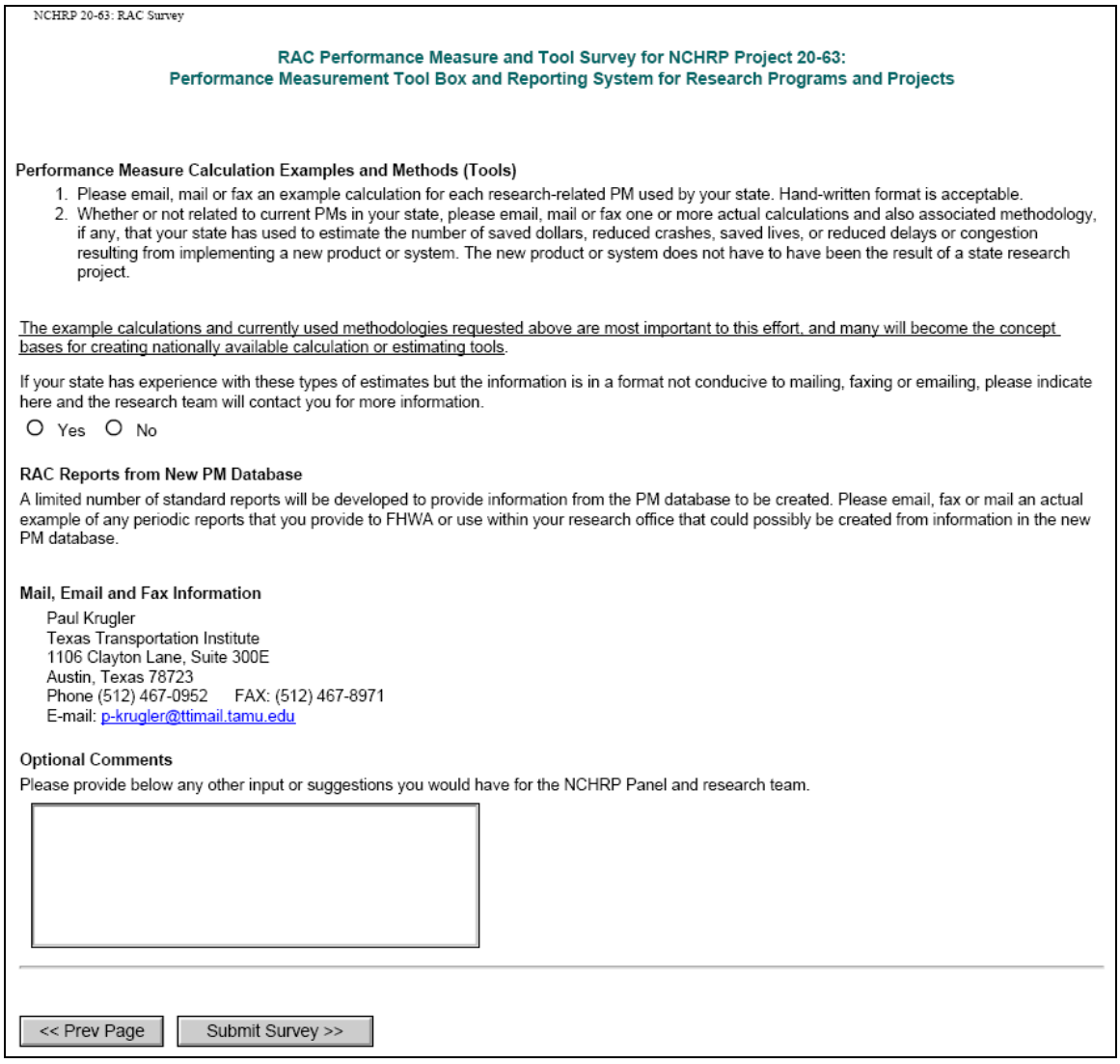
26. Performance Measure:
Frequency of Use: Select Frequency
Rating: Select Rating
Comments:

27. Performance Measure:
Frequency of Use: Select Frequency
Rating: Select Rating
Comments:

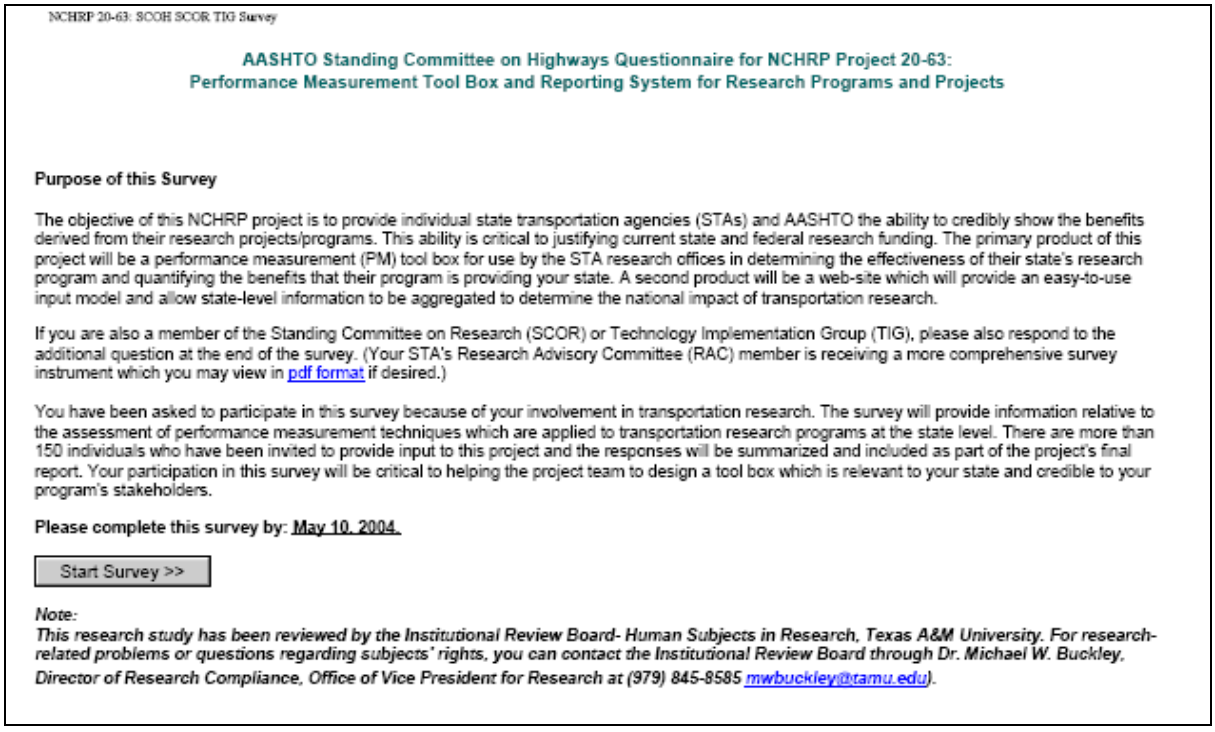
28. Performance Measure:
Frequency of Use: Select Frequency
Rating: Select Rating
Comments:

29. Performance Measure:
Frequency of Use: Select Frequency
Rating: Select Rating
Comments:





AASHTO AGENCY ADMINISTRATOR WEB SURVEY INSTRUMENT



NCHRP 20-63: SCOH SCOR TIG Survey

AASHTO Standing Committee on Highways Questionnaire for NCHRP Project 20-63:
Performance Measurement Tool Box and Reporting System for Research Programs and Projects

Purpose of this Survey

The objective of this NCHRP project is to provide individual state transportation agencies (STAs) and AASHTO the ability to credibly show the benefits derived from their research projects/programs. This ability is critical to justifying current state and federal research funding. The primary product of this project will be a performance measurement (PM) tool box for use by the STA research offices in determining the effectiveness of their state's research program and quantifying the benefits that their program is providing your state. A second product will be a web-site which will provide an easy-to-use input model and allow state-level information to be aggregated to determine the national impact of transportation research.

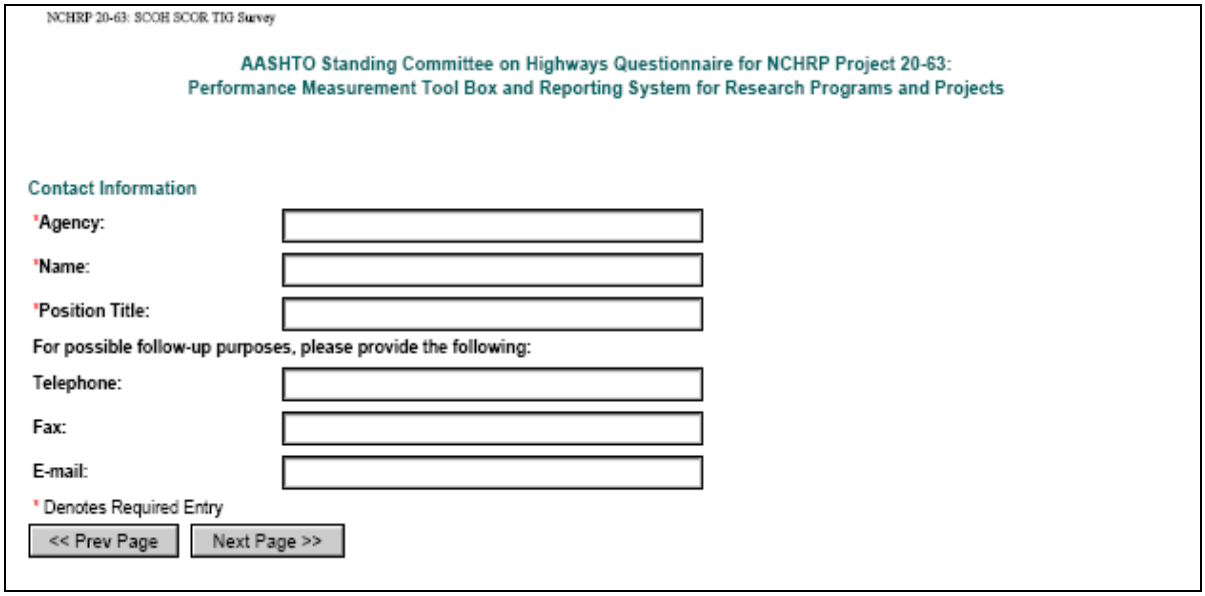
If you are also a member of the Standing Committee on Research (SCOR) or Technology Implementation Group (TIG), please also respond to the additional question at the end of the survey. (Your STA's Research Advisory Committee (RAC) member is receiving a more comprehensive survey instrument which you may view in pdf format if desired.)

You have been asked to participate in this survey because of your involvement in transportation research. The survey will provide information relative to the assessment of performance measurement techniques which are applied to transportation research programs at the state level. There are more than 150 individuals who have been invited to provide input to this project and the responses will be summarized and included as part of the project's final report. Your participation in this survey will be critical to helping the project team to design a tool box which is relevant to your state and credible to your program's stakeholders.

Please complete this survey by: May 10, 2004.

Start Survey >>

Note:
This research study has been reviewed by the Institutional Review Board- Human Subjects in Research, Texas A&M University. For research-related problems or questions regarding subjects' rights, you can contact the Institutional Review Board through Dr. Michael W. Buckley, Director of Research Compliance, Office of Vice President for Research at (979) 845-8585 mwbuckley@tamu.edu).



NCHRP 20-63: SCOH SCOR TIG Survey

AASHTO Standing Committee on Highways Questionnaire for NCHRP Project 20-63:
Performance Measurement Tool Box and Reporting System for Research Programs and Projects

Contact Information

*Agency:
*Name:
*Position Title:

For possible follow-up purposes, please provide the following:

Telephone:
Fax:
E-mail:

* Denotes Required Entry

<< Prev Page Next Page >>

NCHRP 20-63: SCOH SCOR TIG Survey

AASHTO Standing Committee on Highways Questionnaire for NCHRP Project 20-63:
Performance Measurement Tool Box and Reporting System for Research Programs and Projects

Performance Measures. Please provide your opinion on applicability and value of the following twenty research-related performance measures (PMs).

- **Applicability:** You may indicate applicability at more than one of the levels shown, when appropriate.
- **Rating:** Provide your perspective on probable effectiveness (value) of every listed PM, whether or not you currently use it as a PM in your state. Please indicate your rating of 1 (little value) to 5 (extremely valuable).

---

1. **Performance Measure:** Return on Investment or Benefit vs. Cost Ratio
   Description: Total dollar savings associated with the project (based on STA's standard benefit/payback period (example-10 years)) versus total cost of the project (including implementation, tangible, recurring, & sunk costs).
   Applicability:
   - ☐ Internal STA Management
   - ☐ External: State Level - Legislative, etc.
   - ☐ External: National Level - Congressional, etc.

   Rating: Select Rating

2. **Performance Measure:** Lives saved
   Description: Projected number of lives saved during a standard payback period based on the anticipated effectiveness of the improvement and the number of fatalities associated with the problem prior to the project/product implementation.
   Applicability:
   - ☐ Internal STA Management
   - ☐ External: State Level - Legislative, etc.
   - ☐ External: National Level - Congressional, etc.

   Rating: Select Rating

3. **Performance Measure:** Construction, maintenance & operations savings
   Description: Total dollar savings in the cost of contracts and agency materials & labor costs (reduction or avoidance of costs) during a specified payback period.
   Applicability:
   - ☐ Internal STA Management
   - ☐ External: State Level - Legislative, etc.
   - ☐ External: National Level - Congressional, etc.

   Rating: Select Rating

4. **Performance Measure:** Reduction in crashes
   Description: Projected reduction in number of crashes during a specified payback period based on the anticipated or measured effectiveness of the improvement and the total number of crashes attributed to problem prior to the project/product implementation.
   Applicability:
   - ☐ Internal STA Management
   - ☐ External: State Level - Legislative, etc.
   - ☐ External: National Level - Congressional, etc.

   Rating: Select Rating

5. **Performance Measure:** Reduction in system delays
   Description: Projected reduction in traffic delays during a specified period based on the anticipated or measured effectiveness of the improvement.
   Applicability:
   - ☐ Internal STA Management
   - ☐ External: State Level - Legislative, etc.
   - ☐ External: National Level - Congressional, etc.

   Rating: Select Rating

NCHRP 20-63: SCOH SCOR TIG Survey

<< Prev Page | Next Page >>

NCHRP 20-63: SCOH SCOR TIG Survey

AASHTO Standing Committee on Highways Questionnaire for NCHRP Project 20-63:
Performance Measurement Tool Box and Reporting System for Research Programs and Projects

Performance Measures. (continued)

6. Performance Measure: Positive environmental impact
Description: Number of research projects/products improving or protecting the natural environment.
Applicability:
- ☐ Internal STA Management
- ☐ External: State Level - Legislative, etc.
- ☐ External: National Level - Congressional, etc.

Rating: Select Rating

7. Performance Measure: Quality of life enhancement
Description: Number of research projects/products improving the psychological or physical comfort of the user or enhancing the aesthetic quality of the system or system security.
Applicability:
- ☐ Internal STA Management
- ☐ External: State Level - Legislative, etc.
- ☐ External: National Level - Congressional, etc.

Rating: Select Rating

8. Performance Measure: Safety enhancement
Description: Number of research projects/products improving design methodologies in regards to safety or the perception of the transportation system safety.
Applicability:
- ☐ Internal STA Management
- ☐ External: State Level - Legislative, etc.
- ☐ External: National Level - Congressional, etc.

Rating: Select Rating

9. Performance Measure: Level of knowledge increased
Description: Number of research projects/products improving the body of knowledge in a specific area(s) or our decision-making processes.
Applicability:
- ☐ Internal STA Management
- ☐ External: State Level - Legislative, etc.
- ☐ External: National Level - Congressional, etc.

Rating: Select Rating

10. Performance Measure: Management tool or policy improvement
Description: Number of research projects/products improving or informing the department's decision-making process with regards to policy, design standards, training and/or procedure development.
Applicability:
- ☐ Internal STA Management
- ☐ External: State Level - Legislative, etc.
- ☐ External: National Level - Congressional, etc.

Rating: Select Rating

<< Prev Page | Next Page >>

NCHRP 20-63: SCOH SCOR TIG Survey

AASHTO Standing Committee on Highways Questionnaire for NCHRP Project 20-63:
Performance Measurement Tool Box and Reporting System for Research Programs and Projects

Performance Measures. (continued)

11. Performance Measure: Public image enhancement
Description: Number of research projects/products enhancing the public image of the STA.
Applicability:
- ☐ Internal STA Management
- ☐ External: State Level - Legislative, etc.
- ☐ External: National Level - Congressional, etc.

Rating: Select Rating

12. Performance Measure: Technical practices or standards upgraded
Description: Number of research projects/products improving the design processes or contributing new information to technical standards or practices.
Applicability:
- ☐ Internal STA Management
- ☐ External: State Level - Legislative, etc.
- ☐ External: National Level - Congressional, etc.

Rating: Select Rating

13. Performance Measure: Leadership
Description: Number of research projects/products providing a pro-active solution or adding to scientific or technological knowledge in the field.
Applicability:
- ☐ Internal STA Management
- ☐ External: State Level - Legislative, etc.
- ☐ External: National Level - Congressional, etc.

Rating: Select Rating

14. Performance Measure: Percent of projects/products implemented
Description: Number of projects/products implemented (completely or partially) divided by total number of projects/products during a specific period (according to state standard).
Applicability:
- ☐ Internal STA Management
- ☐ External: State Level - Legislative, etc.
- ☐ External: National Level - Congressional, etc.

Rating: Select Rating

15. Performance Measure: Percent of projects completed on time
Description: Number of projects completed on/before the scheduled completion date divided by total number of projects to have been completed during a specific time period.
Applicability:
- ☐ Internal STA Management
- ☐ External: State Level - Legislative, etc.
- ☐ External: National Level - Congressional, etc.

Rating: Select Rating

<< Prev Page | Next Page >>

NCHRP 20-63: SCOH SCOR TIG Survey

AASHTO Standing Committee on Highways Questionnaire for NCHRP Project 20-63:
Performance Measurement Tool Box and Reporting System for Research Programs and Projects

Performance Measures. (continued)

16. Performance Measure: Percent of projects completed within budget
Description: Number of projects completed within budget divided by total number of projects completed during a specific time period.
Applicability:
- ☐ Internal STA Management
- ☐ External: State Level - Legislative, etc.
- ☐ External: National Level - Congressional, etc.

Rating: Select Rating

17. Performance Measure: Number of contractors
Description: Number of unique entities with active research projects during a specific time period.
Applicability:
- ☐ Internal STA Management
- ☐ External: State Level - Legislative, etc.
- ☐ External: National Level - Congressional, etc.

Rating: Select Rating

18. Performance Measure: Number of contractor partnerships
Description: Number of partnerships formed between researching entities.
Applicability:
- ☐ Internal STA Management
- ☐ External: State Level - Legislative, etc.
- ☐ External: National Level - Congressional, etc.

Rating: Select Rating

19. Performance Measure: Percent of satisfied customers
Description: Number of customers reporting satisfied or very satisfied on survey divided by total number of customers survey
Applicability:
- ☐ Internal STA Management
- ☐ External: State Level - Legislative, etc.
- ☐ External: National Level - Congressional, etc.

Rating: Select Rating

20. Performance Measure: Contribution to the overall mission of the department
Description: Number of research projects/products contributing to the overall mission of your transportation department.
Applicability:
- ☐ Internal STA Management
- ☐ External: State Level - Legislative, etc.
- ☐ External: National Level - Congressional, etc.

Rating: Select Rating

Note: The next page will provide you with boxes for suggesting additional performance measures.

<< Prev Page | Next Page >>

NCHRP 20-63: SCOH SCOR TIG Survey

AASHTO Standing Committee on Highways Questionnaire for NCHRP Project 20-63:
Performance Measurement Tool Box and Reporting System for Research Programs and Projects

Additional Performance Measures. There are undoubtedly other research-related Performance Measures (PMs) used by individual states, some of which may be exceptionally good for all states to consider using. Please briefly describe any research-related PM not mentioned above, whether or not currently used by your STA, but that is or would be particularly beneficial to you as a transportation agency administrator. The comment area may be used to further describe the PM, if necessary.

---

21. Performance Measure:

Comments:

22. Performance Measure:

Comments:

23. Performance Measure:

Comments:

24. Performance Measure:

Comments:

25. Performance Measure:

Comments:

<< Prev Page | Next Page >>

NCHRP 20-63: SCOH SCOR TIG Survey

AASHTO Standing Committee on Highways Questionnaire for NCHRP Project 20-63:
Performance Measurement Tool Box and Reporting System for Research Programs and Projects

Performance Measure Ratings

---

26. Considering all the PMs mentioned in this survey, including any that you may have briefly described above, please indicate three PMs which would be the most helpful to you in administering your state's transportation agency.

Select 1st Choice

Select 2nd Choice

Select 3rd Choice

27. ***Optional Additional Input***
Please provide any other input or suggestions you might have for the NCHRP panel and research team.

28. ***SCOR and TIG Member Input***
Members of AASHTO's Standing Committee on Research (SCOR) and Technology Implementation Group (TIG) may have unique perspectives of research performance measure applicability and value from those roles. Of all the PMs mentioned in this survey, please indicate which three PMs would be the most helpful to you as a member of AASHTO's SCOR or TIG?

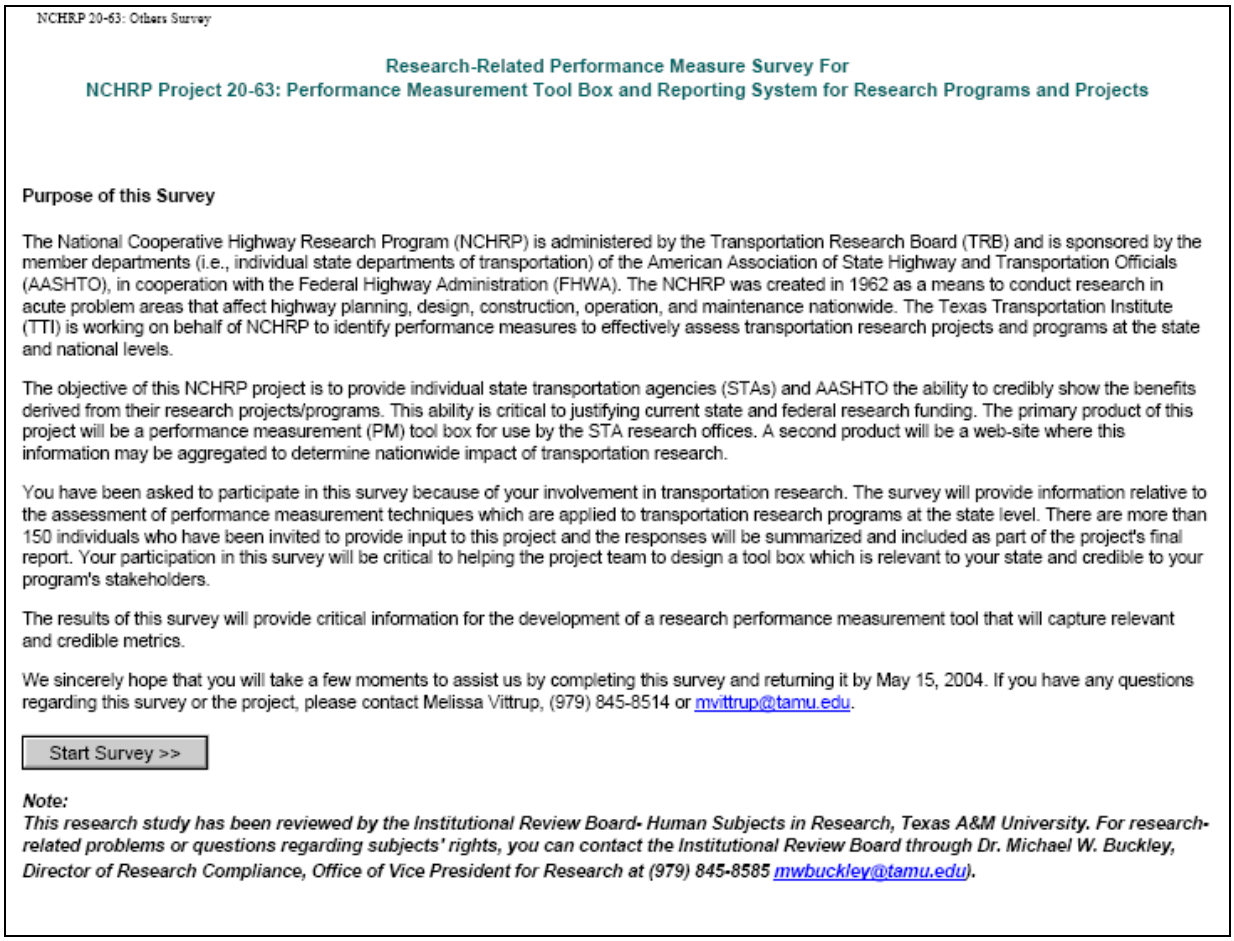
Select 1st Choice

Select 2nd Choice

Select 3rd Choice

<< Prev Page Submit Survey >>

FEDERAL AND PRIVATE INDUSTRY RESEARCH MANAGER WEB SURVEY INSTRUMENT



NCHRP 20-63: Others Survey

Research-Related Performance Measure Survey For
NCHRP Project 20-63: Performance Measurement Tool Box and Reporting System for Research Programs and Projects

Purpose of this Survey

The National Cooperative Highway Research Program (NCHRP) is administered by the Transportation Research Board (TRB) and is sponsored by the member departments (i.e., individual state departments of transportation) of the American Association of State Highway and Transportation Officials (AASHTO), in cooperation with the Federal Highway Administration (FHWA). The NCHRP was created in 1962 as a means to conduct research in acute problem areas that affect highway planning, design, construction, operation, and maintenance nationwide. The Texas Transportation Institute (TTI) is working on behalf of NCHRP to identify performance measures to effectively assess transportation research projects and programs at the state and national levels.

The objective of this NCHRP project is to provide individual state transportation agencies (STAs) and AASHTO the ability to credibly show the benefits derived from their research projects/programs. This ability is critical to justifying current state and federal research funding. The primary product of this project will be a performance measurement (PM) tool box for use by the STA research offices. A second product will be a web-site where this information may be aggregated to determine nationwide impact of transportation research.

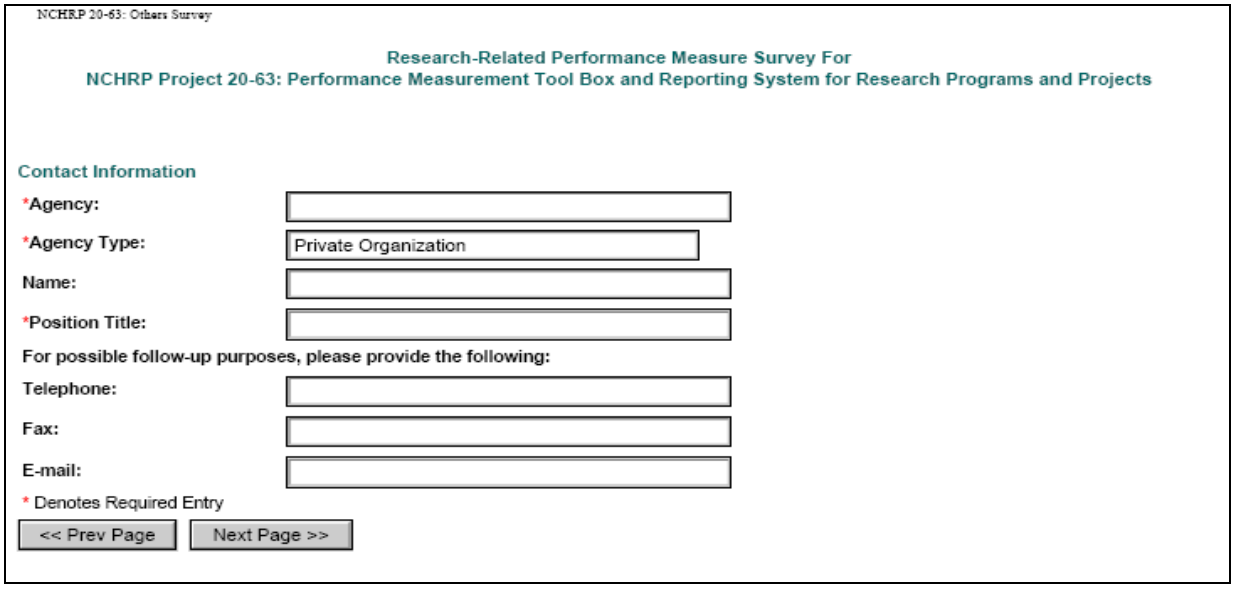
You have been asked to participate in this survey because of your involvement in transportation research. The survey will provide information relative to the assessment of performance measurement techniques which are applied to transportation research programs at the state level. There are more than 150 individuals who have been invited to provide input to this project and the responses will be summarized and included as part of the project's final report. Your participation in this survey will be critical to helping the project team to design a tool box which is relevant to your state and credible to your program's stakeholders.

The results of this survey will provide critical information for the development of a research performance measurement tool that will capture relevant and credible metrics.

We sincerely hope that you will take a few moments to assist us by completing this survey and returning it by May 15, 2004. If you have any questions regarding this survey or the project, please contact Melissa Vittrup, (979) 845-8514 or mvittrup@tamu.edu.

Start Survey >>

Note:
This research study has been reviewed by the Institutional Review Board- Human Subjects in Research, Texas A&M University. For research-related problems or questions regarding subjects' rights, you can contact the Institutional Review Board through Dr. Michael W. Buckley, Director of Research Compliance, Office of Vice President for Research at (979) 845-8585 mwbuckley@tamu.edu).



NCHRP 20-63: Others Survey

Research-Related Performance Measure Survey For
NCHRP Project 20-63: Performance Measurement Tool Box and Reporting System for Research Programs and Projects

Contact Information

*Agency:
*Agency Type: Private Organization
Name:
*Position Title:
For possible follow-up purposes, please provide the following:
Telephone:
Fax:
E-mail:
* Denotes Required Entry
<< Prev Page Next Page >>

NCHRP 20-63: Others Survey

Research-Related Performance Measure Survey For
NCHRP Project 20-63: Performance Measurement Tool Box and Reporting System for Research Programs and Projects

Performance Measures. Please provide your opinion on applicability and value of the following twenty research-related performance measures (PMs). Those respondents not currently involved in transportation research should respond to this survey based on their experience in measuring research performance and from a more general perspective. If the specific performance measure (example: lives saved) is not relevant to your perspective, please feel free to disregard that measure. There will also be an opportunity for you to suggest additional performance measures or make optional comments after providing your opinion on the specific performance measures shown below.

- **Applicability:** You may indicate applicability at both of the levels shown, when appropriate.
- **Rating:** Provide your perspective on probable effectiveness (value) of every listed PM, whether or not you currently use it as a PM in the research arm of your organization. Please indicate your rating of 1 (little value) to 5 (extremely valuable).

---

1. Performance Measure: Return on Investment or Benefit vs. Cost Ratio
Description: Total dollar savings associated with the project (based on STA's standard benefit/payback period (example-10 years)) versus total cost of the project (including implementation, tangible, recurring, & sunk costs).
Applicability: ☐ Internal Management ☐ External Stakeholders
Rating: Select Rating

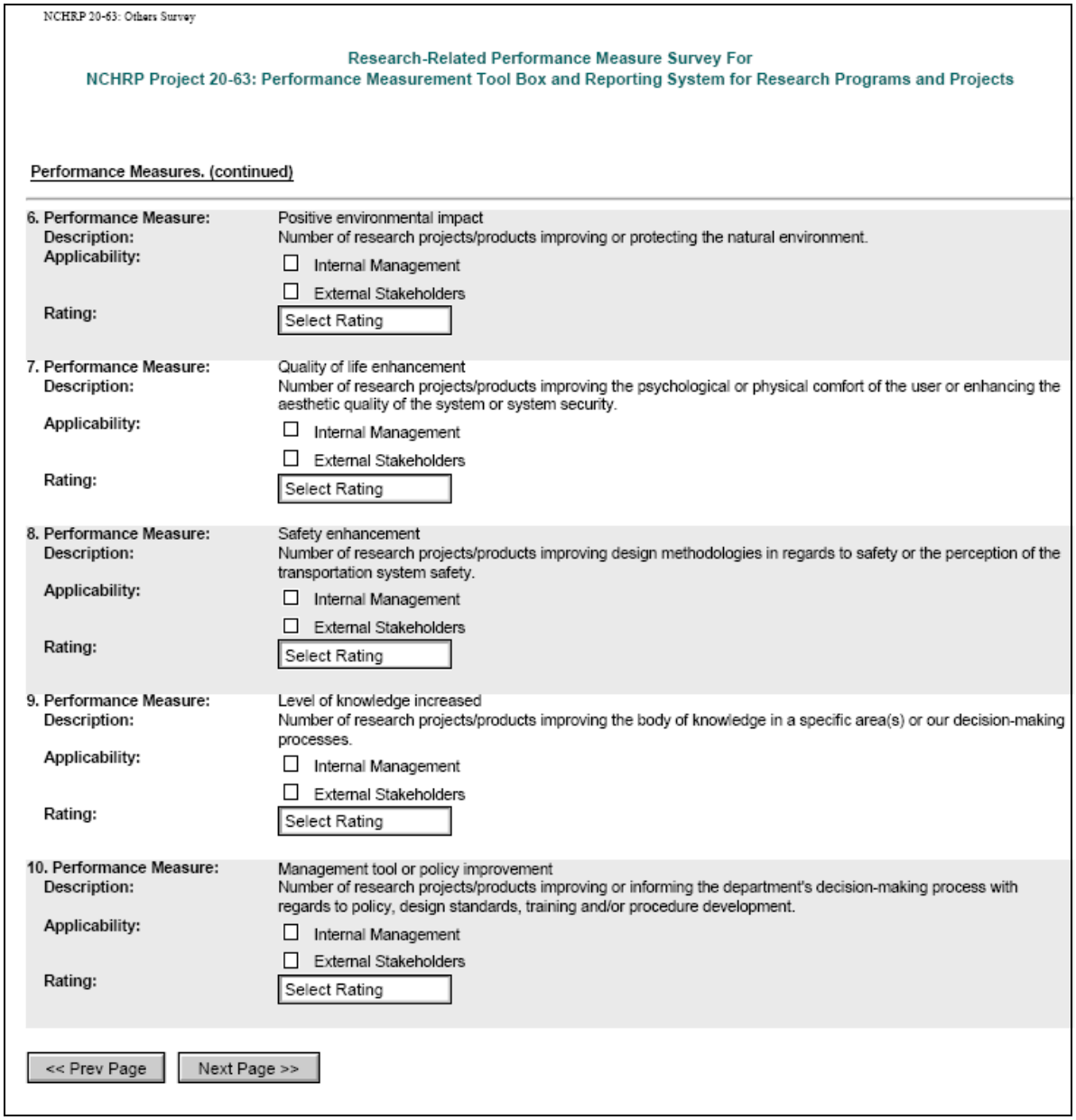
2. Performance Measure: Lives saved
Description: Projected number of lives saved during a standard payback period based on the anticipated effectiveness of the improvement and the number of fatalities associated with the problem prior to the project/product implementation.
Applicability: ☐ Internal Management ☐ External Stakeholders
Rating: Select Rating

3. Performance Measure: Construction, maintenance & operations savings
Description: Total dollar savings in the cost of contracts and agency materials & labor costs (reduction or avoidance of costs) during a specified payback period.
Applicability: ☐ Internal Management ☐ External Stakeholders
Rating: Select Rating

4. Performance Measure: Reduction in crashes
Description: Projected reduction in number of crashes during a specified payback period based on the anticipated or measured effectiveness of the improvement and the total number of crashes attributed to problem prior to the project/product implementation.
Applicability: ☐ Internal Management ☐ External Stakeholders
Rating: Select Rating

5. Performance Measure: Reduction in system delays
Description: Projected reduction in traffic delays during a specified period based on the anticipated or measured effectiveness of the improvement.
Applicability: ☐ Internal Management ☐ External Stakeholders
Rating: Select Rating

<< Prev Page Next Page >>



NCHRP 20-63: Others Survey

Research-Related Performance Measure Survey For
NCHRP Project 20-63: Performance Measurement Tool Box and Reporting System for Research Programs and Projects

Performance Measures. (continued)

6. Performance Measure:	Positive environmental impact
Description:	Number of research projects/products improving or protecting the natural environment.
Applicability:	☐ Internal Management ☐ External Stakeholders
Rating:	Select Rating
7. Performance Measure:	Quality of life enhancement
Description:	Number of research projects/products improving the psychological or physical comfort of the user or enhancing the aesthetic quality of the system or system security.
Applicability:	☐ Internal Management ☐ External Stakeholders
Rating:	Select Rating
8. Performance Measure:	Safety enhancement
Description:	Number of research projects/products improving design methodologies in regards to safety or the perception of the transportation system safety.
Applicability:	☐ Internal Management ☐ External Stakeholders
Rating:	Select Rating
9. Performance Measure:	Level of knowledge increased
Description:	Number of research projects/products improving the body of knowledge in a specific area(s) or our decision-making processes.
Applicability:	☐ Internal Management ☐ External Stakeholders
Rating:	Select Rating
10. Performance Measure:	Management tool or policy improvement
Description:	Number of research projects/products improving or informing the department's decision-making process with regards to policy, design standards, training and/or procedure development.
Applicability:	☐ Internal Management ☐ External Stakeholders
Rating:	Select Rating

<< Prev Page Next Page >>

NCHRP 20-63: Others Survey

Research-Related Performance Measure Survey For
NCHRP Project 20-63: Performance Measurement Tool Box and Reporting System for Research Programs and Projects

Performance Measures. (continued)

11. Performance Measure: Public image enhancement
Description: Number of research projects/products enhancing the public image of the STA.
Applicability: ☐ Internal Management ☐ External Stakeholders
Rating: Select Rating

12. Performance Measure: Technical practices or standards upgraded
Description: Number of research projects/products improving the design processes or contributing new information to technical standards or practices.
Applicability: ☐ Internal Management ☐ External Stakeholders
Rating: Select Rating

13. Performance Measure: Leadership
Description: Number of research projects/products providing a pro-active solution or adding to scientific or technological knowledge in the field.
Applicability: ☐ Internal Management ☐ External Stakeholders
Rating: Select Rating

14. Performance Measure: Percent of projects/products implemented
Description: Number of projects/products implemented (completely or partially) divided by total number of projects/products during a specific period (according to state standard).
Applicability: ☐ Internal Management ☐ External Stakeholders
Rating: Select Rating

15. Performance Measure: Percent of projects completed on time
Description: Number of projects completed on/before the scheduled completion date divided by total number of projects to have been completed during a specific time period.
Applicability: ☐ Internal Management ☐ External Stakeholders
Rating: Select Rating

<< Prev Page | Next Page >>

NCHRP 20-63: Others Survey

Research-Related Performance Measure Survey For
NCHRP Project 20-63: Performance Measurement Tool Box and Reporting System for Research Programs and Projects

Performance Measures. (continued)

16. Performance Measure: Percent of projects completed within budget
Description: Number of projects completed within budget divided by total number of projects completed during a specific time period.
Applicability: ☐ Internal Management ☐ External Stakeholders
Rating: Select Rating

17. Performance Measure: Number of contractors
Description: Number of unique entities with active research projects during a specific time period.
Applicability: ☐ Internal Management ☐ External Stakeholders
Rating: Select Rating

18. Performance Measure: Number of contractor partnerships
Description: Number of partnerships formed between researching entities.
Applicability: ☐ Internal Management ☐ External Stakeholders
Rating: Select Rating

19. Performance Measure: Percent of satisfied customers
Description: Number of customers reporting satisfied or very satisfied on survey divided by total number of customers surveyed.
Applicability: ☐ Internal Management ☐ External Stakeholders
Rating: Select Rating

20. Performance Measure: Contribution to the overall mission of the department
Description: Number of research projects/products contributing to the overall mission of your transportation department.
Applicability: ☐ Internal Management ☐ External Stakeholders
Rating: Select Rating

Note: The next page will provide you with boxes for suggesting additional performance measures.

<< Prev Page | Next Page >>

NCHRP 20-63: Others Survey

Research-Related Performance Measure Survey For
NCHRP Project 20-63: Performance Measurement Tool Box and Reporting System for Research Programs and Projects

Additional Performance Measures. There are undoubtedly other research-related Performance Measures (PMs) used by individual organizations, some of which may be exceptionally good for all organizations to consider using. Please briefly describe any research-related PM not mentioned above, whether or not currently used by your organization, but that is or would be particularly beneficial to you. The comment area may be used to further describe the PM, if necessary.

---

21. Performance Measure:

Applicability:
- ☐ Internal Management
- ☐ External Stakeholders

Rating: Select Rating

Comments:

22. Performance Measure:

Applicability:
- ☐ Internal Management
- ☐ External Stakeholders

Rating: Select Rating

Comments:

23. Performance Measure:

Applicability:
- ☐ Internal Management
- ☐ External Stakeholders

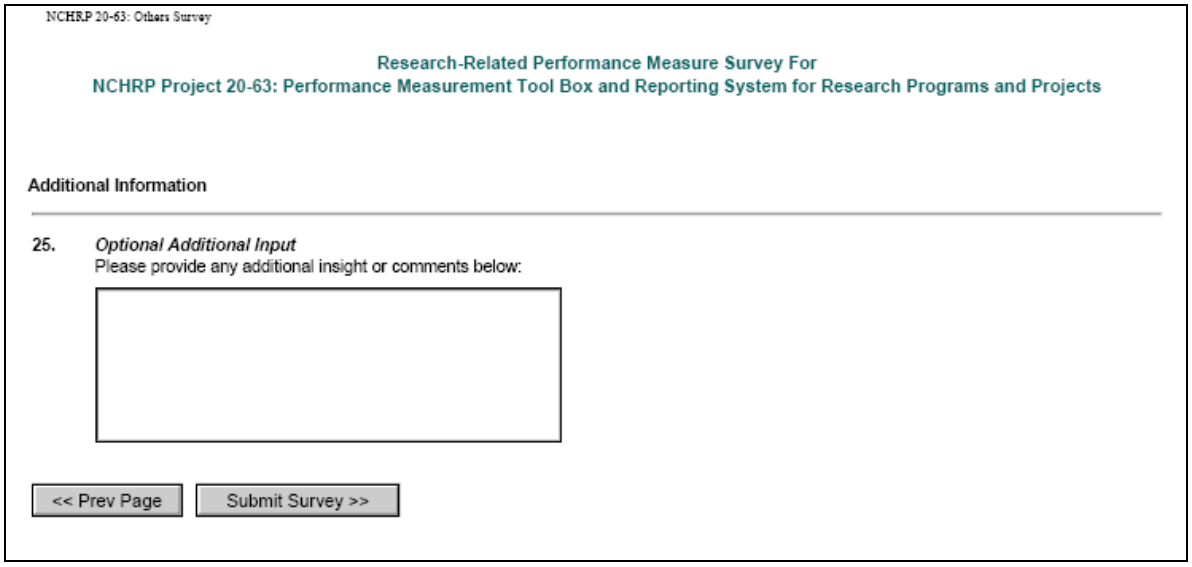
Rating: Select Rating

Comments:

24. Performance Measure:

Applicability:
- ☐ Internal Management
- ☐ External Stakeholders

Rating: Select Rating



NCHRP 20-63: Others Survey

Research-Related Performance Measure Survey For
NCHRP Project 20-63: Performance Measurement Tool Box and Reporting System for Research Programs and Projects

Additional Information

25. *Optional Additional Input*
Please provide any additional insight or comments below:

<< Prev Page | Submit Survey >>

APPENDIX D – Organizations Responding to Surveys

State Transportation Agencies Providing Responses to the AASHTO RAC Survey

Alaska	Illinois	Montana	Rhode Island
Alberta	Indiana	Nebraska	South Carolina
Arizona	Iowa	New Hampshire	South Dakota
Arkansas	Kansas	New Jersey	Texas
California	Louisiana	New Mexico	Utah
Colorado	Maine	New York	Vermont
Connecticut	Maryland	North Carolina	Virginia
Delaware	Minnesota	Ohio	Washington
Florida	Mississippi	Oregon	Wisconsin
Hawaii	Missouri	Pennsylvania	Wyoming

State Transportation Agencies Providing Responses to the AASHTO Agency Administrator Survey

Alabama	Idaho	Montana	Ohio
Arizona	Iowa	New Hampshire	South Dakota
California	Maryland	New Jersey	Utah
Connecticut	Massachusetts	New York	Vermont
Georgia	Michigan	North Dakota	West Virginia
Florida	Minnesota	Oklahoma	Wyoming

List of Federal and Private Industry Survey Responses

Balanced Transportation Concepts
FHWA - Office of Safety R&D
FHWA - Office of Infrastructure R&D
FHWA - Texas Division
FHWA - Office of Research, Development, and Technology
Iowa State University - Center for Transportation Research and Education
Mineta Transportation Institute
National Association of County Engineers
National Transportation Center
University of California at Berkeley - Institute of Transportation Studies
University of Idaho
University of Illinois - Urban Transportation Center - Chicago
University of Kentucky - Kentucky Transportation Center
University of Minnesota - Center for Transportation Studies
University of Missouri at Columbia
University of Pennsylvania
University of Texas at Austin - Center for Transportation Research
US Department of Transportation - Volpe Center
Virginia Tech Transportation Institute
Wilbur Smith Associates

APPENDIX E – RAC Survey Performance Measure Comments

Return on Investment or Benefit-Cost Ratio

- It's a good performance measure but we do not have the resources or knowledge to implement and monitor the return on investment or benefit vs. cost ratio.
- This PM can be useful if it is accurate. It is often difficult to achieve an accurate measure.
- Most of our projects are selected for immediate implementation and payback.
- Benefit values are too subjective.
- While we do not currently use benefit cost ratios as a selection tool nor as a performance measure, we are currently contemplating making this a deliverable to be calculated by the contract research team for each applicable research project. We have not implemented this process yet.
- Usually done only when benefit is clear - around 10% of projects.
- All Ratings are based on the assumption that the research project lends itself to that particular measure.
- Obviously most projects would potentially utilize some but not all tools in the toolbox.
- This PM cannot be applied across the board, as this type of evaluation will not fit all projects. However, we are developing a process which will allow us to perform with regularity B/C on those projects for which B/C and ROI are appropriate.
- This process is currently being employed, and B/C analyses are forthcoming.
- We use general benefit vs. cost ratio as one element in the project and final evaluation of a research project.
- We have not tracked this as a formal research performance measurement.
- We will be developing more performance measurements in this area in the future.
- It is a more general performance measurement used by the agency, but has not been applied directly to research.
- This PM cannot be applied across the board, as this type of evaluation will not fit all projects. However, we are developing a process which will allow us to perform with regularity B/C on those projects for which B/C and ROI are appropriate. This process is currently being employed, and B/C analyses are forthcoming.
- We attempt to quantify triennial dollar benefits vs. costs on all K-TRAN (university research) projects with products or findings that have been implemented. Benefits are accumulated and compared to the total cost of the program to calculate an overall BCR for the K-TRAN Program.
- We would like to establish performance measures in various categories; this would be a likely category.
- Would be valuable. However difficult to generate potential cost savings on most projects.
- This should be added to our program in the future where appropriate.
- The assumptions regarding benefits are often difficult to assess and may be discounted when very favorable B/C ratios are given.
- Material characteristics and performance are subjected to analysis for contentious issues, such as roadway delineation features, e.g. markings or delineators

- I think that this kind of measure can be misleading. Research is no more than information. Economic benefits may result indirectly from research but those benefits are realized by the implementing organization, not the research organization. Second, they tend to overlook or discount those benefits that are harder to quantify, like improved service level, cost avoidance and safety improvements.
- We do a sort of harvest ratio with the projects that we select to evaluate. Given that we complete approximately 50 projects per year we find it most effective to select about half of these projects to evaluate for benefit to cost. We conduct these evaluations on a project-by-project basis.
- "In September 2002, TxDOT's Research and Technology Implementation Office (RTI) was asked by the Texas Transportation Commission to document the value of research by providing information on the return on investment from the research program. The Commission wanted to use the information to demonstrate the benefits of a research program during budget discussions with the Texas Legislature for the upcoming 2003 session. We limited our analysis to TxDOT's 21 top innovations from 1999 to 2001. For the 21 selected, the benefits were estimated over a ten-year return period after the implementation of the product began. The analysis included:

  - Reductions in the number of fatalities occurring on the transportation system
  - Reductions in the number of accidents
  - Operational cost savings for TxDOT (considered as reductions in taxpayer cost for operating, constructing, and maintaining the transportation system).

  This coming fiscal year (beginning 9/2004, RTI will require the university researchers on Research Management Committee (RMC) 3 projects, to submit as a separate deliverable, a project specific estimate of projected benefits (reductions in accidents, reductions in fatalities, and operational cost savings). RMC 3's area of research focuses on environmental, right-of-way, geometric design, and hydraulics issues. This is the first year that the benefits estimation requirement will be in place. If the pilot is successful in RMC 3, the requirement will be adapted in all RMCs for all research projects."
- This may have been a subjective or qualitative criteria for WSDOT Research, rather than quantitative.
- I view this as a valuable tool, but we don't currently use it primarily because of the time it takes to gather all of the information needed to do the calculation and the inherent difficulty in defining and justifying the costs & benefits.
- We have used a cost/benefit ratio in the past, but not on a consistent basis. In general, the negative feedback we have received from using such a measure has been that it is too subjective. However, we have recently picked up the banner again and are using life cycle costing as means for describing the benefit.
- As the department is now using LCCA to determine pavement alternates, this method is more accepted.
- Although we are not using this as a performance measure, we intend to use extensively for project evaluation as part of our infrastructure management system.

- Not suitable in all cases - some benefits and some costs cannot be accurately quantified.
- When the nature of the research lends itself to quantification of costs and benefits, this statistic can be extremely persuasive.
- Assessing long-term benefits, or the portion of benefit directly attributable to research, is difficult.

Lives Saved

- We do not have the resources or knowledge to implement and monitor this performance measure.
- As with item number 1, this is a useful measure if it is accurate.
- This may be hard to prove based on the variability of fatalities each year. But, it would be a very powerful statement to show the value of the research conducted. I would take approximately three years after the study ended to have data in the accident records system to perform an after study analysis. This performance measure may be used by the contract research team to project the impact of their research findings, but it is currently not mandated by our Research group.
- We more typically note improved safety, but don't correlate to fatalities or crashes. Also, our safety folks rather talk about crashes than fatalities due to it being a more reliable value.
- May be difficult to measure in many cases.
- This PM is used at the Departmental level; however, it is not used as a project level measure.
- I anticipate that we will be using lives saved as a formal research performance measure in the future. We have past research that undoubtedly saved lives, but it has not been formally tracked as a research performance measurement.
- This PM is used at the Departmental level; however, it is not used as a project level measure.
- While lives saved are documented on individual research implementation plans as appropriate only the dollar benefits are accumulated and reported on our status reports.
- We would like to establish performance measures in various categories; this would be a likely category.
- Difficult to generate data.
- It is difficult to estimate how many lives a safety research project really saves. This measure could be extremely valuable because safety is the top priority of many DOTs but given the difficulty of determining the number of lives saved/reduced injuries we have not done such calculations.
- Hard to prove. Again, we tend not to claim credit for what our customers are able to accomplish by implementing research results.
- This measurement is used by our Bureau of Highway Safety and Traffic Engineering to measure how our department is doing in meeting the 10% reduction of fatalities and serious crashes goals of TEA-21. We don't use this measure for our research program.

- See comments in #1.
- This may have been a subjective or qualitative criteria for WSDOT Research, rather than quantitative.
- It may be interesting to examine the number of lives we expect to save by implementing the results from a proposed research project, but the difficulty in isolating contributing factors makes it very hard to actually confirm this after completion of a project.
- PROJECTED numbers that never get verified don't really tell us anything about performance.
- We have only had one safety study many years ago that used lives saved as a measure of the effectiveness of the treatments to be employed, not the study.
- We have performance measures based on driver behaviors, but nothing related to highway improvements.
- More appropriate to use in conjunction with total crashes.
- "If the nature of the research and post-research performance monitoring would lend itself to quantification of lives saved, this statistic would be persuasive.
- It is almost impossible to generate this data for a specific research project's cause and effect, so although it would be valuable, it is unrealistic to count on this statistic."
- This is usually done for safety-related research.

Construction, Maintenance & Operations Savings

- Again, we don't have the resources or knowledge
- This is the basis for selecting projects.
- "Showing a cost saving for a given operation change due to research could be performed. The problem is getting the products of research implemented with any regularity.
  The cost of the item for the research is always higher until it gets wide use."
- Usually done only when benefit is clear - around 10% of projects.
- This PM is currently being applied to many projects. The overall goal is to provide information both at the program and at the project level. This PM will increasingly be more systematically and formally be applied.
- I anticipate that we will be using cost savings as a formal research performance measure in the future.
- This PM is currently being applied to many projects. The overall goal is to provide information both at the program and at the project level.
- This PM will increasingly be more systematically and formally be applied.
- These savings are documented on individual project research implementation plans as appropriate but are not reported as a specific category on our status reports.
- We would like to establish performance measures in various categories; this would be a likely category.
- This is somewhat easier to quantify than lives saved. We do not use it very often but hope to make this a required component of more research projects for which this measure could apply.

- Our customer's accomplishment, not ours.
- This measure is used extensively by our highway maintenance and construction organizations. However, we don't use this measure in our research program. Our benefit-to-cost measure does get most of this information for the research program.
- This may have been a subjective or qualitative criteria for WSDOT Research, rather than quantitative.
- We use this as justification to start many research projects, but we are just starting to verify these cost savings AFTER the research has been implemented.
- This type of measure has been used not so much as a measure of study success, but as a way to market the implementation and incorporation into specs.
- We have done various studies related to cost of outsourcing things like maintenance and planning/design/construction supervision.
- When the nature of the research lends itself to quantification of costs and benefits, this statistic can be extremely persuasive.

Reduction in Crashes

- This may be hard to prove based on the variability of fatalities each year. But, it would be a very powerful statement to show the value of the research conducted. I would take approximately three years after the study ended to have data in the accident records system to perform an after study analysis.
- We more typically note improved safety, but don't correlate to number of crashes.
- This PM hasn't been applied to research. In the past, the usefulness of crash reduction factors (CRFs) generally has been limited because of the data. However, this measure will increasingly be applied as a result of the improvements to the Department's CRF database, which has been enhanced as a result of past and ongoing research.
- We have a new research project which is tracking crash rate decreases for an improved safety area for a performance measurement.
- While reduction in crashes are documented on individual research implementation plans as appropriate only the dollar benefits are accumulated and reported on our status reports.
- We would like to establish performance measures in various categories; this would be a likely category.
- This measure does not have the same impact as lived saved but is still very valuable. However, similar issues as with estimating lives saved are difficult to arrive at a crash reduction number that can be attributed to a research project.
- Our customer's accomplishment, not ours.
- This measurement is used by our Bureau of Highway Safety and Traffic Engineering to measure how our department is doing in meeting the 10% reduction of fatalities and serious crashes goals of TEA-21. We don't use this measure for our research program.
- This may have been a subjective or qualitative criteria for WSDOT Research, rather than quantitative.

- While the comments for number 2 are also applicable for this case, it may be easier to collect data for this PM. As we continue to grapple with increasing congestion, this actual reduction of crashes will become increasingly important.
- Never used.
- If the nature of the research and post-research performance monitoring would lend itself to quantification of reduction in crashes, this statistic would be extremely persuasive. It is almost impossible to generate this data for a specific research project's cause and effect, so although it would be valuable, it is unrealistic to count on this statistic.
- This is usually done for safety-related research.

Reduction in System Delays

- Congestion is not a significant problem in Alaska
- Using projection or results of models is a two edge sword. As the warning in the commercial states, actual results may vary.
- In a very congested state like NJ, we have many reasons for delays. Showing projects of expected reduction in delays and actual no reduction or increase can mean a loss of credibility for the research program.
- There are issues of how well you can calculate delays.
- This PM is a general program level PM for the Department; it is not currently a PM for our research.
- We have a new ITS project which is coming on line that targets traffic delay reduction through public information. We will measure the reduction in delays as a performance measurement of the ITS project.
- This PM is a general program level PM for the Department; it is not currently a PM for our research.
- While reduction in system delays are documented on individual research implementation plans as appropriate only the dollar benefits are accumulated and reported on our status reports. (Rarely used to date) We would like to establish performance measures in various categories; this would be a likely category.
- Haven't had this type of project yet. However have upcoming evaluations to conduct that will include delay data, before and after.
- We have done some work trying to quantify and document the benefits of our emergency road side patrols and ITS activities.
- Our customer's accomplishment, not ours.
- This measure is used extensively by our highway maintenance and construction organizations. However, we don't use this measure in our research program. Our benefit-to-cost measure does get most of this information for the research program.
- If appropriate and can be realistically quantified, this is a good measure. However, this measure can be misleading. For instance, a product such as a new traffic control device of signal optimization could result in the aggregate, a huge travel time savings in terms of person-minutes. However, the large savings disaggregated at the person level could only be few seconds; hardly a benefit.

- This may have been a subjective or qualitative criteria for WSDOT Research, rather than quantitative.
- While the comments for number 2 are also applicable for this case, it may be easier to collect data for this PM. Also a good PM for the system user (traveling public).
- We have recently used projected reduction in traffic delays not as measure of a technique or process coming out of research, but for LCCA analysis of alternate design systems.
- On the Alberta highway system (primarily rural) congestion isn't an issue.
- If the nature of the research and post-research performance monitoring would lend itself to quantification of reduction in system delays, this statistic would be persuasive. It is almost impossible to generate this data for a specific research project's cause and effect, so although it would be valuable, it is unrealistic to count on this statistic.
- This is useful in some locations in a rural state like SD, but is not a primary factor everywhere.

Positive Environmental Impact

- It's a very good performance measure but we do not have the resources or knowledge to implement this performance measure.
- Environmental issues are a major part of our program and growing.
- This could be a valuable PM as long as the product of the research is implemented with any frequency.
- We closely monitor how much research effort and money is applied to the environment, both natural and human.
- We have noted the direction such as improved or more environmentally friendly, but have not quantified.
- The number of projects fitting any specific criteria (such as positive environmental impact) would not generally be valuable to a small state like NH where we might only cross into a particular discipline once in a while.
- This is not used as a PM; however, we can readily identify how much of the program is environmental research (i.e. categorized as Environmental Mgt). In addition, other offices conduct research with ancillary environmental benefits (e.g., scour studies dealing with countermeasures that affect turbidity in waterways). We use performance measurements for general environmental improvements, but not for special research environmental projects. I anticipate that we will be developing this research performance measurement in the future.
- This is not used as a PM; however, we can readily identify how much of the program is environmental research (i.e. categorized as Environmental Mgt). In addition, other offices conduct research with ancillary environmental benefits (e.g., scour studies dealing with countermeasures that affect turbidity in waterways).
- The number of projects/products shows the breadth and balance of the program and the ability to respond to a particular category. It is not as critical as the effectiveness of the product when deployed.

- Too many of our environmental studies tend to be evaluated qualitatively. But many environmental projects could be evaluated quantitatively, e.g. amount of pollutant removed, sediment removed, noxious weeds killed, etc.
- Small scale research projects have been undertaken to evaluate mitigation effectiveness and alternate mechanisms to protect wildlife with case specific results. For example, protection of amphibians during a seasonal migration with directed access to safe crossing zones (culverts, pre-cast boxes under the highway) had immediate positive results both in animal fatalities and public relations.
- Our customer's accomplishment, not ours.
- The PennDOT Research Performance Measures Toolbox includes 5 tools. They are: Benefit-to-Cost, Peer Review, Performance Indicators, Customer Surveys, Life-cycle Cost Analysis. This measurement fits within our Performance Indicators tool area. From time-to-time we are asked to show how our research efforts are supporting PennDOT's strategic plan that includes an environmental/quality of life plank.
- We determined in analyzing our top innovations from 1999 to 2001, we did, where appropriate, determine environmental impact savings.
- Especially with wildlife habitat connectivity and with animal crash mitigation.
- This may have been a subjective or qualitative criteria for WSDOT Research, rather than quantitative. A criteria for removing uncertainty in environmental regulatory programs.
- We have done individual environmental research projects that are designed to have specific positive impacts, but we do not have a goal for the number of projects that must do this, nor do we track how many. If there is a specific need, we do the research; if not, we don't.
- We do not break down implemented research by area. We do track implemented projects. We have demonstrated positive environmental impact for several projects, but not as a performance measure.
- At present we do not have a measure with respect to environmental impact.
- It is not clear how to gather these data for a specific research project's cause and effect, so although it appears to be valuable, we have never used this statistic.
- Numbers of projects or products is not considered of prime importance by upper management. They are more concerned with outcome measures, such as dollars of benefits.

Quality of Life Enhancement

- I believe that this will be very subjective and hard to document.
- This is not a PM: projects are not broken out categorically as providing psychological or aesthetic benefits.
- I see this as a potential future research performance measurement. This is a general performance measurement area.
- This is not a PM: projects are not broken out categorically as providing psychological or aesthetic benefits.

- The number of projects/products shows the breadth and balance of the program and the ability to respond to a particular category. It is not as critical as the effectiveness of the product when deployed.
- Haven't had this type of project.
- Quality of Life benefits are very difficult to assess because quality of life is such a nebulous term. What is important to me ma not be as important to others or may have a different level of importance.
- Really hard to measure credibly.
- The PennDOT Research Performance Measures Toolbox includes 5 tools. They are: Benefit-to-Cost, Peer Review, Performance Indicators, Customer Surveys, Life-cycle Cost Analysis. This measurement fits within our Performance Indicators tool area. From time-to-time we are asked to show how our research efforts are supporting PennDOT's strategic plan that includes an environmental/quality of life plank.
- We don't care if people feel good; we just want to move them faster, safer and cheaper. ;-) Seriously, this is a good option to have, but it will require customer surveys to implement. May be useful on certain high profile projects, but probably not economically feasible for most projects.
- We do not break down implemented research by area. We do track implemented projects. This seems to be difficult to quantify other than by anecdotal means.
- This could be complicated because quality of life can mean different things for different people. It is not clear how to gather these data for a specific research project's cause and effect, so although it appears to be valuable, we have never used this statistic.
- Numbers of projects or products is not considered of prime importance by upper management. They are more concerned with outcome measures, such as dollars of benefits.

Safety Enhancement

- Could be a powerful PM to support the value of research program. Here we are talking about the perception of improvements based on the Number of research projects.
- We usually state item will improve safety or enhance it, but do not quantify. In rare cases we are able to quantify impact on specific projects.
- For comments on this item, simply substitute safety for environmental in the answer to #6. Many other offices do research that enhances safety (much more than is the case with environmental research).
- See the answer to question number 4. For comments on this item, simply substitute safety for environmental in the answer to #6. Many other offices do research that enhances safety (much more than is the case with environmental research).
- The number of projects/products shows the breadth and balance of the program and the ability to respond to a particular category. It is not as critical as the effectiveness of the product when deployed.

- It seems that if you can make the case that a research project improves design methodologies in the area of safety that you could go further and estimate the impact on crashes, fatalities and injuries.
- Our customer's accomplishment, not ours.
- The PennDOT Research Performance Measures Toolbox includes 5 tools. They are: Benefit-to-Cost, Peer Review, Performance Indicators, Customer Surveys, Life-cycle Cost Analysis.
- This measurement fits within our Performance Indicators tool area. From time-to-time we are asked to show how our research efforts are supporting PennDOT's strategic plan that includes a highway safety plank.
- Out top innovations benefits analysis focused on reductions in traffic related accidents and fatalities.
- Guardrail impacts.
- This may have been a subjective or qualitative criteria for WSDOT Research, rather than quantitative.
- The number of projects that fall into this category is not as important as the extent of their impact on safety improvements.
- We do not break down implemented research by area.
- We do track implemented projects. Safety enhancement has been concluded on research projects, but not used a measure.
- No measure, but are increasingly paying more attention to the safety aspects of our designs.
- If the nature of the research and post-research performance monitoring would lend itself to quantification of the perception of safety enhancement through surveys, this statistic could be persuasive.
- Numbers of projects or products is not considered of prime importance by upper management. They are more concerned with outcome measures, such as dollars of benefits.

Level of Knowledge Increased

- Development of manuals and direct training is becoming a major part of our research program.
- This PM is decision-maker dependent. We have seen very different emphasis from one group to another after elections.
- In some cases, we state a project will increase level of knowledge on specific projects, but do not quantify.
- We do not do basic research. We do, however, conduct research that enhances our decision-making processes and that provides increased knowledge as an ancillary benefit.
- Not a formal research performance measurement. We do not do basic research. We do, however, conduct research that enhances our decision-making processes and that provides increased knowledge as an ancillary benefit.

- The number of projects/products shows the breadth and balance of the program and the ability to respond to a particular category. It is not as critical as the effectiveness of the product when deployed.
- Haven't used. See this has below average value.
- Most all research projects improve the state of knowledge in the subject area. If I old people that we had 10 research projects that improved the state of knowledge it would not mean much to me, nor do I suspect to them.
- We specifically use this measurement for our LTAP efforts. At the end of each training session we ask the participants to gauge their gain in knowledge from this course.
- This may have been a subjective or qualitative criteria for WSDOT Research, rather than quantitative.
- We carve out a small portion of our budget specifically to support the ODOT Partnered Research Exploration Program (OPREP). These funds are used for basic research activities which may increase the general body of knowledge; however, we do not use the number of projects we fund in this category as a PM for the program.
- We do not break down implemented research by area. We do track implemented projects. We often conduct research for research sake; that is for our own use for future purposes. We do not use as a measure.
- We tend to concentrate on practical research, not just knowledge research. We may use to justify a research project with negative results!
- If the nature of the research and post-research performance monitoring lends itself to qualitative statements of an improved body of knowledge, then this would be cited. It is not clear how persuasive these statements are.
- Numbers of projects or products is not considered of prime importance by upper management. They are more concerned with outcome measures, such as dollars of benefits.

Management Tool or Policy Improvement

- We would probably capture this under #9, Level of Knowledge Increased.
- This is a valuable PM. It works at the customer/bureau manager level. It has not been as powerful at the upper level management level.
- While this is a research area of ours, it has not been a formal performance measurement.
- Not a PM.
- We count products from implemented K-TRAN projects in the following categories: Hardware/Physical Product; Software; Policy Study; Design/Evaluation Procedure; Test Method; and Training Materials.
- The number of projects/products shows the breadth and balance of the program and the ability to respond to a particular category. It is not as critical as the effectiveness of the product when deployed.
- We have highlighted a few projects along these lines in our research newsletter and annual report. We also try to present a research project at each Research Advisory Board meeting and a number of them have fallen under this heading.

- Our customer's accomplishment, not ours.
- During our annual research program development we analyze the level and quality of research effort that we make in policy research. We roughly try to keep this level at around 10%.
- Very hard to quantify.
- This may have been a subjective or qualitative criteria for WSDOT Research, rather than quantitative.
- This is probably the most common tool used to measure the performance of Ohio's research projects; however, we don't typically look at how MANY projects produce these effects, but rather the EXTENT to which each project does. All of our projects are expected to address one or more of these components.
- We do not break down implemented research by area. We do track implemented projects. Not used as a performance measure
- If the nature of the research and post-research performance monitoring lends itself to qualitative statements about policy, design standards, training and/or procedure development, then this would be cited. It is not clear how persuasive these statements are.
- Numbers of projects or products is not considered of prime importance by upper management. They are more concerned with outcome measures, such as dollars of benefits

Public Image Enhancement

- This is also a two edge sword. If the research goes well, the Department takes credit for implementing an improvement. If not is another research project that went astray.
- We routinely try to involve our Public Information Office and therefore the media in our successful research projects.
- This is not a PM, per se. However, the project selection process now identifies projects whose results are expected to be observable to the traveling public. Such projects can be used as public relations opportunities. Other projects that achieve substantial results (e.g., cost savings, safety improvement) can also be marketed. Not a research performance measurement.
- This is not a PM, per se. However, the project selection process now identifies projects whose results are expected to be observable to the traveling public. Such projects can be used as public relations opportunities. Other projects that achieve substantial results (e.g., cost savings, safety improvement) can also be marketed.
- Just the number per se has little value from my perspective. If provided with short descriptions of how the projects enhanced the STA public image, then it would have a higher value.
- This could be very valuable in communicating and marketing the Department or Division's value.
- This could be useful, though we (wrongly) do not toot our horn enough.
- Our customer's accomplishment, not ours.
- We've never been asked to make this assessment. However, we do conduct projects on behalf of our Office of Communications and Customer Relations each year that

are meant to enhance PennDOT's public image. We just don't measure this in any way.
- Projects are selected for actual public benefit--not for enhancing image of STA.
- Other PMs (e.g. crash reductions, safety improvements, dollars saved) indirectly address this issue.
- We have recently conducted a customer satisfaction survey for the department to be used as an instrument to enhance public image.
- We are actually using a variation of this in our Department wide goals.
- If the nature of the research and post-research performance monitoring lends itself to qualitative improvements in public image, then this would be cited. It is not clear how persuasive these statements are, but image improvement is almost always beneficial to an agency and its research program.
- Numbers of projects or products is not considered of prime importance by upper management. They are more concerned with outcome measures, such as dollars of benefits.

Technical Practices or Standards Upgraded

- This is a powerful measure at the customer/bureau manager level.
- Again, there are many projects that do this, which could be identified as such in our tracking database. However, projects aren't categorically identified, as such.
- Has not been used as a formal research performance measurement. Again, there are many projects that do this, which could be identified as such in our tracking database. However, projects aren't categorically identified, as such.
- As a number alone this means very little. A percentage would be better but still conveys little information.
- Our performance indicator tool measures this information.
- This may have been a subjective or qualitative criteria for WSDOT Research, rather than quantitative.
- We combine this with number 10.
- Provides direct feedback with respect to impact of research.
- When the nature of the research lends itself to improving the design processes or contributing new information to technical standards or practices, this fact can be extremely persuasive to decision makers.
- Numbers of projects or products is not considered of prime importance by upper management. They are more concerned with outcome measures, such as dollars of benefits.

Leadership

- This is very similar to #9, Increasing Knowledge
- This is a powerful measure at the customer/bureau manager level.
- As we continue to emphasize that research be strategically focused, the amount of proactive research conducted will likely increase. Most research (as applied)

responds to existing problems. Currently, FDOT does not support basic research (except by supporting federal research).

- Has not been used as a formal research performance measurement. As we continue to emphasize that research be strategically focused, the amount of proactive research conducted will likely increase. Most research (as applied) responds to existing problems. Currently, FDOT does not support basic research (except by supporting federal research).
- This is a good measure for those who are either technically oriented or are wanting to make significant improvements thru research.
- Our program has been somewhat oriented in this direction.
- Our performance indicator tool measures this information.
- This has been a subjective or qualitative criteria for WSDOT Research, rather than quantitative.
- We feel we are leading the pack in a number of transportation research areas; however, we don't perform any work exclusively to maintain our position in the field. This is interesting, but seems to be an extremely subjective thing to measure.
- While we don't count projects in this category, we certainly use in-house developed work to promote the benefits of the research section. We also use this measure for what we call technical assistance projects that we report in our annual report. These are typically informal research that we initiate in response to operational or headquarters problems.
- If the nature of the research and post-research performance monitoring lends itself to a pro-active solution or adding to scientific or technological knowledge in the field, then this would be cited. It is not clear how persuasive these statements are, but we think its impact is similar to that of image enhancement.
- Numbers of projects or products is not considered of prime importance by upper management. They are more concerned with outcome measures, such as dollars of benefits.

Percent of Projects/Products Implemented

- We track both the number of implementation plans we have developed and the measurability of the impact that implementation has.
- This is dependent on the interest of the project managers in implementing a research product verses effecting design/construction project costs or schedule.
- Although this measure may be too broad, any measure on implementation of research findings is among the most important to our programs. This measure does have the problem of being skewed depending upon how a state runs their research. Very short projects to select a needed change for implementation get high marks. Longer term riskier projects don't result in implementation as often, but may have a much higher payoff.
- Some version of this PM will is in the process of being implemented. Most projects (as being applied) are expected to be implemented. However, formal processes weren't in place in the past (implementation was treated as a foregone conclusion for a number of reasons) and are only now being instituted.

- Has not been used as a formal research performance measurement. Some version of this PM will is in the process of being implemented. Most projects (as being applied) are expected to be implemented. However, formal processes weren't in place in the past (implementation was treated as a foregone conclusion for a number of reasons) and are only now being instituted.
- We report the number of projects authorized, projects implemented and projects with implementation in progress. (percentage is not calculated)
- We are under new research management that makes this one of highest priorities of the program. We are reorganizing and developing procedures to incorporate implemented research into all phases of research until the product is a standard for the department.
- Have attempted to implement this PM
- Something we need to be aware of but not used as a performance measure
- This measure sounds good, but ignores the fact that we can learn just as much from a research study that says a solution was not found or that it action should not be taken.
- A better direct measure of what we do and how we do it. Does not require us to take credit for the uses to which our customers are able to put research.
- Our performance indicator tool measures this information.
- RTI reports to our Research Oversight Committee (TxDOT's executive steering committee for research) every six months the status of implementation. We report status on product implementation for the previous five year period. There are three categories reported: implemented, not implementable, and pending. The pending category means the product implementation is planned but not yet begun, or that TxDOT is still waiting on delivery of the product from the researcher.
- This may have been a subjective or qualitative criteria for WSDOT Research, rather than quantitative. Feasibility issues related because projects are incremental and budget for implementation may not be readily available. How is implemented defined?
- We are currently focusing on implementation in the two areas that have the most projects and funding for the department (structures and pavements). We have implementation plans for several (but not all) of the projects completed within the last 3 years in these areas. Ideally, we would like to have a formal implementation plan for every research project. Time and staff are is the biggest constraints.
- We have, under the threat of having to justify our existence, looked at a ratio of projects implemented. More recently under a quality initiative program we have looked at a process review of our implementation process. The committee found that we had implemented 47 percent of our projects.
- We have not done this recently as our present performance measures are more outcome orientated.
- Implementation needs to have greater emphasis
- We have avoided this type of score keeping because the definition of implementation (complete or partial) is not clear and it may not be persuasive statements. Most often, the rule of thumb '20% of the projects generate 80% of the benefits' holds true for transportation research, and nobody knows which 20% will pay off handsomely at the start of each project.

- Numbers of projects or products is not considered of prime importance by upper management. They are more concerned with outcome measures, such as dollars of benefits.

Percent of Projects Completed on Time

- Research is unpredictable, there are many factors that are uncontrollable, sometimes it is better to have a comprehensive research project that lasts a year longer that expected, rather than be caught up in the project being done
- We use university contracts to perform our research. It is often difficult to get the project completed in accordance with the schedule.
- Tracked only as a matter of interest on an occasional basis as an internal audit.
- This ratio hasn't been used as a PM. However, the information is readily available through the tracking database. It may be used for assessing Project Mgr or Principal Investigator performance. It may be used in the future as a PM.
- We are in the process of collecting this data and developing this performance measurement. We will have data this calendar year.
- This ratio hasn't been used as a PM. However, the information is readily available through the tracking database, and it may be used for assessing Project Mgr or Principal Investigator performance. Not being on time has a negative impact on our ability to implement improvements on some projects. Further, some of these projects could reduce resources, so delays may have a significant impact. However, unlike PM for a construction/maintenance program, on time and on budget for research is really not that important. Those research projects for which it is important can be targeted for special attention.
- While not a performance measure we do track all projects for time and money.
- We track time the number of projects completed on time. This is more of a program management measure that does not really get at measuring the reason why we do research. We do it because it easy.
- Again, this measures our efficiency and effectiveness as a research organization
- Our performance indicator tool measures this information. I put of little value on this because I've come to expect time extensions as a standard in the research business
- While we want to get research results in a timely manner and we actively manage our projects to ensure that all milestones are met, I do not feel that this is a particularly useful PM, because it does not address the QUALITY of the results.
- It's good info to have, but it should not drive a program.
- We have avoided this type of score keeping because there does not appear to be strong correlation between project-result value and on-time completion.
- Use of the measure does encourage more timely completion, but we are a long ways from 100% on time.

Percent of Projects Completed Within Budgets

- Projects are paid for on a lump sum basis so very few projects run over budget. In the rare occasion that they do it is based on a valid change in scope of work.

- This would be a very good PM for our unit since all project are completed within the proposal budget unless the Department chooses to add work. For NCDOT, very few projects are not completed within original budget unless scope is increased. For this reason, it is not currently a performance measure for us.
- Tracked as a matter of interest - but more on an occasional audit basis not yearly. no opinion
- This has not been used as a performance measure because supplemental agreements usually represent an expansion of scope, additional requested services, etc., rather than a failure to work within the estimated budget.
- Project by project qualification/analysis would be required to render this a viable PM.
- This is a research performance measurement that will be started soon.
- This has not been used as a performance measure because supplemental agreements usually represent an expansion of scope, additional requested services, etc., rather than a failure to work within the estimated budget. Project by project qualification/analysis would be required to render this a viable PM.
- We do track the money but this is not a performance measure.
- Funding is a constrained resource. In a given year we approve quite a few no-cost extensions, but rarely approve a request for additional money. Consequently this measure would not have much meaning for us because so few projects exceed the budget.
- I don't think this is a number we want to advertise. I also think it could become a counterproductive measure. I take a fairly lenient view of scope and budget changes, on the assumption that if we know what we would find going in, it probably isn't research.
- Our performance indicator tool measures this information. This measure is more useful than timeliness. However, many research projects have tasks added to them because discoveries are made throughout a typical project that can be and are added to existing projects.
- Our research is based on contractual project agreements with universities. The project agreements stipulate a budget amount that the researchers must adhere to.
- Used more subjectively and qualitatively in WSDOT Research, rather than given a numerical value.
- All of our projects are completed within budget unless we authorize additional funds for additional work.
- Generally, all projects are completed within budget except those projects which have been modified to incorporate additional work requested by the project review committee.
- We have avoided this type of score keeping because there does not appear to be strong correlation between project-result value and on-budget completion.

Number of Contractors

- Our resource pool is fairly fixed. We have the ability to contract with 18 primary universities. They can subcontract to other consultant, or universities. Also the number of contractors will be dependent on the number of project let each year.

- Important for diversifying research program content. We have seen a dramatic improvement in research proposals since diversifying the contract universities with which we contract over the last decade.
- Tracked as a matter of interest, but not a goal.
- While the Research Center is conscious of its relationships with its research contractors, especially the state universities in Florida, the number of contractors is not used as a PM.
- We track this, but it is not a formal performance measurement.
- While the Research Center is conscious of its relationships with its research contractors, especially the state universities in Florida, the number of contractors is not used as a PM.
- In our annual report we do a pie graph showing the distribution of contractors (including in-house staff). We like to have some diversity in who conducts our research. Historically it was very concentrated with one university and we have consciously tried to move away from this. In this regard the measure is useful.
- I think this is possibly of significant operational value, not of much external value. It's been a personal goal to expand our stable of investigators and I've encouraged staff to take projects out of state.
- We report monthly through the vehicle of a Dashboard information to our deputy secretary. This information includes a measurement on the number of contractors currently conducting research for PennDOT.
- Used more subjectively and qualitatively in WSDOT Research, rather than given a numerical value.
- Because we have a large number of qualified universities and private researchers in Ohio who are interested in contracting with us, we are diligent in our efforts to ensure open access o all qualified parties. We don't, however, use a formal PM to assess how well we are doing this.
- We do not run a contract program like NCHRP and so do not have any need of this statistic.

Number of Contractor Partnerships

- We do encourage partnerships with other agencies especially resource agencies
- Our goal is to get buy-in on the results.
- Most of the projects are single university contracts-very small % are joint.
- Although important for the reasons described in 17 above, not currently used as a performance measure.
- Tracked as a matter of interest only.
- The nature of partnerships is not uniform: e.g., we have partnerships with two UTCs, a partnership with another university to conduct our LTAP, and a partnership with yet another university to engage in specialized work (it is to be self-sufficient in 5 years, although we'll continue to use it, as needed, thereafter).
- We have these partnerships, but they are not part of a formal research performance measurement.

- Efforts to partner are low in priority compared to other issues. Further, the nature of partnerships is not uniform: e.g., we have partnerships with two UTCs, a partnership with another university to conduct our LTAP, and a partnership with yet another university to engage in specialized work (it is to be self-sufficient in 5 years, although we'll continue to use it, as needed, thereafter).
- This program has always valued partnered research and makes special efforts to find innovative ways to partner.
- I view this measure as similar to the last; a good indirect measure of the quality of a research program, but I do not believe it has much marketing value.
- Report monthly through the vehicle of a Dashboard information to our deputy secretary.
- This information includes a measurement on the number of partnerships currently in place within PennDOT's Research Program.
- Used as a qualitative measure as well as given a quantitative value to leverage other people's money to increase the depth of the WSDOT Research Program.
- This is a requirement for research projects selected for funding under the ODOT Partnered Research Exploration Program (OPREP).
- Affects about 2-3 projects per year. Not really used as a formal PM.
- We encourage these partnerships but have not used as a PM yet.
- We do not run a contract program like NCHRP and so do not have any need of this statistic.
- Partnership is hard to measure. A yes/no criterion doesn't really quantify the strength or value of the partnership.

Percent of Satisfied Customers

- Never directly measured, but satisfactions is very important if people are going to turn to research for help.
- This is probably the best PM.
- Our customers within the NCDOT are the most important indicator of our program. If our customers are happy, and then continually come back to us with more research ideas and with a greater number of requests for assistance, then there is no more powerful indicator of the success of our program. In fact, we currently keep track of the number of current active customers as a performance measure unto itself. We are also looking to enable the customers to define the performance measures for a project on a case-by-case basis at the inception of the project.
- The Research Center is very concerned about customer service, but there are many customer groups: e.g., functional areas, Project Mgrs, researchers, universities/other contractors. No formal surveys have been conducted, but numerous forums have been provided to engage each of these areas in conversation and to gain feedback.
- Not a formal research performance measurement.
- The Research Center is very concerned about customer service, but there are many customer groups: e.g., functional areas, Project Mgrs, researchers, universities/other contractors. No formal surveys have been conducted, but numerous forums have been provided to engage each of these areas in conversation and to gain feedback.

- Some times the only feed back we get is whether the customer is satisfied with the results or not.
- Last year we conducted our first survey of Research Division customers and held a workshop to review the results and identify ideas for improvement in specific areas that were rated lower. This survey was very valuable regarding how we should align our selves work wise and in identifying what is important to others. We like to tout that more than 86% of the respondents are very satisfied with our services, but the real benefit of the survey is identify our performance in more specific areas that we can work on addressing.
- As part of the Planning Section we do a biennial customer satisfaction survey. For the most part it has provided fair and constructive feedback.
- Our Customer Survey tool is specifically designed for this purpose.
- We report this information to the Secretary of Transportation via our Quarterly Dashboard.
- Our research committee structure provides RTI with an adequate feedback mechanism. Also, our research project directors often come from the districts or divisions who will be responsible for implementing the products developed by the research.
- Used as a qualitative as well as quantitative percentage in the past by the WSDOT Research Program.
- The bulk of our PM comes from the results of qualitative surveys distributed to our technical liaisons and researchers. It's good feedback on the project level, but lacks usefulness on the program level.
- We have recently conducted three customer satisfaction surveys that are being analyzed; one each for our DOTD employees, industry partners (contractors, suppliers, governmental agencies, consultants), and our university researchers (more devoted to the research process or the PI experience).
- This is in our provincial business plan.
- If the nature of the research and pre-/post-research customer-satisfaction surveys would lend itself to quantification of satisfied customers, this statistic would be persuasive.
- We haven't used this, but suspect it would have high value.
- Research customers set research priorities and participate in the research. Customers are involved in the research process from the problem identification through product test and evaluation. Research is not complete until the customer is not satisfied.

Contribution of the Overall Mission of the Department

- We have found mission statements to be vague and all encompassing. We now take the approach that the department's performance measures are a more specific representation of the department's mission and that each of our research projects should have the potential to improve at least one department performance measurement.
- This would be good if there was a strategic plan to compare your projects against.

- We conduct very little basic research. All of our projects are driven by the needs of the Department.
- This one seems to be very nebulous.
- All projects contribute to the overall mission. Project ideas develop from within each area requesting research, the areas prioritize the projects, and upper mgt reviews and approves the projects to ensure that they are in line with the Department's strategic direction. Constant improvements are made to this process.
- This has not been a formal research performance measurement, but I anticipate adding this measurement in the near future.
- It should go without saying that this PM should be implicit in any research program. All projects should contribute to the overall mission. In Florida, project ideas develop from within each area requesting research, the areas prioritize the projects, and upper mgt reviews and approves the projects to ensure that they are in line with the Department's strategic direction. Constant improvements are made to this process.
- Seemingly all projects would contribute to the mission of the STA in some way.
- This should be included in our program in the near future.
- We have been trying to better align our research work program to support the goals and objectives in our agency's business plan. As such this is very valuable measure for us. The difficulty in the past has been those projects that do not more directly fit support a goal or objective (e.g. smoother pavements) in a definitive area can always be lumped under a business plan emphasis area of improved efficiency. To help address this issue we modified our problem statement form to request that the submitter identify the specific goals and objective the research project would support. So in essence all of projects will support a goal/objective in the business plan. What may be more important to show is how the project are distributed over the six emphasis areas of the business plan. e.g. safety, mobility, system preservation, customer service, etc.
- Hard to measure. Frankly, our Department's stated mission is a bit of a moving target.
- We report this measurement through our Annual Business Plan.
- Not a formal PM. However, through our research committee structure, the research undertaken by TxDOT is consistent with the overall mission of the department. In theory, 100% of our research contributes to the overall mission of TxDOT.
- Used as a subjective or qualitative assessment as well as quantitative. All projects were expected to contribute to the overall mission of the STA. However no projects are outside of mission, so is it meaningful?
- This is another item that is examined BEFORE the research is funded as opposed to afterwards.
- We have provided measures to our department over the years as we are required to submit measures to the legislature for our programmatic based budget. Generally, the indicators used were on the order of number of projects started, completed and underway. These are not considered to be effective measures. If effective measures were chosen, I would probably change this rating.
- Have not quantified this.
- It is not clear how to gather this type of impact information for a specific research project's cause and effect, so although it appears to be valuable, we have never used this statistic.

- We make a very strong effort to both align our research to the Department's strategic plan and to use our research to inform and influence the plan. I believe we could contribute some unique examples of how this is done.
- The research program is aligned with Department priorities. Each research project is explicitly related to the Departments Guiding Principles that are associated with the overall mission of the Department.

APPENDIX F - Comprehensive List of Research Performance Measures

	Research Performance Measures Presented on Surveys	Definition
1	Construction, maintenance, & operations savings	Total dollar savings in the cost of contracts and agency materials and labor costs (reduction and/or avoidance of costs) during a specified payback period.
2	Percent of satisfied customers	Number of customers reporting satisfied or very satisfied on survey divided by total number of customers surveyed.
3	Reduction in crashes	Projected reduction in number of crashes during a specified payback period based on anticipated or measured effectiveness of the improvement and the total number of crashes attributed to problem prior to the project/product implementation.
4	Lives Saved	Projected # of lives saved based on the number of fatalities associated with the problem prior to the project/product implementation (part of the source data in the problem statement)
5	Return on Investment or Benefit vs. Cost Ratio	Total savings associated with the project or present value of benefits (based on SHA's standard benefit/payback period ex: 10 years) divided by total cost of the project or present value of costs (including implementation costs)
6	Percent of projects/products implemented	Number of projects/products implemented (completely or partially) divided by total number of projects/products during a specific period (according to state standard).
7	Contribution to the overall mission of the department	Number of research projects/products contributing to the overall mission of your transportation department.
8	Safety enhancement	Number of research projects/products improving the design methodologies in regards to safety or the perception of the transportation system safety.
9	Technical practices or standards upgraded	Number of research projects/products improving the design processes or contributing new information to technical standards or practices.
10	Reduction in system delays	Projected reduction in traffic delays during a specified period on the anticipated or measured effectiveness of the improvement.
11	Management & policy improvement	Number of research projects/products improving or informing the department's decision-making process with regards to policy, design standards, training and/or procedure development.
12	Positive environmental impact	Number of research projects/products improving the psychological or physical comfort of the user or enhancing the aesthetic quality of the system or system security.

	Research Performance Measures Presented on Surveys	Definition
13	Leadership	Number of research projects/products providing a pro-active solution or adding to scientific or technological knowledge in the field.
14	Public image enhancement	Number of research projects/products enhancing the public image of the agency.
15	Level of knowledge increased	Number of research projects/products improving the body of knowledge in a specific area(s)) or our decision-making processes.
16	Percent of projects completed on time	Number of projects completed on/before the scheduled completion date divided by total number of projects to have been completed during a specific time period.
17	Percent of projects completed within budget	Number of projects completed within budget divided by total number of projects completed during a specific time period.
18	Number of contractor partnerships	Number of partnerships formed between research entities.
19	Quality of life enhancement	Number of research projects/products improving or protecting the natural environment
20	Number of contractors	Number of unique entities with active research projects during a specific time period.

Nominating Agency	Nominated Research Performance Measure	Comment
South Dakota DOT	Percent of research value performed in house & by contract	Significant impact on staff allocation and budgeting.
South Dakota DOT	Percent of research value performed by DBE/MDE	Track this in regards to Title VI Civil Rights
South Dakota DOT	Average time from research suggestion to contract	Motivates prompt response to research requests
South Dakota & New Hampshire DOTs DOT	Average percent of implementation recommendations adopted	Adopted means recommended actions were authorized by DOT top management. It is measure of whether recommendations are sound, practical, & responsive to DOT needs.
South Dakota DOT	Balance (percent) of research program in general theme areas	Assesses the research program's relative value to all DOT constituencies.
South Dakota DOT	Dollar value of research assigned to each staff member	Aids in staff allocation

Nominating Agency	Nominated Research Performance Measure	Comment
South Dakota DOT	Percent of research addressing local government needs	Measure of our intention to devote attention to local needs.
Louisiana & Colorado DOTs	Customer satisfaction surveys	Results of this survey can be used to modify DOT/SHA processes.
Louisiana & North Carolina DOTs	After action surveys of the project review	Self explanatory
Louisiana DOT	Number of graduate students supported	Important to the university partnerships within the state.
Louisiana DOT	Create a research metrics page for our web site	Snapshot of the research being conducted.
North Carolina DOT	Number of stakeholders or customers	The number of participants is important to our program to illustrate diversity & expand the exposure of the research program to a variety of groups in the DOT. The broader spectrum of participants raises our awareness of methods & serves to propagate a research culture throughout the DOT.
North Carolina & Kansas DOTs	Number of papers written as a result of our program	Supports university objectives to publish, but also elevates national exposure of the program as well as provides a direct measure of technology transfer.
North Carolina & New Jersey DOTs	Number of research projects needs statements submitted	The more ideas that are submitted each year is a good measure of the perception of our program & the belief that research can solve their problems.
New Jersey DOT	Number of personnel from operation units that attend our quarterly meetings	Indication of how the customers throughout the agency value our efforts
Colorado DOT	Number of projects funded divided by number of projects requested	Monitors the participation in the selection process
Iowa DOT	Percent of 511 travel information service implemented	None
Iowa DOT	Percent of current & completed SP&R funded projects tracked	None
Iowa DOT	Percent of remaining SP&R funds recovered from completed projects	None
Iowa DOT	Percent of final research project reports with implementation plans	None
Kansas DOT	Highway user cost savings	None

Nominating Agency	Nominated Research Performance Measure	Comment
Maryland SHA	Number of research reports completed per year	More of an activity measure that anything else, but helped focus on projects which were not being completed & illustrate our progress on the issue
Ohio DOT	Flexibility of program	Measure of our ability to do quick, rapid turnaround projects that provide timely solutions to decision makers is critical for our program.
Pennsylvania DOT	Life-Cycle cost analysis	Return-on-investment over a period of time. Particularly useful for research on construction projects.
Pennsylvania DOT	Peer Review	Investigation of similar projects & performance on these projects with our SHA - useful along with benchmarks
Texas DOT	Percent of researchers' recommendations implemented	Not currently used at DOT

APPENDIX G – Performance Measurement 101 Narration

Welcome to the Performance Measurement 101 tutorial, PM 101.

It is important for the user to understand the basics of performance measurement when using the RPM System. Many users may also benefit from an orientation to the commonly used research performance measures (PMs) and from discussions about the somewhat unique aspects of research performance measurement. To assist first-time users, PM 101 includes an overview of the entire RPM System and information about each of the system tools.

Click on **Next** to proceed through PM 101 from the beginning or on the information of particular interest in the drop-down box below.

RPM System Overview

The RPM System consists of two major components: RPM-Tools and RPM-Web. Each includes a number of resources designed to assist you in calculating the return on research investment. The following chart provides a complete list of the resources available and indicates where to find each one.

The RPM System is composed of a website called RPM-Web located at the website indicated below**,** and RPM-Tools, a CD-ROM designed to complement the website while operating independently. The RPM System allows assessment of performance on an individual research project basis or on an annual research program basis. The RPM System also provides the user with a variety of options for reporting the performance being measured.

RPM-Tools is a collection of resources and automated tools to assist the user in research performance management. These items are linked at appropriate locations to facilitate navigation. The major elements of RPM-Tools are:

Home – Returns you directly to the opening screen of this CD-ROM.

PM 101 – The PM 101 tutorial is an introduction to performance measurement principles, application of these principles to research program activities and products, and general instructions in use of other RPM-Tools.

PM Wizard – The wizard is an analysis tool that offers guidance during the process of selecting research Performance Measures for an agency.

Data Entry – Data entry screens for entering product-level specifics. Only product-level reports can be generated from the RPM-Tools CD.

Benefit Calculation – A catalog of benefit estimation examples from which users can select an automated worksheet for creating their own estimations.

PM Reports – Generate a report summarizing all information entered and created concerning a single research product. The report can be saved for later access or uploaded to RPM-Web.

Resource Links – A listing of sources for statistics and other information frequently needed during benefit estimation.

Glossary – Definitions of important terms used within the RPM System.

RPM-Tools assists the user in assessing performance of a research program, project and/or product. The key tool in this set is the PM Wizard, a decision tree that guides the user through the initial selection of performance measures. There are also user-friendly calculation tools for appropriate performance measures. The user may navigate the decision tree and complete the performance measures which are designated as appropriate for the product.

Information entered or calculated using RPM-Tools cannot be saved to the CD-ROM, but it can be saved to the user's hard drive for later viewing or completion of the work session.

RPM-Web is the dynamic hub of the RPM System. While offering virtually all of the features of RPM-Tools, RPM-Web is the place where agencies store research performance measurement information. RPM-Web also offers a suite of pre-programmed reports that summarize research performance information for individual research projects, categorized groups of research projects, an agency's entire annual research program, or the nationwide annual research program.

Access to the RPM-Web is restricted. Research managers will designate key individuals to enter the necessary agency and research program information. This process is greatly facilitated by periodic downloading of project information from the Research-In-Progress (RIP) database maintained by the Transportation Research Board. RPM-Web allows both direct user input of information and PM calculation, and it also accepts uploaded product-level information from RPM-Tools.

Once an annual research program is established on RPM-Web, authorized individuals may input individual project and product information. Most performance measurement information is introduced into the RPM System at the research project and research product levels. An agency may choose to include and evaluate all of the agency's research projects or only a sub-set of their projects.

Unlike RPM-Tools, multiple users can access project and product information on RPM-Web. A project or product can remain open on RPM-Web until such time as all of the information is entered. Performance measure determinations which are completed are integrated into the program-level assessment for each state agency.

RPM-Tools and **RPM-Web** are designed to allow flexibility in how they may be utilized. Agencies may choose to use both RPM-Web and RPM-Tools internally for calculating performance measurement information. They may alternatively decide to provide RPM-Tools

and/or information-entry access to RPM-Web to their research contractors. Requiring research contractors to estimate potential benefits at the end of their research projects has potential to greatly assist the sponsoring agency in performance measurement.

Necessary project information includes project title, number, total budget, and beginning and end dates. The user also identifies anticipated products to result from each research project. It is at the product level where benefits of implemented research are estimated and a number of performance measurement assessments are performed.

Access to RPM-Web is assigned by the agency research program manager. A log-in and password security system is used. Several levels of access are available for assignment by the research program manager.

The RPM System offers research program managers and agency administrators a powerful means of establishing and maintaining a performance measurement strategy for the agency's research program.

1.0 What is performance measurement?

Defining performance measurement and management

Performance *measurement* may be defined as the act of comparing results to specified standards. These standards may be established internally or imposed by an external entity. Specific performance measures are indicators or metrics that are used to gauge, quantitatively and/or qualitatively, the impact of activities and actions. Collecting quantitative data is the preferred method of measurement. However, uses of qualitative information and hybrid measures have become increasingly popular.

Performance *management* is the use of techniques and processes to set goals, identify appropriate performance measures, assess the impact of initiatives and effectively communicate the information internally and externally. Performance management assists both the operational and strategic planning structure of organizations.

Specific performance measures are indicators, or metrics, used to gauge the impact of activities and actions. These indicators can be quantitative or qualitative, or both.

Why is measuring performance beneficial?

Performance measurement is no longer reserved for organizations seeking to produce a profit or satisfy stockholders. Interestingly, performance measurement has seen its most recent growth in applications such as government programs, non-profit organizations, health care and customer service areas of business. Although quantitative data is still the preferred method of measurement, qualitative information as well as hybrid measures which integrate the two methodologies have become increasing popular.

Performance measurement serves many purposes and can speak to a number of audiences. Performance measurement can be any of the following:

- Program justification
- Communication tool
- Management metric
- Motivational technique
- Feedback mechanism
- Process indicator

In the past, performance measurement has sometimes been saddled with a negative reputation. Activities and output were measured for the sake of measurement and often failed to identify the impact or quality level of a particular operation or process. Performance measures and their associated results were used as negative motivators with employees. Soon the sentiment became that certain jobs were too complex to be measured or related to development activities which were not expected to have performance goals or measurements imposed on the work. The thought was that some things should be exempt from performance measurement.

Even though that argument still exists, it has not stopped progress in the area of performance measurement. With the level of information which is available to stakeholders as well as the general public through mainstream media and the internet, it is critical that we feel comfortable with identifying appropriate performance measures and interpreting the results.

Transportation research is not exempt from the application of performance measures. Stakeholders, such as federal and state agencies which support transportation research, use performance measurement to determine funding allocation as well as a resource for appropriation requests from Congress and state legislators.

2.0 What are the characteristics of a good performance measure? And what are the basic types?

The value of a performance measure to the organization is determined by the extent to which it possesses the following characteristics.

Relevance - The core mission of the organization is impacted by the factor being measured.

Measurability – An objective means of determining tangible degree of success is available. The method used to determine performance or to estimate future impact is straight forward.

Clarity - The meaning and application of the factor being measured are easily understood by both those striving to achieve the standard and by those evaluating performance. Highly technical terminology should be avoided.

Feasibility – It is practical to obtain the necessary information within the resource limitations of the organization.

Credibility – The information being collected and the means of collecting it are plausible to users of the performance information. In order to be credible, performance determinations dependent upon the use of estimations should be based on conservative estimates. These estimations should be provided by the most knowledge personnel available. The source of the estimation must be documented.

Budget Importance – The information being gathered provides useful information to budget decision-makers. Proper resource allocation is a primary management tool for optimizing organizational success.

Impact on Collaboration – The performance measurement provides the means for focusing different organizational entities on a common goal. Major organization objectives usually require cooperative effort between organizational units or programs.

The above characteristics are all desirable for transportation research performance measures. The core mission of a transportation agency could be said to be to provide safe and efficient movement of people and goods. Therefore, transportation research performance measurement ideally will include measurement of factors associated with transportation safety and cost-effectiveness in agency operations.

There are different types of performance measures. Performance measures can be placed into one of five categories. Each performance measure included in the RPM System has been assigned to one of these categories.

Outcome Measures capture the extent of desired results provided by the activity or area being evaluated. Transportation examples of outcome measures are number of lives saved, reduction in number of crashes, and financial savings.

Output Measures count the produced or delivered units derived from an operation being evaluated. Examples of research program output measures include number of technical products being developed and number of environmental products being implemented.

Resource Allocation Measures quantify the deployment of personnel and financial assets. This category of performance measure is usually considered at the program and project levels. Examples of resource allocation measures include the number of research projects addressing specific areas, such as safety or quality of life, and also measures which track contractor demographics.

Efficiency Measures are rates or ratios which compare what is accomplished to the amount of effort or opportunity involved. Examples of efficiency measures are benefit-cost ratio, percent of budget allocated to administrative costs, percent of projects completed within budget, and percent of research products being implemented.

Stakeholder Measures determine the extent that customers are involved and their level of satisfaction. The goal of these measures is to capture the impact of the research program on the intended customer as well as to gage the internal involvement of the agency. Examples of stakeholder measures include percentage of satisfied customers and the number of agency personnel participating in the research program.

Performance measures are often grouped by category in performance measurement reports. It is also helpful to consider performance measures by category during the process of selecting measures for an agency. A set of performance measures which involves only a couple of performance measure categories is unlikely to provide a comprehensive view of performance.

3.0 How does research performance measurement benefit the research program and help the program manager?

Measuring performance can be a powerful tool for the transportation research program manager. Research performance measurement provides four primary benefits for both the research program and the program manager.

Improved Communication – Performance measurement provides a communication tool for articulating research program objectives and the results being obtained.

It is not uncommon for transportation research program managers to have limited opportunities to interface with agency administrators. Also, the turnover rate of top agency administrators increases difficulty in keeping the research program aligned with administration objectives. The process of establishing performance measures often allows direct interaction with top administrators, thereby assuring that desires of administrators are heard and understood. The research program manager is also assured that accomplishments of the research program are communicated appropriately.

Program Justification – Performance measurement documents the value of the research program to the organization.

Transportation research programs receive funding primarily through state legislative action. As state funding levels are usually limited, organizations closely evaluate their allocation of funding between various programs. Documentation of the financial, safety and environmental benefits made possible by the research program can be a critical factor in determining continued funding levels.

By utilizing a performance measurement system which addresses outcome, output, resource allocation, efficiency and stakeholder metrics, a research program can demonstrate the effective use of funding on multiple levels. By

using the different types of measures, the research program can speak to concerns of a diverse set of stakeholders.

Improved Performance – Performance measurement cultivates an environment of accountability where high performance standards are common and achievement of high performance is rewarded.

Performance management has always been an integral part of business operations in the private sector due to the required reporting to stockholders and other stakeholders. Specific industries have developed elaborate systems to assist in managing quality and improving performance. Total Quality Management (TQM), Balanced Scorecard and Six-Sigma are all examples of programs which address performance management and which have successfully improved performance within organizations.

Feedback – Performance measurement provides the research program manager important statistics which allow timely revision of the program.

In addition to tabulating outcomes, such as reduced fatalities and operational financial savings, there are a number of other important statistics for a research program manager to monitor if a healthy research program is to be maintained. Customer satisfaction level is a good example. Customer perceptions will affect the future of the program whether or not the perceptions are correct.

Trends in various performance measure statistics can indicate changes occurring within the program that need to be addressed. For example, should the percentage of projects completed within budget be in a clearly downward trend, the research program manager would be wise to investigate and determine the cause for the trend. Are agency project managers beginning to require work beyond the original work plan? Or perhaps is there evidence that contractor budgeting is weak, thereby causing the problem? Or have some contractors begun showing lower budget estimates to increase the chances of getting the work, but planning to obtain additional funding later? Each of these possible scenarios would require different actions from the program manager to remedy. But the problem developing within the program would likely have gone unnoticed for much longer if not for performance measurement statistics.

4.0 What research performance measures are commonly used?

Definitions and basic information about forty different research performance measures are provided here. Thirty of the performance measures are programmed for automated user assistance should they be selected by the user. The remaining performance measures must be manually entered into appropriate performance reports if they are to be used and reported.

The thirty research performance measures include all of those reported to be commonly used by state transportation agencies in 2004. As discussed in Section 2.0, these

performance measures are each assigned to one of five categories. The short names for all performance measures are listed by category. Click on the short name to obtain the full name, definition and additional information about the performance measure. You may also browse information on all included performance measures by clicking View All PM Tables.

5.0 What performance measurement tools are provided in the RPM System? What will they do for me?

RPM System includes a variety of tools to assist research program managers in establishing and conducting performance measurement within their programs. While most tools within the system are available in both RPM-Tools and RPM-Web, the several exceptions are indicated in the brief tool descriptions provided below.

PM 101 *(available in RPM-Tools only)* – This tutorial is an introduction to performance measurement principles and the application of these principles to research program activities and products. It also provides general instructions in the use of tools available in the RPM System.

PM Selection Wizard *(available in RPM-Tools only)* – The wizard is an analysis tool that offers guidance during the process of selecting research PMs for an agency.

Benefit Estimation Catalog – This catalog provides a series of benefit estimation examples from which users can select an automated worksheet for creating their own benefit estimation.

Resource Collection – The resource collection is a listing of sources for statistics and other information frequently needed during the process of estimating benefits to be derived from research products. The listing is composed primarily of resources that may be found on websites, and URLs are provided for quick access.

Present Worth Calculator – This tool converts future or historical monetary amounts into present-day dollars.

Glossary – The glossary defines important terms used within the RPM System.

Product Report – A report may be generated which summarizes all information entered and created concerning a single research product. This report may be saved outside of RPM-Tools for later access. The information may also be uploaded to RPM-Web.

Project and Program Reports *(available in RPM-Web only)* – This suite of pre-programmed reports allows authorized users to obtain summaries of all information entered or created in RPM-Web concerning a single research project, an entire agency research program, a sub-set of projects from a single agency's research program, and all projects nationwide. This reporting function may be accessed by clicking on the **Reports** tab in the main navigation of RPM-Web.

6.0 How do I get started?

A. Selecting performance measures

A universally ideal set of research performance measures does not exist. The most appropriate set of research performance measures for a given agency may well differ from those of all other state research programs. Each agency has somewhat different goals and visions, and every research program has somewhat different strengths and opportunities. So, there will naturally be uniqueness among the agencies in research performance measurement.

However, there are several performance measures that warrant strong consideration by every research program manager. These include the three outcome performance measures, Lives Saved, Crashes Avoided, and Dollars Saved, all of which are tied closely to the collective mission of AASHTO transportation agencies.

Several factors should be kept in mind during the process of selecting research performance measures for an agency's research program.

- **Alignment with agency strategic objectives –** The set of selected performance measures should include measures which monitor the success of the research program in directly supporting applicable agency goals.

- **Value as a management aide –** Every research program manager depends upon certain "vital statistics" for generally monitoring research program health. These may differ from manager to manager, and they are often monitored informally. These are good candidates for performance measures if it is desired to bring emphasis to them within the organization and to insure their periodic review.

- **Availability of resources to track performance –** Measurement of some performance measures is a time-consuming endeavor. Most programs must prioritize and select only those performance measures of most importance to the agency and the research program manager.

- **Availability of the information necessary to track performance –** There may be performance measures that are used in other states, and that would be great for your agency, except that the data to support it is not readily available in your agency's organization. Look closely at the minimum data inputs required for a performance measure before selecting it for your program.

- **Scope of performance measurement –** Before completing performance measure selection, an important question to ask is if the set of selected performance measures is broad enough in coverage to adequately assess overall program performance. In addition to outcome measures, including one or more efficiency measures, output measures, stakeholder measures, and/or resource allocation measures can assure a much more comprehensive annual analysis of the program.

- **Agency approval process –** Every agency has an established procedure for establishing formal performance measures. Insuring familiarity with this process, particularly regarding the frequency with which revisions might be possible, can help avoid time-consuming errors and frustration in later years.

- **PM Selection Wizard –** The wizard is a tool which can quickly provide the user some suggestions during the process of selecting research performance measures. In addition, the wizard provides the user with information about the relative usefulness of each performance measure in the pre-programmed standard report formats.

B. Selecting performance goals

Establishing appropriate performance goals or targets is just as important as selecting a good set of performance measures. The goals should be challenging yet achievable. Determining levels of performance which will be a challenge yet achievable normally takes some homework and serious consideration.

The first step should be to assess the research program's performance over the past several years in each new performance area being considered. This assessment should be done by those individuals who will make these measurements during the actual measurement process. It is important to discover during this process the degree of difficulty involved with obtaining the necessary information and making the actual measurements. The results during previous years, together with the program manager's assessment of the degree of effort expended to obtain the levels of performance obtained in previous years, will establish a performance baseline for each new performance measure.

The next step is for the research program manager to establish the ultimate performance goals for the program to achieve in new performance measurement areas. The program manager should establish these goals cooperatively with the managers or individuals who will be primarily responsible for goal achievement, whenever this is feasible. The program manager may also wish to consider generally accepted goals, or goals used by other similar agencies. However, this can lead to serious errors in goal selection if basic differences exist between the manager's program and the programs in other agencies.

If current performance is not meeting some of the ultimate goals that were determined in step two, the final step is to assess how long it may practically take to achieve the desired level of performance in each of these areas. It may be that the ultimate goals will require more than one year to achieve. Again, input from those directly responsible should be obtained and considered. Caution should be taken considering the input from those who will be responsible for goal achievement. Highly motivated employees are just as likely to overestimate what achievement is practical as some may be to underestimate it.

Following this three-step process will result in good initial selections for most new performance measure goals.

C. Entering information into the RPM System

There are several ways provided to enter information into the RPM System database. All required information may be directly entered using RPM-Web add/update screens, provided that the user has authorized access to these screens. Additionally, any user of RPM-Tools may enter all information pertinent to a given product into screens provided in RPM-Tools. This information can then be saved outside of RPM-Tools, or the information may be uploaded to RPM-Web if the user has an appropriate RPM-Web access role.

Basic annual research program information must be provided to RPM-Web to establish the annual research program in the system database. This must occur prior to entry of project information for that program. Project information, including identification of anticipated products, must be established prior to entering detailed product information.

Authorized access to RPM-Web is required to enter any information into the system's database. Five of the nine access roles allow entry of certain types of information. The research program manager assigns access roles. All access roles and levels, and their access to RPM-Web add/update screens, are shown below. As can be seen, each research program manager may elect to grant principal investigators and/or contractor administrative offices level two access, which allows entry of certain information for their research projects. However, information entered through these access roles is placed in a pending status until approval by one of two agency roles incorporates it into the RPM-Web database.

User entry of specific research project information is being greatly facilitated by the Transportation Research Board, which is providing periodic downloading of project information from the Research-In-Progress (RIP) database. *For this reason, the agency will benefit considerably from routine and early entry of information on new projects into RIP*. When project information from RIP has been downloaded, the authorized user establishes the downloaded information into the RPM-Web database by simply reviewing and indicating that the information is accurate. This process allows the user to correct potential errors, particularly involving information which matches RPM-Tools uploads to the appropriate RPM-Web project file.

An agency may choose to include and evaluate all of the agency's research projects or only a sub-set of their projects.

Unlike RPM-Tools, multiple users can access project and product information on RPM-Web. A project or product can remain open on RPM-Web until such time as all of the information is entered. Performance measure determinations which are completed are integrated into the program-level assessment for each state agency.

When and how is the data entered into the RPM system?

On an annual basis, the state agency which is the designated transportation research entity will initialize the RPM system for the fiscal year. The data in the system can remain the same from year to year with the exception of the budget, number of projects and fiscal

period. Once this operation is completed, authorized users can begin loading project information into the system.

The agency can enter project and product data at any time during the year. It is recommended that project information be loaded into the system for a fiscal year at the beginning of that year. Adding a project to a program is simple, only requiring the user to enter general project information and answer several questions relative to the anticipated impact of the project. The following is a list of the questions which are presented at the project entry level:

- Is a purpose of the project to improve safety, reducing crashes, injuries or fatalities?
- Is a purpose of the project to reduce the cost of providing the transportation system, thereby saving or stretching tax dollars?
- Is a purpose of the project to positively impact the environment through recycling, improving air quality, or by other means?
- Is a purpose of the project to improve traveler comfort by reducing traffic congestion, improving security, improving ride quality, or by other means?

Once a project has been loaded, the user can identify the products which are associated with the project. The user will indicate whether the deliverable is a product or a report. Additionally, the user will designate the product as being a technical product, a management product, or simply basic knowledge advancement.

After the project is completed, or whenever a product is delivered, the user will re-enter the system to close out the product. Based on the information initially entered at the product and project levels, the user will be prompted with only those questions which are pertinent to the specific product. Once the user closes out the product(s), the project level will need to be completed. The project and product data will be automatically integrated into the program level.

The following sections provide some additional information relative to the particular levels of information in the RPM system.

Entering Program Level Data

The RPM System requires the state agency or a designee to enter information related to the transportation agency, the annual research program, individual projects and specific products. The program level information is set-up on an annual basis and serves as the foundation for all of the information entered relative to a particular fiscal year. Information contained at the program level includes, but is not limited to, the following:

- State agency name
- Contact information for the research program manager
- Overhead or indirect rate
- Number of projects
- Contractor or grantee information
- Total annual research budget

- Total number of project needs submitted for funding consideration
- State agency strategic objectives
- Fiscal year definition

Entering Project Level Data

The project level of the RPM System allows the user to enter the projects which have been designated to be included in the database. The agency decides if all of their funded projects will be included in the systems or only a subset of projects.

Information contained at the project level includes, but is not limited to, the following information items.

- Project title
- Budget amount
- Project period
- Contractor or grantee
- Designation of completion
- Type of project

Entering Product Level Data

The product level of the RPM System allows the user to assign products to a specific project. These products are either considered actual products or reports, which are considered an administrative type of deliverable. The system is designed to integrate product information into the project level and subsequently into the program level. Most of the performance measurement information the user enters into the system is completed at this level. Of the three levels, this level is the most complex because the user may have to calculate benefits based on the implementation strategy as well as assess the specific impact in a number of areas such as traveler comfort, environmental, safety, etc.

Information contained at the product level includes, but is not limited to, the following items.

- Name of product
- Type (report or product and technical, management, or basic knowledge)
- Implementation status of product
- Completion status of product (completed, waived or not complete)
- How product implementation affects safety and/or operational cost
- Calculation of estimated benefits

D. Measuring performance

The RPM System provides for tracking both quantitative and qualitative performance measures. Qualitative measures are converted to quantitative measurement through counting the number of qualitative impacts which are pursued and the number of qualitative products that are implemented.

Most performance measurement information is entered at the project and product levels. Responses to questions at the time of project and product information entry provide the bases for a number of performance measurements. However, the outcome measures must be performed through an estimation of benefits to be obtained from each implemented product.

Benefit estimates should be performed by the most knowledgeable individuals available. These estimates may be performed entirely within the agency sponsoring the research, or they may be performed by the contractor at the request of the sponsoring agency.

Benefits should be estimated conservatively. And it is imperative that sources for statistical information and expert estimates be documented at the time that the estimate is made. Without source documentation, the estimate will not be credible to a questioning user of performance measure information.

A catalog of example benefit estimations with automated worksheets is provided. The user may select an example to follow when creating their own benefit estimate. The user can insert the information relevant to their specific product into the example, and working formulas will determine their benefits. Alternatively, the user may choose to use a blank worksheet provided within the **Benefit Estimation Catalog**.

Additionally, the user will find a **Resource Collection** composed of sources for statistics and other information commonly needed in estimating benefits. Simply go to the Resource Collection and browse the contents, or search by key word to make locating desired information much quicker.

The contents of the Resource Collection are listed by category. The categories are infrastructure, safety, freight transportation, passenger travel, registered vehicles and vehicle-miles traveled, economy and finance, and energy and environment. A resource is listed in multiple categories when appropriate.

Another aide provided to users is **Discount Rate Guidance**. Credible business investment analyses extending over a period of years require use of a discount rate to account for the time value of money. Estimations of monetary benefits being derived from research should also consider the time value of money. Research benefit estimates are the bases of major investment decisions within the agency, just as investment analyses are in private business.

While discount rates in private business usually include a minimum acceptable profit percentage, as established by business owners, non-profit organizations often base discount rates on the interest rate they pay for long-term loans. This interest rate is called their cost of capital. Other agencies base their discount rate on other factors.

It is recommended that each research program manager, in consultation with their agency's financial officer, establish the discount rate to be used in their benefit estimations. The discount rate to be used should be reviewed annually.

Additional information and recommendations concerning discount rate selection may be found at the website of the Office of Management and Budget (OMB) at the URL shown.

A default discount rate of 2.5 percent is shown on the automated benefit estimation worksheets. It was selected based upon the 2005 real discount rates recommended by the OMB for cost-effectiveness analyses.

Historical OMB recommendations for real discount rates may also be found by following the appropriate link provided at the website above.

It is also required during benefit estimation for the estimator to select an **Anticipated Life of Products before Obsolescence**. As when other types of estimates are necessary, three recommendations are made to improve credibility. First, the most knowledgeable person available should make the estimate. Second, that person should make the estimate on the conservative side of the probabilities foreseen. And third, the identification of the person providing the estimate should be documented.

To assist in this estimation, the following table provides suggested ranges from which the useful life of a variety of research product types may be selected. These ranges are provided as guidelines only, and a useful life outside of this range may be used when warranted. The suggested ranges were developed from responses to an opinion survey taken at the 2004 National AASHTO Research Advisory Committee Meeting.

It is understood that the next generation of a technology is often based upon the technology of the product being replaced. Since the next generation technology would not have been possible without the development of the replaced product, the case can be made that some degree of benefits continue to be derived from a given innovation after the product itself has become obsolete. However, for purposes of determining benefits for research performance measurement, benefits should be considered to cease at the point that the specific product becomes obsolete. This principle is also in the spirit of conservatism, thereby increasing credibility.

The **Present Worth Calculator** provided can help the user quickly discount future monetary amounts occurring in future years as well as adjust monetary transactions occurring in prior years. The user simply enters the monetary amounts involved, the year in which each occurs, the desired present worth year, and the discount rate to be used, and the calculator does the rest.

E. Creating performance reports

A series of pre-programmed reports are provided within the RPM System. Access to RPM-Web reports varies according to the access role of the user, as shown in the table below. There are no restrictions to access to reports available within RPM-Tools. The PM Selection Wizard Report and the Individual Product Report are the only reports available within RPM-Tools.

All reports except for the PM Selection Wizard Report may be modified by the report creator. The user has the option to delete any performance measurement data from any performance report by deleting entire rows or entire columns of information from the pre-programmed format. Performance measures which were not selected by the agency will not appear on performance reports created for that agency.

A modified report format on RPM-Web, created by deleting rows or columns of information, is automatically saved for later use by personnel in that agency.

RPM-Web reports displaying performance information may be named and saved to the RPM-Web database by clicking on the **Save Report** button on the report page. These reports may then be accessed by anyone with authorized access. RPM-Tools reports may be saved on the user's computer, outside of RPM-Tools.

Reports generated in RPM-Web and RPM-Tools may be printed by clicking on the **Print Report** button on the report page.

A description of each RPM System report follows.

PM Selection Wizard Report

A listing of performance measures selected for use by an agency may be saved or printed for user convenience. The list is sorted by performance measure category.

Individual Product Report

The default format of this report contains all product information available in the database for a selected research product. This report also displays documentation of benefit estimation sources and calculations.

Individual Project Report

The default format of this report contains all project and product information available in the database for a selected research project.

The primary purpose for this customizable report is to provide the Research Program Manager one or more report formats suitable for either internal research office or to meet the information needs of individuals or organizations external to the research office. A feature of this report, like the Individual Product Report, is that it includes documentation of the method of benefit calculations. In this report, information on each product entered into RPM-Web is displayed.

The sponsoring agency user may also add one or more unique performance measures, goals, and results achieved in free form text fields provided for unique performance measures. The title of the report may also be customized.

The Research Program Manager has the option to save this customized report configuration on RPM-Web to make it available to other system users within his or her

own agency. Upon opening a saved report configuration, an authorized user obtains up to the minute information pertinent to that report unless the report was saved as a static report.

The Research Program Manager may also save a report to their computer for attaching to emails, preserving data reflecting that report date, or otherwise handling. Users from another agency will only be able to access the default format of the Individual Project Report. The default format of this report is the report available from RPM-Tools**.**

Multiple Project Report

The default format of this report contains most project and product information available in the database for each research project sponsored by the requestor's agency.

The primary purpose for this customizable report is to provide the Research Program Manager one or more report formats suitable either for internal research office use or for providing information to individuals or organizations external to the research office.

This report may also be customized to include only projects associated with one or more agency strategic objectives, agency-defined categories, funding type, or national standard categories from the fiscal year being reported. The title of this report may be customized. As with the Individual Project Report, the Research Program Manager may save a configuration of this report on RPM-Web to make it available to other system users within his or her own agency. The user may also save a specific report to his or her computer.

State Research Program Performance Report

The default format of this report contains two tables of information describing the performance of the agency's entire research program for the requested fiscal year. The first table includes program efficiency information; and the second table includes program effectiveness information.

The primary purpose for this customizable report is to provide the Research Program Manager one or more report formats for use in monitoring program performance or for reporting program performance to agency administrators.

The report for a given agency is available only to system users belonging to that agency. The prior fiscal year's performance is displayed along with the requested fiscal year's targeted and actual performance. A user may customize the default report format by eliminating rows or columns of information. The sponsoring agency user may add one or more unique performance measures and results in free-form text fields. The title of the report may also be customized. The Research Program Manager has the option to save this customized report configuration on RPM-Web, to make it available to other system users within his or her own agency, or he or she may save the specific report to their computer.

State Research Program Impact Report

The default format of this report provides information about an agency's research program that is pertinent to three common and primary research program objectives: to save lives, to reduce costs of providing transportation, and to improve quality of life. The default report includes an indication of the amount of research being performed toward each objective, the outputs and outcomes which resulted, and indicators of the efficiency of the agency's entire research program.

This primary purpose for this report is to succinctly provide information needed by decision-makers responsible for requesting or approving an agency's research program funding level.

The report for a given agency is available only to system users belonging to that agency. A user may customize the default report format by eliminating rows or columns of information. The title of the report may also be customized. The Research Program Manager may save this customized report configuration on RPM-Web, to make it available to other system users within his or her own agency, or he or she may save the specific report to their computer.

National Research Program Impact Report

The default format of this report provides information about the effect of the combined state research programs. Like the similar agency-level report, this report focuses on three common and primary objectives of every research program: to save lives, to reduce the costs of providing transportation, and to improve quality of life. The default report includes an indication of the amount of research being performed nationally toward each objective, the outputs and outcomes which resulted, and indicators of the efficiency of the nationwide research program.

The primary purpose for this report is to succinctly provide information needed by the Standing Committee on Research (SCOR) and other national decision-makers responsible for requesting or approving research program funding levels during federal transportation program reauthorization deliberations.

A user may customize the default report format by eliminating rows or columns of information. The title of the report may also be customized. An authorized user may save the created report to their computer. The Research Program Manager may save a customized report configuration on RPM-Web to make it available to other system users within their agency authorized to view this report.

Performance Measure Listing

The thirty research performance measures include all of those reported to be commonly used by state transportation agencies in 2004. As discussed in Section 2.0, these performance measures are each assigned to one of five categories. The short names for all performance measures are listed by category. Click on the short name to obtain the full name, definition and additional information about the performance measure. You may also browse information on all included performance measures by clicking View All PM Tables.

APPENDIX H - PM Selection Wizard Questions, Answer Weights, and Comments

Questions and Optional Response Choices

1. This agency would probably benefit most if in the near future the research program budget was:
   a. increased substantially
   b. increased slightly
   c. maintained
   d. reduced

2. Current sentiment among appropriation decision-makers is that near-future budgets for the research program will most likely be:
   a. increased substantially
   b. increased slightly
   c. maintained
   d. reduced

3. Elected officials and agency administrators who review performance measurement data are probably:
   a. highly focused on eliminating transportation impacts upon the environment
   b. very interested in all transportation-related environmental matters
   c. interested in transportation-related environmental matters
   d. believe that there are many other matters of considerably high importance to the agency

4. This agency's research program currently uses annual customer surveys to measure satisfaction level and the degree that needs are being met:
   a. yes
   b. no, but we are already planning to initiate an annual survey
   c. no, but this is something that we would consider in the future
   d. no, this is not an option that we will consider right now

5. From the list below, indicate *up to four* statistics that the research program manager considers highly important for monitoring contractor/researcher participation and performance quality:
   a. % of research projects that result in implemented products
   b. % of research projects completed on or before originally proposed completion date
   c. % of research projects completed within the originally proposed budget
   d. % of research projects with all reports delivered within one year of project completion date
   e. total number of research contractors with an active project this fiscal year
   f. % of total research program contract dollars that was awarded to minority research contractors this fiscal year
   g. % of total research project funding supporting research performed within the agency (in-house research)

6. From the list below, indicate *up to four* research product types considered to be of highest important to your agency at this time (there is overlap between some of the categories):

a. environmental quality solutions or advancements
b. congestion mitigating solutions or advancements
c. safety solutions or advancements (general, including in work zones)
d. operational cost savings for the agency
e. traveler comfort advancements (ride quality, aesthetics, system security, sign legibility)
f. quality of life advancements (traveler comfort items plus environmental protection and congestion mitigation)

7. From the list below, indicate the research product type of most importance to your agency at this time:

a. basic knowledge advancement (with no immediate application to be implemented)
b. technical advancements which improve quality of transportation system and/or agency operation
c. agency policy and management advancements which improve quality of transportation system and/or agency operation

8. Agency resources available for tracking research program performance are best described as:

a. not a factor in selecting the number and types of performance measures
b. some resources will be diverted from other priorities, as needed, for this high priority activity
c. limited resources are available
d. it's uncertain where the resources could be found

9. From the list below, indicate *each* item which is a current concern and a focus area for improvement in your research program at this time.

a. Quality of research work
b. Timeliness of implementation
c. Timeliness of research completion
d. Adequacy of research program funding

10. From the list below, indicate *up to three* agency performance indicators that are currently of the highest interest to the research program manager or agency administrator.

a. Research office overhead expenses as a percentage of the total research budget.
b. Total number of agency personnel involved in any manner with the agency research program.
c. Percentage of research program customers reporting "satisfied" or "very satisfied" in a customer survey.
d. Number of project needs statements submitted by agency personnel.
e. Number of graduate students financially supported or otherwise involved in the research program.

Table of Weighting Scores Associated with Each Question Response

	Impact Points for Question Responses																																								
PM #	1a	1b	1c	1d	(1c or 1d) & 2a	(1c or 1d) & 2b	(1a or 1b) & 2c	(1a or 1b) & 2d	3a	3b	3c	3d	4a	4b	4c	4d	5a	5b	5c	5d	5e	5f	5g	6a	6b	6c	6d	6e	6f	7a	7b	7c	9a	9b	9c	9d	10a	10b	10c	10d	10e
1	4	3	2	2			3	4																			4						4			4	1				
2	3	2	1	1			2	3																		4							4			3					
3	2	1	1	1			1	2																		4							4			3					
4																									1	2	2	1	1		4		1								
5																								1		1						3	1								
6																														5			1								
7								1	10	4	3	2												4				1	4			1	1								
8								1																	4	2		2	4				1								
9								1																1	1	1		4	4				1								
10	1							2	3	2	1													2	1	1		1	4				1			1					
11	1							2																		4					1		1			1					

Table of Weighting Scores Associated with Each Question Response (cont.)

12	**1**							**2**																			**4**				**1**		**1**			**3**	**1**				
13																														**5**	**1**	**2**		**2**							
14																																									**10**
15	**2**	**1**					**1**	**2**																			**4**									**3**	**1**				
16	**2**	**1**					**1**	**2**																		**4**		**1**	**1**												
17	**2**	**1**					**1**	**2**	**3**	**2**	**1**													**2**	**1**	**1**		**1**	**4**			**1**									
18																					**10**	**2**																			
19																						**10**																			
20																							**10**																		
21	**2**	**1**					**1**	**4**																			**4**						**4**			**4**	**1**				
22																											**4**						**1**			**1**	**10**				
23	**2**	**1**																									**1**									**4**	**1**				
24																	**10**																**4**	**1**	**1**						

Table of Weighting Scores Associated with Each Question Response (cont.)

25																		10															1	1	4						
26																			10								1						1				1				
27																				10													1	4	1						
28																							1															10			
29																																								10	
30													10	10	3													2	2				2	1					10		

Note: Question 8 responses do not impact selection of individual PMs. These responses assist in analysis of selected sets of PMs at the conclusion of the wizard.

PM Selection Wizard Comments and Triggers

Trigger	Displayed Comment
Question 4 – Response d. selected, and Customer Satisfaction Level is manually selected as a performance measure.	You indicated in a question response that your agency will not consider initiating customer surveys at this time. Your selection of the Customer Satisfaction Level performance measure may require that you initiate a customer survey.
Question 4 – Response c. selected, and Customer Satisfaction Level is manually selected as a performance measure	You indicated in a question response that customer surveys are not something that your agency is considering at this time. Your selection of the Customer Satisfaction performance measure may require that you initiate a customer survey.
Question 8 – Response c. selected, and PM selections include #1, #2, #3 and #21 and more than 12 total PMs were selected.	You indicated that resources are limited for tracking research program performance. The group of performance measures that you have selected may prove difficult to track within available resources.
Question 8 – Response d. selected, and PMs selections include #1, #2, #3 and #21.	You indicated that resources are very limited for tracking research program performance. The group of performance measures that you have selected may prove difficult to track within available resources.
#21 is selected.	Accuracy of the annual program benefit-cost ratio is improved by increasing the number of projects for which cost-saving benefits have been estimated.
#1 is not selected.	You have not selected Agency Costs Saved, which is one of the key performance measurements to be aggregated at the national level. You may wish to consider determining and entering this information into RPM Web even if it is not a formally used performance measures within your agency.
#2 is not selected.	You have not selected Lives Saved, which is one of the key performance measurements to be aggregated at the national level. You may wish to consider determining and entering this information into RPM Web even if it is not a formally used performance measures within your agency.
#3 is not selected.	You have not selected Reduction in Crashes, which is one of the key performance measurements to be aggregated at the national level. You may wish to consider determining and entering this information into RPM Web even if it is not a formally used performance measures within your agency.
Performance measures are selected in only three or less of the five PM categories.	You have selected performance measures in less than four of the five categories. A broader assessment of research program performance is obtainable by selecting at least one performance measure in additional categories.
At least one performance measure is selected in each of the five PM categories.	You have selected at least one performance measure in each of the five categories, which tends to assure a broader assessment of program performance.

APPENDIX I – Resource Collection Items

Title Air Pollutant Emission Trends
Publisher U.S. Environmental Protection Agency
Description The National Air Pollutant Emission Trends report presents the estimate of national emissions of the criteria air pollutants. The emissions of each pollutant are estimated for many different source categories, which collectively account for all anthropogenic emissions. The report presents the total emissions from all 50 states. These estimates are updated annually. The emission trends are the net effect of many factors, including changes in the nation's economy and in industrial activity, technology, consumption of fuels, traffic, and other activities that cause air pollution. The trends also reflect changes in emissions as a result of air pollution regulations and emission controls.
Data URL http://www.epa.gov/ttn/chief/trends/index.html

Title Airport Activity Statistics of Certificated Air Carriers: Summary Tables
Publisher U.S. Department of Transportation, Bureau of Transportation Statistics
Description The Bureau of Transportation Statistics (BTS) Airport Activity Statistics of Certificated Air Carriers: Summary Tables presents summary data for all scheduled and nonscheduled service by large certificated U.S. air carriers—including the volume of passenger, freight, and mail enplanements, and aircraft departures for each airport served each year.
Data URL http://www.bts.gov/publications/airport_activity_statistics_of_certificated_air_carriers/

Title Annual Energy Review
Publisher U.S. Department of Energy, Energy Information Administration
Description The Annual Energy Review (AER) is the Energy Information Administration's primary report of historical annual energy statistics. For many series, data begin with the year 1949. Included are data on total energy production, consumption, and trade; overviews of petroleum, natural gas, coal, electricity, nuclear energy, renewable energy, international energy, as well as financial and environmental indicators; and data unit conversion tables.
Data URL http://www.eia.doe.gov/emeu/aer/

Title Annual Update on the Automotive Fuel Economy Program
Publisher U.S. Department of Transportation, National Highway Traffic Safety Administration
Description This annual report summarizes the fuel economy performance of the current vehicle fleet and highlights the activities of the National Highway Traffic Safety Administration (NHTSA), during the calendar year. This report also includes a section summarizing rulemaking activities.
Data URL http://www.nhtsa.dot.gov/cars/rules/CAFE/updates.htm

Title Appendix C: Discount Rates for Cost-Effectiveness, Lease-Purchase, and Related Analyses for OMB Circular No. A-94

Publisher The Executive Office of the President, Office of Management and Budget

Description Includes both Nominal Discount Rates and Real Discount Rates._
Nominal Discount Rates includes a forecast of nominal or market interest rates for 2005 based on the economic assumptions from the 2006 Budget. These nominal rates are to be used for discounting nominal flows, which are often encountered in lease-purchase analysis._
Real Discount Rates includes a forecast of real interest rates from which the inflation premium has been removed and based on the economic assumptions from the 2006 Budget. These real rates are to be used for discounting real (constant-dollar) flows, as is often required in cost-effectiveness analysis.

Data URL http://www.whitehouse.gov/omb/circulars/a094/a94_appx-c.html

Title Benefit-Cost Analysis

Publisher California Department of Transportation

Description Benefit-Cost Analysis, also sometimes referred to as Cost-Benefit Analysis, is a systematic process for calculating and comparing benefits and costs of a project for two purposes:_
- to determine if it is a sound investment (justification/feasibility)
- to see how it compares with alternate projects (ranking/priority assignment)_
This web site leads users, step by step, through the process of benefit-cost analysis, explaining concepts and describing methodologies.

Data URL http://www.dot.ca.gov/hq/tpp/offices/ote/Benefit_Cost/index.html

Title Binational Border Transportation Planning & Program Process Phase I: Task 2. U.S. Report - Inventory of Transportation Facilities

Publisher U.S. Department of Transportation, Federal Highway Administration

Description This report is an overview of the U.S./Mexico binational border transportation facilities located on the U.S. side of the border. The inventory of binational transportation facilities considers five modes of transportation: roadways, railroads, seaports, airports, and pipelines. In addition, the inventory documents the socioeconomic and demographic characteristics of the border region (California, Arizona, New Mexico, and Texas).

Data URL http://www.fhwa.dot.gov/binational/reports/task2/task2us.html

Title Boating Statistics

Publisher The U.S. Coast Guard

Description The annual Boating Statistics publication contains statistics on numbered boats and recreational boating accidents, and information on boating safety activities in the fifty states, five U.S. territories and the District of Columbia for the calendar year.

Data URL http://www.uscgboating.org/statistics/accident_stats.htm

Title Census Transportation Planning Package (CTPP)
Publisher American Association of State Highway and Transportation Officials
Description The CTPP Profiles contain selected transportation-related data items from Census. The sheets are published for all states and counties, and for all minor civil divisions in the six New England states. Data covered includes: Population, Household Size, Vehicles Available, Workers by Sex, Means of Transportation to Work, Travel Time to Work, and Time Leaving Home to Go to Work.
Data URL http://ctpp.transportation.org/home/default.htm

Title Commercial Construction Cost Estimator: Preliminary Service Estimate
Publisher The McGraw-Hill Companies, Inc.
Description A square foot based online construction estimating tool. After a few critical pieces of data (Project Name, Project Address, Project Parameters - Total Square Feet & Total Floor Count) is entered, an online result displays a localized square foot cost and total cost for the project.
Data URL http://costest.construction.com/cest/
Notes Login is required to access this web site.

Title Commodity Flow Survey
Publisher U.S. Department of Transportation, Bureau of Transportation Statistics
Description The Commodity Flow Survey (CFS) series produces data on the movement of goods in the United States. It provides information on commodities shipped, their value, weight, and mode of transportation, as well as the origin and destination of shipments of manufacturing, mining, wholesale trade, and select retail trade industries, namely, electronic shopping and mail-order houses. The CFS captures data on shipments originating from select types of business establishments located in the 50 states and the District of Columbia.
Data URL http://www.bts.gov/publications/commodity_flow_survey/

Title Congestion Data for Your City: Base Statistics for the 85 Urban Areas
Publisher Texas Transportation Institute
Description This spreadsheet provides basic statistics and ranking for 85 urban areas in terms of the following by Year (1982 to 2002): Population; Urban Area Size; Population Density; Peak Period Travelers; Daily Vehicle-Miles of Travel and Lane-miles of Freeway and Principal Arterial Street; Daily Vehicle-Miles of Travel and Centerline Miles of Total System; Annual Passenger-miles and Annual Unlinked Passenger Trips of Public Transportation; Value of Time; Average State Fuel Cost; Total Delay; Annual Hours of Delay; Percent of Delay due to Incidents; Travel Time Index; Annual Delay Saved by Operations and Public Transportation; Congested Travel; Congested System; Number of Rush Hours; Annual Lane-miles, Daily Transit or Carpool Riders Needed To Maintain Constant Congestion Level; Annual Excess Fuel Consumed; and Annual Congestion Cost.

Title Cost Index in 20 Cities
Publisher The McGraw-Hill Companies, Inc.
Description The city indexes use local prices for portland cement and 2 X 4 lumber and the national average price for structural steel. The city's BCI uses local union wages, plus fringes, for carpenters, bricklayers and iron workers. The city's CCI uses the same union wages for laborers.
Data URL http://enr.construction.com/features/coneco/subs/default-city.asp

Title Cost Indexes
Publisher The McGraw-Hill Companies, Inc.
Description ENR publishes both a Construction Cost Index (CCI) and Building Cost Index (BCI) that are widely used in the construction industry. This web site contains an explanation of the indexes methodology and a complete history of the 20-city national average for the CCI and BCI. Both indexes have a materials and labor component. In the second issue of each month ENR publishes the CCI, BCI, materials index, skilled labor index and common labor index for 20 cities and the national average. The first issue also contains an index review of all five national indexes for the latest 14 month period.
Data URL http://enr.construction.com/features/conEco/subs/default.asp

Title Count, Area, Length of Bridges by Highway System
Publisher U.S. Department of Transportation, Federal Highway Administration
Description Includes Length, Area, and number of Bridges, Structurally Deficient Bridges, Functionally Obsolete Bridges, and Deficient Bridges by State and Functional Classification (Rural Principal Arterial - Interstate, Rural Principal Arterial - Other, Rural Minor Arterial, Rural Major Collector, Rural Minor Collector, Rural Local, Urban Principal Arterial - Interstate, Urban Principal Arterial - Other Freeways or Expressways, Urban Other Principal Arterial, Urban Minor Arterial, Urban Collector, and Urban Local) for 2001-present.
Data URL http://www.fhwa.dot.gov/bridge/fc.htm

Title County Employment and Wages
Publisher U.S. Department of Labor, Bureau of Labor Statistics
Description Includes establishments, employment, and wages by state and country (for the 318 largest counties).
Data URL http://www.bls.gov/news.release/cewqtr.toc.htm

Title Crash Outcome Data Evaluation System (CODES)
Publisher U.S. Department of Transportation, National Highway Traffic Safety Administration
Description The CODES Project seeks to develop the capability to link state crash and medical outcome data to identify the medical and financial consequences of motor vehicle crashes. Linked data identify the types of injuries and the costs that result from specific driver, vehicle, and crash characteristics.
Data URL http://www-nrd.nhtsa.dot.gov/departments/nrd-30/ncsa/CODES.html

Title Crash Profile Summary Report for the 50 States and the District of Columbia
Publisher U.S. Department of Transportation, Federal Motor Carrier Safety Administration
Description Includes summarized crash statistics for large trucks and buses involved in fatal and non-fatal crashes that occurred in the United States by state. These statistics are derived from two sources: the Fatality Analysis Reporting (FARS) and the Motor Carrier Management Information System (MCMIS).
Data URL http://ai.volpe.dot.gov/CarrierResearchResults/HTML/CrashSummary_May2003/CrashSummarynew.htm

Title Davis-Bacon Wage Determinations by State
Publisher U. S. Government Printing Office
Description Includes construction labor rates issued by the U.S. Department of Labor under the Davis-Bacon and related Acts. The rates are listed by state, then, county and type of construction (Building, Heavy, Highway, and Residential).
Data URL http://www.gpo.gov/davisbacon/allstates.html

Title Deficient Bridges by State and Highway System
Publisher U.S. Department of Transportation, Federal Highway Administration
Description Includes number of Deficient Bridges by State and Highway System (NHS Bridges, Non NHS Bridges, and All Bridges) for 1992-present.
Data URL http://www.fhwa.dot.gov/bridge/deficient.htm

Title The Economic Impact of Motor Vehicle Crashes, 2000
Publisher U.S. Department of Transportation, National Highway Traffic Safety Administration
Description This report presents the results of an analysis of motor vehicle crash costs in the United States in the year 2000. Contents include Human Capital Costs (Market Productivity, Household Work Loss, Travel Delay, Medical Care, and Costs Derived from Medical and Work Loss Costs), Incidence (Fatalities, Nonfatal Injuries, Property Damage Crashes, Unreported Crashes and Injuries, Uninjured Occupants in Injury Crashes, and Crashes), Alcohol Costs (Fatalities, Nonfatal Injuries, Underreported Alcohol, BAC Levels, PDO Crashes, Uninjured Occupants, Alcohol-Involved Crash Costs, and Alcohol Crash Causation), State Costs (Economic Costs Due to Motor Vehicle Crashes by state), Speeding (Speed-Related Crash Costs and Incidence), Safety Belt Use (Impact of Safety Belt Use on Motor Vehicle Casualties and Economic Costs for 1975-2000), Source of Payment (Estimated Source of Payment by Cost Category - Medical, Emergency Services, Market Productivity, HH Productivity, Insurance Admin, Workplace Costs, Legal/Cour, Travel Delay, and Property Damage)
Data URL http://www.nhtsa.dot.gov/staticfiles/DOT/NHTSA/Communication%20&%20Consumer%20Information/Articles/Associated%20Files/EconomicImpact2000.pdf

Title Emergency Vehicle Accident Study
Publisher U.S. Department of Transportation, Federal Highway Administration, ITS Joint Program Office
Description This report examined emergency vehicle accident data rates before and after installation of emergency vehicle traffic signal preemption systems (Opticom) in St. Paul, Minnesota. A data table listing Number of Emergency Vehicle Accidents, Total Emergency Alarms, Number of Signalized Intersections, Number of Intersections With Opticom from 1962 through 1976 is included.
Data URL http://www.benefitcost.its.dot.gov/its/benecost.nsf/0/6924914edc61ecff85256b22004b3efa?OpenDocument

Title ENR's Common Labor Index
Publisher The McGraw-Hill Companies, Inc.
Description The Common Labor Index is the labor component of ENR's Construction Cost Index and tracks the union wage, plus fringe benefits, for laborers.
Data URL http://enr.construction.com/features/coneco/subs/04-commonLaborIndex.asp

Title ENR's Construction Materials Price Indexes
Publisher The McGraw-Hill Companies, Inc.
Description Prices in this index are updated monthly by ENR's price reporters who call a single source for each product in 20 U.S. cities. The price represents that paid by a contractor for a specified large order. Monthly prices appear on the following weekly rotating cycle:_
- Week one has prices for 21 products covering asphalt, cement, aggregates, concrete, brick, concrete block and mason's lime._
- Week two has prices for 20 pipe products covering reinforced concrete pipe, corrugated steel pipe, vitrified clay pipe, PE underdrain, PVC sewer and water pipe, ductile iron pipe and copper water tubing._
- Week three has prices for 18 products covering lumber, plywood, plyform, particle board, gypsum wallboard and insulation._
- Week four has prices for 16 products covering structural steel, reinforcing bar, steel plate, metal lath, aluminum sheet, stainless steel sheet and plate and H-piles.
Data URL http://enr.construction.com/features/conEco/subs/default_week1.asp

Title ENR's Materials Price Index
Publisher The McGraw-Hill Companies, Inc.
Description The Materials Cost Index is the materials component of ENR's building and construction cost indexes. It tracks the weighted price movement of structural steel, portland cement and 2 X 4 lumber.
Data URL http://enr.construction.com/features/coneco/subs/04-materialPriceIndex.asp

Title ENR's Skilled Labor Index
Publisher The McGraw-Hill Companies, Inc.
Description The Skilled Labor Index is the labor component of ENR's Building Cost Index and tracks union wages, plus fringe benefits, for carpenters, bricklayers and iron workers.
Data URL http://enr.construction.com/features/coneco/subs/04-skilledLaborIndex.asp

Title Equipment Rental Rate Information
Publisher California Department of Transportation
Description This web site includes current and retrospective data on equipment rental rates.
Data URL http://www.dot.ca.gov/hq/construc/equipmnt.html

Title Estimating Information: Average Low Bid Unit Price
Publisher Texas Department of Transportation
Description This web site includes average low unit bid prices for highway construction and maintenance projects statewide and by district.
Data URL http://www.dot.state.tx.us/business/avgd.htm

Title Fatality Analysis Reporting System (FARS)
Publisher U.S. Department of Transportation, National Highway Traffic Safety Administration
Description The Fatality Analysis Reporting System (FARS) contains data on all vehicle crashes in the United States that occur on a public roadway and involve a fatality. This FARS Query System provides interactive public access to fatality data through this web interface. Each crash has more than 125 different coded data elements, grouped by Crashes, Persons, Vehicles, and Drivers, that characterize the crash, the vehicles, and the people involved.
Crashes include data elements such as the time and location of the crash, whether a school bus was involved, the number of vehicles and people involved, weather conditions, and so on.
Vehicles include data elements such as the vehicle type, role in the crash, initial and principal impacts points, and the most harmful event.
Drivers include data elements such as the driver's record and license status, Previous DWI Convictions, and Violations Charged.
Persons include data elements such as their age and gender, their role in the crash (driver, passenger, non-motorist, or unknown), alcohol and drug involvement, injury severity, restraint usage, and so on.
Data URL http://www-fars.nhtsa.dot.gov/

Title Federal Minimum Wage Rates, 1955–2004
Publisher Information Please
Description Includes Federal Minimum Wage for 1955-2005 in Current Dollars and Constant (1996) Dollars.
Data URL http://www.infoplease.com/ipa/a0774473.html

Title FRA Office of Safety Analysis
Publisher Federal Railroad Administration

Description This web site provides access to railroad safety information including Accident/Incident Trends such as Train Accidents, Employee on Duty Casualties, Trespasser Casualties; Casualties such as Casualties By State, Railroad or Type; Highway-Rail Crossing Accidents such as Highway/Rail Incidents By State/Railroad; FRA Inspections, and Highway-Rail Crossing Inventory data by state, county, and city.

Data URL http://safetydata.fra.dot.gov/officeofsafety/

Title Freight Analysis: Data Sources

Publisher U.S. Department of Transportation, Federal Highway Administration

Description This web page provides links to major sources of national freight transportation data.

Data URL http://ops.fhwa.dot.gov/freight/freight_analysis/data_sources.htm

Title Freight Analysis Framework (FAF)

Publisher U.S. Department of Transportation, Federal Highway Administration

Description The Freight Analysis Framework (FAF) provides detailed information on freight flows for the truck, rail, water, and air modes and for various commodities among states, regions, and major international gateways. It also forecasts freight activities for 2010 and 2020.

Data URL http://ops.fhwa.dot.gov/freight/freight_analysis/faf/

Title Freight Analysis Framework (FAF): State Profiles

Publisher U.S. Department of Transportation, Federal Highway Administration

Description The state profiles highlight the relationship of freight movement for each state. They provide a brief overview of current and forecasted tonnage and truck volumes. Each state profile includes 2 tables and 4 figures.
Table 1 presents information on freight shipments that have either an origin or a destination in the state.
Figures 1 and 2 show freight flows on the highway and rail modes.
Figures 3 and 4 show the expected growth of truck traffic throughout the state over the next 20 years.
Table 2 shows the top five commodity groups shipped to, from, and within the state by all modes.

Data URL http://ops.fhwa.dot.gov/freight/freight_analysis/state_info/state_profiles.htm

Title Freight Analysis Framework (FAF): Truck Tonnage by State

Publisher U.S. Department of Transportation, Federal Highway Administration

Description Includes truck tonnage and ratio of Leaving, Entering, Within, Through, and Total for 1998 and 2020 by state. The tonnage totals are derived from the tonnage origin and destination estimates found in the Freight Analysis Framework (FAF) database. The number for each state's "through" tonnage is estimated by using "through truck FAF vehicle miles traveled (VMT)." The ratio of "through truck FAF VMT" to "leaving/entering/within truck FAF VMT" for each state is then applied to the "leaving/entering/within FAF tonnage" to generate the "through FAF tonnage."

Data URL http://ops.fhwa.dot.gov/freight/freight_analysis/faf/tons_truck_state.htm

Title Freight Analysis: Information by State

Publisher U.S. Department of Transportation, Federal Highway Administration

Description This page provides a drop-down list and a state map for you to choose a state for information on its commodity flows, truck fleet characteristics, other aspects of freight transportation, and truck size and weight enforcement activities. Points of contact in state DOTs and links to other valuable Web sites are also provided.

Data URL http://ops.fhwa.dot.gov/freight/freight_analysis/state_info/index.htm

Title Government Transportation Financial Statistics

Publisher U.S. Department of Transportation, Bureau of Transportation Statistics

Description Government Transportation Financial Statistics (GTFS) consists of transportation revenues and expenditures for Federal, state and local governments. In addition, the GTFS contains Federal transportation grants, budget authority, and obligations. The data goes back as far as to 1977. The searchable database allows users to generate customized GTFS tables, and the mapping application allows users to generate customized maps of state and local government revenues and expenditures for all 50 states and the District of Columbia.

Data URL http://www.bts.gov/publications/government_transportation_financial_statistics/

Title HBRRP Fund Transfers to the NHS and STP

Publisher U.S. Department of Transportation, Federal Highway Administration

Description Includes Highway Bridge Replacement and Rehabilitation Program (HBRRP) fund transfers to National Highway System (NHS) and Surface Transportation Program (STP) by State and Fiscal Year for 2001-present.

Data URL http://www.fhwa.dot.gov/bridge/transfer.htm

Title Highlights of the 2001 National Household Travel Survey

Publisher U.S. Department of Transportation, Bureau of Transportation Statistics

Description This report presents selected highlights from the 2001 National Household Travel Survey (NHTS) on daily and long-distance passenger travel in the United States. The report has three main content areas:
- travel-related characteristics of households and individuals in the United States,
- characteristics of daily trips taken in the nation, and
- characteristics of long-distance travel by people. _

This report also includes a methodological section that provides details on data collection, methodological constraints, and the computation of standard errors for estimates in this report. There is also a glossary of travel-related terms used in this report. Appendix A provides tables with estimates that were used in the text and figures, along with their associated standard errors.

Data URL http://www.bts.gov/publications/highlights_of_the_2001_national_household_travel_survey/

Notes The National Household Travel Survey web site is at http://www.bts.gov/programs/national_household_travel_survey/

Title Highway Bridge by Owner
Publisher U.S. Department of Transportation, Federal Highway Administration
Description Includes number of Bridges, Structurally Deficient Bridges, Functionally Obsolete Bridges, and Deficient Bridges owned by State and agencies by year (from 1992-present).
Data URL http://www.fhwa.dot.gov/bridge/owner.htm

Title Highway Safety Information System
Publisher U.S. Department of Transportation, Federal Highway Administration, Turner Fairbank Highway Research Center
Description A multi-state database that contains crash, roadway inventory, and traffic volume data for a select group of States - California, Illinois, Maine, Michigan, Minnesota, North Carolina, Ohio, Utah, and Washington.
Data URL http://www.hsisinfo.org/

Title Highway Statistics
Publisher U.S. Department of Transportation, Federal Highway Administration
Description The Highway Statistics Series consists of annual reports containing analyzed statistical data on motor fuel; motor vehicles; driver licensing; highway-user taxation; State and local government highway finance; highway mileage, and Federal aid for highways. This data is presented in tabular format as well as selected charts and has been published each year since 1945.
Data URL http://www.fhwa.dot.gov/policy/ohpi/hss/

Title Interactive Highway Safety Design Model (IHSDM)
Publisher U.S. Department of Transportation, Federal Highway Administration, Turner Fairbank Highway Research Center
Description The Interactive Highway Safety Design Model (IHSDM) is a suite of software analysis tools for evaluating safety and operational effects of geometric design decisions on two-lane rural highways. It currently includes five evaluation modules (Crash Prediction, Design Consistency, Intersection Review, Policy Review, and Traffic Analysis). A sixth module (Driver/Vehicle) is under development. This Web site summarizes the capabilities and applications of the IHSDM evaluation modules.
Data URL http://www.tfhrc.gov/safety/ihsdm/ihsdm.htm

Title Journey to Work and Place of Work
Publisher U.S. Census Bureau
Description This web site includes data on Means of Transportation to Work, Travel Time to Work, Time Leaving Home to Go to Work, Private Vehicle Occupancy, and Travel to Work Characteristics. Data are available by state, county, and city (for 50 largest cities).
Data URL http://www.census.gov/population/www/socdemo/journey.html

Title Life-Cycle Benefit-Cost Analysis Model
Publisher California Department of Transportation
Description The Office of Transportation Economics routinely conducts life-cycle benefit/cost analysis for proposed state highway and public transit projects. Such analysis is performed using Cal-B/C, a PC-based spreadsheet model developed by the Office and outside consultants. Cal-B/C can be used to analyze many types of highway construction and operational improvement projects, as well as some Intelligent Transportation System (ITS) and transit projects.

Data URL http://www.dot.ca.gov/hq/tpp/offices/ote/benefit_cost.htm

Title Means Concrete / Masonry Cost Data
Publisher RSMeans
Description Concrete & Masonry Cost Data contains unit price data, with illustrated concrete and masonry assemblies cost tables, helpful reference data and estimating aids.
Data URL http://www.rsmeans.com/bookstore/detail.asp?sku=60115
Notes Can be ordered on the web site above. You may want to check to see if your state has the subscription first.

Title Means Estimating Handbook
Publisher RSMeans
Description This handbook covers the full spectrum of technical data required to estimate construction costs. The book includes information on sizing, productivity, equipment requirements, code-mandated specifications, design standards and engineering factors - all organized according to the CSI MasterFormat, and including recent classification changes.
Data URL http://www.rsmeans.com/bookstore/detail.asp?sku=67276A
Notes Can be ordered on the web site above. You may want to check to see if your state has the subscription first.

Title Means Heavy Construction Cost Data
Publisher RSMeans
Description Means Heavy Construction Cost Data provides costs for all types of heavy construction-from highways, bridges, utilities, rails and marine projects, to sanitary and storm sewer projects-which lets you estimate a wider range of street and roadway construction.
Data URL http://www.rsmeans.com/bookstore/detail.asp?sku=65165
Notes Can be ordered on the web site above. You may want to check to see if your state has the subscription first.

Title Means Labor Rates for the Construction Industry
Publisher RSMeans
Description Labor Rates for the Construction Industry provides a quick, convenient way to obtain union wage rates for every major metropolitan area in the United States and Canada. Wage rates listed are the actual negotiated union rates or a reliable estimate for each of the 46 construction trades.
Data URL http://www.rsmeans.com/bookstore/detail.asp?sku=60125
Notes Can be ordered on the web site above. You may want to check to see if your state has the subscription first.

Title Minimum Wage Laws in the States
Publisher Axon User's Group
Description Includes minimum wage and overtime premium pay standards applicable to non-supervisory NONFARM private sector employment under state and federal Laws for each state.
Data URL http://www.axonusergroup.com/state_wages.htm

Title Monthly Energy Review
Publisher U.S. Department of Energy, Energy Information Administration
Description The Monthly Energy Review (MER) is the Energy Information Administration's primary report of recent energy statistics. Included are total energy production, consumption, and trade; energy prices; overviews of petroleum, natural gas, coal, electricity, nuclear energy, renewable energy, and international petroleum; and data unit conversions.
Data URL http://www.eia.doe.gov/emeu/mer/

Title Motor Carrier Management Information System Catalog (MCMIS)
Publisher U.S. Department of Transportation, Federal Motor Carrier Safety Administration
Description The Motor Carrier Management Information System (MCMIS) contains information on the safety fitness of commercial motor carriers and hazardous material (HM) shippers subject to the Federal Motor Carrier Safety Regulations and the Hazardous Materials Regulations. This information is available to the general public through the MCMIS Data Dissemination Program. This catalog describes the Data Dissemination Program. It identifies certain motor carrier data (census data and crash data) available to the public, and explains how to obtain these data.
Data URL http://www.fmcsa.dot.gov/factsfigs/mcmis/mcmiscatalog.htm

Title Motor Vehicle Traffic Accidents
Publisher Texas Department of Public Safety
Description Includes annual statistics regarding traffic accidents in Texas for 1998-2001. Data contents include the following:
- Texas traffic death rates
- Chart of death, mileage & economic loss changes
- Monthly comparison of vehicle miles, accidents and casualties
- Fatal accidents & deaths by month & road class, with two year comparison
- Age, classification & sex of persons killed
- Seat belt use in passenger cars, trucks and buses
- Motorcyclists killed & injured by age indicating seat position & helmet use
- Accidents & casualties by city, road class, and county
- Accidents & casualties by date, month, day and hour of week, and during holiday periods.
- Accidents by severity, manner of collision, alcohol & speeding involvement, violations, vehicle defects, road defects, light, weather, and surface conditions.
- Age and license status of drivers in accidents.
- Types and age of vehicles in accidents, and vehicle body style by severity.
- A separate section includes DWI related fatalities by county and age; accidents by road type; population group, city, and county, drivers by age; Highway Patrol arrests by road type and age; and DWI as a contributing factor, Alcohol Testing in Fatal Accidents, and BAC tests & results on fatally injured drivers.

Data URL http://www.txdps.state.tx.us/administration/driver_licensing_control/arb.htm

Title National Transit Database: Data Tables

Publisher U.S. Department of Transportation, Federal Transit Administration

Description The Data Tables for the National Transit Database (NTD) Report Year is one of three publications comprising the National Transit Database Program's Annual Report. It provides detailed summaries of financial and operating data, including Sources for Transit Operating Funds Applied, State and Local Taxes Dedicated, Transit Operating Expenses, Operators Wages, Energy Consumption, Employee Work Hours and Employee Counts, Transit Operating Statistics, Passenger stations, Maintenance Facilities, Transit Way Mileage, Age distribution of Active Vehicle Inventory, Fare per Passenger and Recovery Ratio, and Service Supplied and Consumed Ratios, submitted to the Federal Transit Administration (FTA) by the nation's mass transit agencies for the Report Year.

Data URL http://www.ntdprogram.com/NTD/ntdhome.nsf/Docs/NTDPublications?OpenDocument

Title National Transit Database: National Transit Summaries and Trends (NTST)

Publisher U.S. Department of Transportation, Federal Transit Administration

Description National Transit Summaries and Trends (NTST), a portion of the Federal Transit Administration's (FTA) annual report, presents aggregate transit operating statistics, including Federal Funds Applied to Transit, Number of Transit Agencies, Vehicle Revenue Miles, Unlinked Passenger Trips, Operating Costs and Performance Measures, Fatalities, ADA Compliance, Operating Funding Sources, Capital Investment in Transit, Capital Expenditures, and Alternative Fuel Usage, by mode (bus, heavy rail, light rail, commuter rail, demand response and vanpool).

Data URL http://www.ntdprogram.com/NTD/ntdhome.nsf/Docs/NTDPublications?OpenDocument

Title National Transit Database: Profiles

Publisher U.S. Department of Transportation, Federal Transit Administration

Description This volume of the National Transit Database (NTD) Annual Report consists of profiles for each transit agency filing an NTD annual report for the report year. A profile consists of general, financial, and modal data, as well as performance and trend indicators.

Data URL http://www.ntdprogram.com/NTD/ntdhome.nsf/Docs/NTDPublications?OpenDocument

Title National Transportation Statistics

Publisher U.S. Department of Transportation, Bureau of Transportation Statistics

Description The annual National Transportation Statistics (NTS) report is the transportation equivalent of the Census Bureau's Statistical Abstract of the United States. The report has four chapters:
- Chapter 1 provides data on the extent, condition, use, and performance of the physical transportation network.
- Chapter 2 details transportation's safety record, giving data on accidents, crashes, fatalities, and injuries for each mode and hazardous materials.
- Chapter 3 focuses on the relationship between transportation and the economy, presenting data on transportation' s contribution to the gross domestic product, employment by industry and occupation, and transportation-related consumer and government expenditures.

- Chapter 4 presents data on transportation energy use and transportation-related environmental impacts.

Data URL http://www.bts.gov/publications/national_transportation_statistics/

Title Nationwide Personal Transportation Survey

Publisher U.S. Department of Transportation, Bureau of Transportation Statistics

Description Nationwide Personal Transportation Survey (NPTS) data are collected by the Federal Highway Administration (FHWA). It is the only national source of information on personal travel for all modes of transportation and all trip purposes. NPTS also tracks the economic, social, demographic, and geographic characteristics of the traveler. It includes the following data files:_
- The Day Trips file contains specific information about each trip taken by respondents during the travel day. _
- The Household file contains household-level demographics such as geography and household composition._
- The Period Trips file contains information about longer trips (75 or more miles one-way) that took place during the two weeks prior to a respondent's interview._
- The Persons file contains person-level characteristics for members of households that participated in the NPTS._
- The Segmented Trips file contains data for up to 4 segments of each segmented travel day trip the person made on travel day . It consists of pieces of travel day trips if transit or Amtrak was used._
- The Vehicles file contains information about each vehicle in responding households.

Data URL http://www.transtats.bts.gov/Tables.asp?DB_ID=545&DB_Name=Nationwide%20Personal%20Transportation%20Survey

Title Rental Rate Blue Book

Publisher EquipmentWatch

Description Specified by 47 DOTs and numerous municipalities and territories, the Rental Rate Blue Book is THE industry guide for determining reimbursement rates for equipment use. The data covered includes Ownership Costs, Estimated Operating Costs, and FHWA Rates, etc.

Data URL https://www.equipmentwatch.com/Marketing/RRBB_overview.jsp

Notes Can be ordered on the web site above. You may want to check to see if your state has the subscription first.

Title Rental Rate Guide

Publisher Rental Equipment Register

Description The Rental Rate Guide is the compilation of nationally averaged rental rates and model specifications for construction equipment.

Data URL http://rermag.com/rate_guide/

Notes To order the publication, go to the web site above or call 866-505-7173 (outside U.S. 402-505-7173). You may want to check to see if your state has the subscription first.

Title Safety and Fitness Electronic Records (SAFER) System
Publisher U.S. Department of Transportation, Federal Motor Carrier Safety Administration
Description This system offers company safety data and related services to industry and the public over the Internet. Users can search FMCSA databases, register for a USDOT number, pay fines online, order company safety profiles, challenge FMCSA data using the DataQs system, access the Hazardous Material Route registry, obtain National Crash and Out of Service rates for Hazmat Permit Registration.
Data URL http://www.safersys.org/

Title Safety Conscious Planning (SCP)
Publisher U.S. Department of Transportation, Federal Highway Administration
Description Provides resources that can be used to integrate safety considerations into the transportation planning processes at all levels, specifically the Statewide Transportation Improvement Programs (STIP) and the Transportation Improvement Programs (TIP) developed by the State Departments of Transportation (DOTs) and Metropolitan Planning Organizations (MPOs) respectively.
Data URL http://www.fhwa.dot.gov/planning/scp/

Title SDOT Transportation Infrastructure Inventory
Publisher Seattle Department of Transportation
Description SDOT Transportation Infrastructure Inventory includes the inventory data for the city of Seattle as follows: Arterial and Non-arterial lane miles; Number of Bridges, Retaining Walls and Seawalls, Stairways, Areaways, Signs, Signals (Signalized Intersections, Controllers, Interconnected Signal Systems, Vehicle Loop Detectors, and Beacons and Lighted Signs), Guardrails, Crash Cushions, Signs, Markings, Parking Meters, Curb Ramps, Bike Racks, Curb Bulbs, Traffic Circles, Diverters, Chicanes, Speed Humps, Street Trees, and Irrigation Systems; miles of Sidewalks and Walkways, Bike Trails, Signed Bike Routes, and Bike Lanes.
Data URL http://www.ci.seattle.wa.us/transportation/inventory.htm

Title State Crash Contacts
Publisher U.S. Department of Transportation, National Highway Traffic Safety Administration, National Center for Statistics and Analysis
Description This web site lists state, contact name, phone, reporting threshold (dollars), and e-mail or web site.
Data URL http://24.123.50.125/crashforms/Pages/coordinators.htm

Title State Data Program (SDP)
Publisher U.S. Department of Transportation, National Highway Traffic Safety Administration
Description The State Data Program provides essential crash information detail that complements national data collection programs such as FARS and NASS GES. The Crash Data Report provides extensive motor vehicle crash data from 1990-1999. These data are not representative of the nation as a whole, but do provide a comprehensive and illustrative census of motor vehicle crash patterns and trends for the 17 states in the State Data System at the time of publication: California, Florida, Georgia, Illinois, Indiana, Kansas, Maryland, Michigan, Missouri, New Mexico, North Carolina, Ohio, Pennsylvania, Texas, Utah, Virginia, Washington. It includes separate Crash Data Report for Crashes, Vehicles, People, Alcohol,

Speeding, Rollovers, Motorcycles, Large Trucks, Fatalities and Injuries by Age, and Safety Equipment.

Data URL http://www-nrd.nhtsa.dot.gov/departments/nrd-30/ncsa/SDP.html

Title State Data System (SDS)

Publisher U.S. Department of Transportation, National Highway Traffic Safety Administration

Description The State Data System refers to the collection of computerized state crash data files derived from data recorded on Police Accident Reports (PARs). Crash statistics are presented in ten sections. General information can be found in the first three sections: Crashes, Vehicles, and People. The remaining sections focus on more specific data subsets. Sections 4 and 5 present alcohol- and speeding-related crash summary data. Specific vehicle actions and types are presented in Sections 6-8 (Rollovers, Motorcycles, and Large Trucks). Finally, Section 9 provides additional information regarding the ages of persons who were killed and injured, while Section 10 focuses on vehicle safety equipment.

Data URL http://www-nrd.nhtsa.dot.gov/departments/nrd-30/ncsa/SDS.html

Title State Occupational Employment and Wage Estimates

Publisher U.S. Department of Labor, Bureau of Labor Statistics

Description Listed by state, this web site includes occupational employment and wage estimates for 50 States plus District of Columbia, Guam, Puerto Rico, and Virgin Islands.

Data URL http://www.bls.gov/oes/current/oessrcst.htm

Title State Traffic Safety Information

Publisher U.S. Department of Transportation, National Highway Traffic Safety Administration

Description This publication includes important traffic safety information and data on a State-by-State basis. Contents include:
- Data on traffic fatalities
- Fatality Rates per Vehicles Miles Traveled (VMT)
- Economic cost data
- Alcohol involvement in fatal crashes
- Occupant restraint use rates
- Speed related fatal crashes
- Highway safety program funds
- Status of key legislative issues

Data URL http://www.nhtsa.dot.gov/STSI/?Year=2003&State=AZ&Accessible=0

Title State Transportation Statistics: Chapter A - Infrastructure

Publisher U.S. Department of Transportation, Bureau of Transportation Statistics

Description Data tables covered in this chapter include:_
- Public Road Length, Miles by Functional System
- Public Road Length, Miles by Ownership
- Toll Roads, Toll Bridges and Tunnels, and Toll Ferries
- Road Condition
- Number of Road Bridges by Functional System
- Number of Road Bridges by Owner
- Road Bridge Condition

- Motor Bus Transit Route Mileage
- Characteristics of Rail Transit by Transit Authority
- Civil and Joint-Use Airports, Heliports, STOLports, and Seaplane Bases
- Top 50 Commercial Service Airport Enplanements by Air Carrier Category
- Commercial Service Airport Enplanements by State and Air Carrier Category
- Number of Freight Railroads by Class
- Miles of Freight Railroad Operated by Class of Railroad
- Top 50 Water Ports by Tonnage
- Inland Waterway Mileage

Data URL http://www.bts.gov/publications/state_transportation_profiles/state_transportation_statistics_2004/

Title State Transportation Statistics: Chapter B - Safety

Publisher U.S. Department of Transportation, Bureau of Transportation Statistics

Description Data tables covered in this chapter include:_

- Highway Traffic Fatalities and Fatality Rates
- Passenger Car and Light Truck Occupants Killed and Restraint Use
- Large Truck Involvement in Fatal Crashes
- Key Provisions of Safety Belt Use Laws
- Helmet Use Laws
- Safety Belt Use
- Pedestrian Fatalities Involving Motor Vehicles
- Fatalities in Motor Vehicle Crashes Involving High Blood Alcohol Concentration
- Maximum Posted Speed Limits by Type of Road
- Rail Accidents/Incidents
- Highway-Rail Grade Crossing Incidents
- Highway-Rail Grade Crossings by Type
- Warning Devices at Public Highway-Rail Grade Crossings
- Train Accident/Incident Fatalities by Category of Person Killed
- Train Accident/Incident Injuries by Category of Person Injured
- Transit Incidents, Fatalities, Injuries, and Property Damage, All Transit Modes
- Recreational Boating Accidents
- Alcohol Involvement in Recreational Boating Accidents
- Hazardous Materials Incidents
- Hazardous Materials Incidents by Mode
- Natural Gas Distribution Pipeline Incidents
- Natural Gas Transmission Pipeline Incidents
- Hazardous Liquid Pipeline Incidents

Data URL http://www.bts.gov/publications/state_transportation_profiles/state_transportation_statistics_2004/

Title State Transportation Statistics: Chapter C - Freight Transportation

Publisher U.S. Department of Transportation, Bureau of Transportation Statistics

Description Data tables covered in this chapter include:_

- Freight Shipments by State of Origin
- Hazardous Material Shipments by Selected State of Origin
- Hazardous Material Shipments by Selected State of Destination
- Rail Shipments
- Waterborne Shipments
- Top 50 U.S. Ports by Port Calls and Vessel Type

- Top 30 U.S. Containership Ports
- Scheduled and Nonscheduled Air Freight and Mail Enplaned
- Top 50 All-Cargo Airports by Landed Weight
- U.S. Surface Merchandise Trade with Canada and Mexico
- U.S. Surface Merchandise Imports from Canada and Mexico
- Incoming Truck Crossings, U.S.–Canadian Border
- Incoming Truck Container (Loaded) Crossings, U.S.–Canadian Border
- Incoming Truck Container (Unloaded) Crossings, U.S.–Canadian Border
- Incoming Train Crossings, U.S.–Canadian Border
- Incoming Rail Container (Full) Crossings, U.S.–Canadian Border
- Incoming Rail Container (Empty) Crossings, U.S.–Canadian Border
- Incoming Truck Crossings, U.S.–Mexican Border
- Incoming Truck Container (Loaded) Crossings, U.S.– Mexican Border
- Incoming Truck Container (Unloaded) Crossings, U.S.– Mexican Border
- Incoming Train Crossings, U.S.– Mexican Border
- Incoming Rail Container (Full) Crossings, U.S.– Mexican Border
- Incoming Rail Container (Empty) Crossings, U.S.– Mexican Border
- Top 50 U.S. Foreign Trade Freight Gateways

Data URL http://www.bts.gov/publications/state_transportation_profiles/state_transportation_statistics_2004/

Title State Transportation Statistics: Chapter D - Passenger Travel

Publisher U.S. Department of Transportation, Bureau of Transportation Statistics

Description Data tables covered in this chapter include:

- Commuting to Work
- Licensed Drivers
- Transit Ridership in the 50 Largest Urbanized Areas
- Urban Transit Ridership by State and Transit Mode
- Top 50 Amtrak Stations by Number of Boardings
- Top 50 Airports by Passengers Enplaned
- Major Airports by On-Time Departure Performance
- Top 15 Cruise Ship Ports by Port of Departure
- Incoming Personal Vehicle Crossings, U.S.–Canadian Border
- Incoming Passengers in Personal Vehicles, U.S.–Canadian Border
- Incoming Train Passengers, U.S.–Canadian Border
- Incoming Bus Crossings, U.S.–Canadian Border
- Incoming Passengers on Buses, U.S.–Canadian Border
- Incoming Pedestrians, U.S.–Canadian Border
- Incoming Personal Vehicle Crossings, U.S.–Mexican Border
- Incoming Passengers in Personal Vehicles, U.S.– Mexican Border
- Incoming Train Passengers, U.S.– Mexican Border
- Incoming Bus Crossings, U.S.– Mexican Border
- Incoming Passengers on Buses, U.S.– Mexican Border
- Incoming Pedestrians, U.S.– Mexican Border
- Overseas Visitors to the United States by Destination State and Territory
- Overseas Visitors to the United States by Destination City

Data URL http://www.bts.gov/publications/state_transportation_profiles/state_transportation_statistics_2004/

Title State Transportation Statistics: Chapter E - Registered Vehicles and Vehicle-Miles Traveled

Publisher U.S. Department of Transportation, Bureau of Transportation Statistics

Description Data tables covered in this chapter include:
- Motor-Vehicle Registrations
- Trailer and Semi-Trailer Registrations
- Highway Vehicle-Miles Traveled
- Highway, Demographic, and Geographic Characteristics of 30 Largest Urbanized Areas
- Highway Congestion in the 50 Largest Urban Areas
- Recreational Boat Registrations by Propulsion Type
- General Aviation and Air Taxi Aircraft and Hours Flown
- Active Aviation Pilots and Flight Instructors

Data URL http://www.bts.gov/publications/state_transportation_profiles/state_transportation_statistics_2004/

Title State Transportation Statistics: Chapter F - Economy and Finance

Publisher U.S. Department of Transportation, Bureau of Transportation Statistics

Description Data tables covered in this chapter include:
- Transportation and Warehousing Establishments and Employment
- Air Transportation Establishments and Employment
- Water Transportation Establishments and Employment
- Truck Transportation Establishments and Employment
- Transit and Ground Passenger Transportation Establishments and Employment
- Pipeline Transportation Establishments and Employment
- Freight Railroad Employment and Wages
- Transportation Expenditures by State Governments
- Transportation Revenues Collected by State Governments
- Federal and State Funding of Public Transit
- Average Motor Gasoline Prices
- State Motor-Fuel Tax Rates

Data URL http://www.bts.gov/publications/state_transportation_profiles/state_transportation_statistics_2004/

Title State Transportation Statistics: Chapter G - Energy and Environment

Publisher U.S. Department of Transportation, Bureau of Transportation Statistics

Description Data tables covered in this chapter include:
- Transportation Energy Consumption by Energy Source
- Energy Consumption by End-Use Sector
- Transportation Energy Consumption per Capita
- Motor-Fuel Use
- Alternative-Fueled Vehicles in Use by Fuel Type
- Top 20 States for Gasoline-Electric Hybrid Automobile Registrations
- Air Pollution in the 50 Largest Metropolitan Areas

Data URL http://www.bts.gov/publications/state_transportation_profiles/state_transportation_statistics_2004/

Title Statistical Abstract of the United States

Publisher U.S. Census Bureau

Description Data tables covered include the following: Population; Vital Statistics; Health and Nutrition; Education; Law Enforcement, Courts, and Prisons; Geography and Environment; Elections; State and Local Government Finances and Employment; Federal Government Finances and Employment; National Defense and Veterans Affairs; Social Insurance and Human Services; Labor Force, Employment, and Earnings; Income, Expenditures, and Wealth Prices; Business Enterprise 3; Science and Technology; Agriculture; Natural Resources; Energy and Utilities; Construction and Housing; Manufactures; Domestic Trade; Transportation; Information and Communications; Banking, Finance, and Insurance; Arts, Entertainment, and Recreation; Accommodation, Food Services, and Other Services; Foreign Commerce and Aid; Puerto Rico and the Outlying Areas; and Comparative International Statistics.

Data URL http://www.census.gov/prod/www/statistical-abstract-04.html

Title Structure Type by State

Publisher U.S. Department of Transportation, Federal Highway Administration

Description Includes number of Bridges, Structurally Deficient Bridges, and Functionally Obsolete Bridges by State and Structure Type (Slab, Stringer/Multi-Beam or Girder, Girder & Floorbeam System, Tee Beam, Box Beam or Girders (Multiple), Box Beam or Girders (Single or Spread), Frame (Except Culverts), Orthotropic, Truss-Deck, Truss-Thru, Arch-Deck, Arch-Thru, Suspension, Stayed Girder, Movable-Lift, Movable-Bascule, Movable-Swing, Tunnel, Culvert, Mixed Types, Segmental Box Girder, Channel Beam, and other) for 1992-present.

Data URL http://www.fhwa.dot.gov/bridge/struct.htm

Title Structure Type by Year Built

Publisher U.S. Department of Transportation, Federal Highway Administration

Description Includes number of Bridges, Structurally Deficient Bridges, Functionally Obsolete Bridges by State and Year Built (from 2000-present).

Data URL http://www.fhwa.dot.gov/bridge/structyr.htm

Title Table of Past Years Discount Rates from Appendix C of OMB Circular No. A-94

Publisher The Executive Office of the President, Office of Management and Budget

Description Includes Nominal Treasury Interest Rates for Different Maturities (3-Year, 5-Year, 7-Year, 10-Year, and 30-Year) from 1979 to present.

Data URL http://www.whitehouse.gov/omb/circulars/a094/dischist-2005.pdf

Title The Traffic Records Forum

Publisher Association of Traffic Safety Information Professionals

Description The Traffic Records Forum is filled with exhibits, workshops, seminars and presentations on topics of interest to the traffic safety data community and those that utilize traffic safety data in their field. Generally, you will be able to get information on traffic safety data:

- Usage
- Collection
- Analysis
- Current and Emerging Technology
- Current Systems and Programs

- Research
- Current Issues and Emerging Needs

Data URL http://www.atsip.org/index.php/trfgen/

Title Traffic Records: State Map

Publisher U.S. Department of Transportation, National Highway Traffic Safety Administration, National Center for Statistics and Analysis

Description This web site includes a US map that you could click on each state to get information such as Crash Factbook, Data Dictionary, and Instruction Manuals, Crash Statistics, and contacts in that state.

Data URL http://24.123.50.125/crashforms/Pages/state_map.htm

Title Traffic Safety Facts Annual Reports: A Compilation of Motor Vehicle Crash Data from the Fatality Analysis Reporting System and the General Estimates System.

Publisher U.S. Department of Transportation, National Highway Traffic Safety Administration, National Center for Statistics and Analysis

Description Published annually, this report has five chapters.

- Chapter 1, "Trends", includes 22 data tables, which provides statistics about drivers, passengers, Motorcycle Riders, pedestrians Killed or Injured in crashes. Criteria used include Crash Severity, Person Type, Vehicle Type, Crash Type, Blood Alcohol Concentration (BAC), Population, Licensed Drivers, Registered Vehicles, Vehicle Miles Traveled, Sex, Time of Day, Sex, Vehicle Type, Age, Survival Status, Age Group, 14 Years and Older, Passenger Cars, Light Trucks, Large Trucks, and Restraint Use.

- Chapter 2, “Crashes”, includes 22 data tables, which describes general characteristics of crashes, such as when and how often they occurred, where they occurred, and what happened during the crash. Criteria used include Time of Day, Day of Week, Weather Condition, Light Condition, Relation to Roadway and Junction, Traffic Control Device, Speed Limit, Crash Type, Number of Lanes, Trafficway Flow, First Harmful Event, Manner of Collision, Crash Severity, Month, Speed Limit, Land Use, Emergency Medical Services (EMS) Response Times Within Designated Minutes and Land Use, Two-Vehicle Crashes, Vehicle Type, and Percent Alcohol Related.

- Chapter 3, “Vehicles”, includes 18 data tables, which concentrates on the types of vehicles involved in crashes and the damage to the vehicles. Criteria used include Vehicle Type, Rollover Occurrence, Fire Occurrence, Roadway Function Class, Crash Type, Hazardous Cargo, Crash Severity, Body Type, Single- and Two-Vehicle Crashes, Vehicle Maneuver, Most Harmful Event, Crash Severity, Initial Point of Impact, Truck Type, Rollover Occurrence, Number of Trailers, Jackknife Occurrence, and involvement of Passenger Cars, Light Trucks, Large Trucks, Motorcycles, Buses, Truck Tractors with Trailers._

- Chapter 4, “People”, has 54 data tables, which provides statistics about drivers, passengers, Motorcycle Riders, pedestrians, and pedalcyclists Killed or Injured in crashes. Tables are also available for injuries and fatalities occurred in construction/maintenance zones, in alcohol, restraint use, school bus, and emergency vehicles related crashes. Criteria used include Person Type, Age, Sex, Injury Severity, Crash Severity, Weather Condition, Light Condition, Speed Limit, Crash Type, Land Use, Time of Day, Crash Type, Roadway Function Class, Person Type, Vehicle Type, Previous Driving Record, License Type Compliance, Most Harmful

Event, Initial Point of Impact, Ejection, Vehicle Body Type, Car Wheelbase Size, Alcohol Involvement, Day of Week, Driver's Blood Alcohol Concentration (BAC), Restraint Use, Seating Position, Type of Restraint, Helmet Use, License Compliance, Striking Vehicle, and Location. _

- Chapter 5. "States", includes 23 data tables, which contains information about drivers, passengers, pedestrians killed in each state, the District of Columbia, and Puerto Rico. Criteria used include State, First Harmful Event, Roadway Function Class, Person Type, Age Group, Vehicle Type, Restraint Use, Blood Alcohol Concentration of the Driver, Road Type, Speed Limit, Average Emergency Medical Services (EMS) Response Times, and City.

Data URL http://www-nrd.nhtsa.dot.gov/departments/nrd-30/ncsa/AvailInf.html

Title Transportation Energy Data Book

Publisher U.S. Department of Energy, Energy Efficiency and Renewable Energy

Description The data book represents an assembly and display of statistics and information that characterize transportation activity, and presents data on other factors that influence transportation energy use. It has 12 chapters which focus on various aspects of the transportation industry. Chapter 1 focuses on petroleum; Chapter 2 – energy; Chapter 3 – highway vehicles; Chapter 4 – light vehicles; Chapter 5 – heavy vehicles; Chapter 6 – alternative fuel vehicles; Chapter 7 – fleet vehicles; Chapter 8 – household vehicles; and Chapter 9– nonhighway modes; Chapter 10 – transportation and the economy; Chapter 11 – greenhouse gas emissions; and Chapter 12 – criteria pollutant emissions. There are also three appendices which include detailed source information for some tables, measures of conversion, and the definition of Census divisions and regions.

Data URL http://cta.ornl.gov/data/index.shtml

Title Transportation Services Index

Publisher U.S. Department of Transportation, Bureau of Transportation Statistics

Description The Transportation Services Index (TSI) measures the movement of freight and passengers. The index, which is seasonally adjusted, combines available data on freight traffic, as well as passenger travel, that have been weighted to yield a monthly measure of transportation services output.

Data URL http://www.bts.gov/xml/tsi/src/index.xml

Title Transportation Statistics Annual Report

Publisher U.S. Department of Transportation, Bureau of Transportation Statistics

Description Data tables covered in this report include:
- Labor Productivity in Transportation
- Multifactor Productivity
- Passenger-Miles of Travel
- Daily Travel by Walking and Bicycling
- Domestic Freight Ton-Miles
- Commercial Freight Activity
- Geography of Domestic Freight Flows
- Passenger and Freight Vehicle-Miles of Travel
- Urban Highway Travel Times
- U.S. Air Carrier On-Time Performance
- Air Travel Time Index Research

- Amtrak On-Time Performance
- Survey Data on Congestion Delays
- Highway Trucks by Weight
- Vehicle Loadings on the Interstate Highway System
- Merchant Marine Vessel Capacity
- Railcar Weights
- Daily Passenger Travel
- Long-Distance Passenger Travel
- Long-Distance Travel by Purpose and Mode
- Long-Distance Travel by Income, Gender, and Age
- Daily Travel by Income, Gender, and Age
- Travel by Older Adults
- Scheduled Intercity Transportation in Rural America
- Household Spending on Transportation
- Cost of Owning and Operating an Automobile
- Cost of Intercity Trips by Train and Bus
- Average Transit Fares
- Air Travel Price Index
- Transit Passenger-Miles of Travel
- Transit Ridership
- Transit Ridership by Transit Authority
- Lift- or Ramp-Equipped Buses and Rail Stations
- Commercial Motor Vehicle Repairs
- Highway Maintenance and Repairs
- Rail Infrastructure and Equipment Repairs
- Transit Vehicle Reliability
- Lock Downtime on the Saint Lawrence Seaway
- Intermittent Interruptions of Transportation Services
- Transportation Fatality Rates
- Years of Potential Life Lost from Transportation Accidents
- Transportation Injury Rates
- Motor Vehicle-Related Injuries
- Economic Costs of Motor Vehicle Crashes
- Key Air Emissions
- Greenhouse Gas Emissions
- Oil Spills into U.S. Waters
- Hazardous Materials Incidents and Injuries
- Transportation Capital Stock
- Highway Condition
- Bridge Condition
- Airport Runway Conditions
- Age of Highway and Transit Fleet Vehicles
- Age of Rail, Aircraft, and Maritime Vessel Fleets
- Relative Prices for Transportation Goods and Services
- U.S. International Trade in Transportation-Related Goods
- U.S. International Trade in Transportation-Related Services
- Transportation-Related Final Demand
- Transportation Services
- Government Transportation Revenues
- Government Transportation Expenditures
- Government Transportation Investment
- Transportation Sector Energy Use

- Transportation Energy Prices
- Transportation Energy Efficiency

Data URL http://www.bts.gov/publications/transportation_statistics_annual_report/

Title TranStats

Publisher U S Department of Transportation, Bureau of Transportation Statistics

Description A web site that claims to be “one stop shopping” for transportation data. Users can explore the data by transportation mode, which includes Aviation, Maritime, Highway, Transit, Rail, Pipeline, Bike/Pedestrian, and Other, or by subject area, which includes Safety, Energy, Freight, Transport, Environment, Passenger Travel, National Security, Infrastructure, Economic/Financial, and Social/Demographic, or use keyword searches to find relevant datasets.

Data URL http://www.transtats.bts.gov/

Title Waterborne Tonnage for Principal U.S. Ports and all 50 States and U.S. Territories.

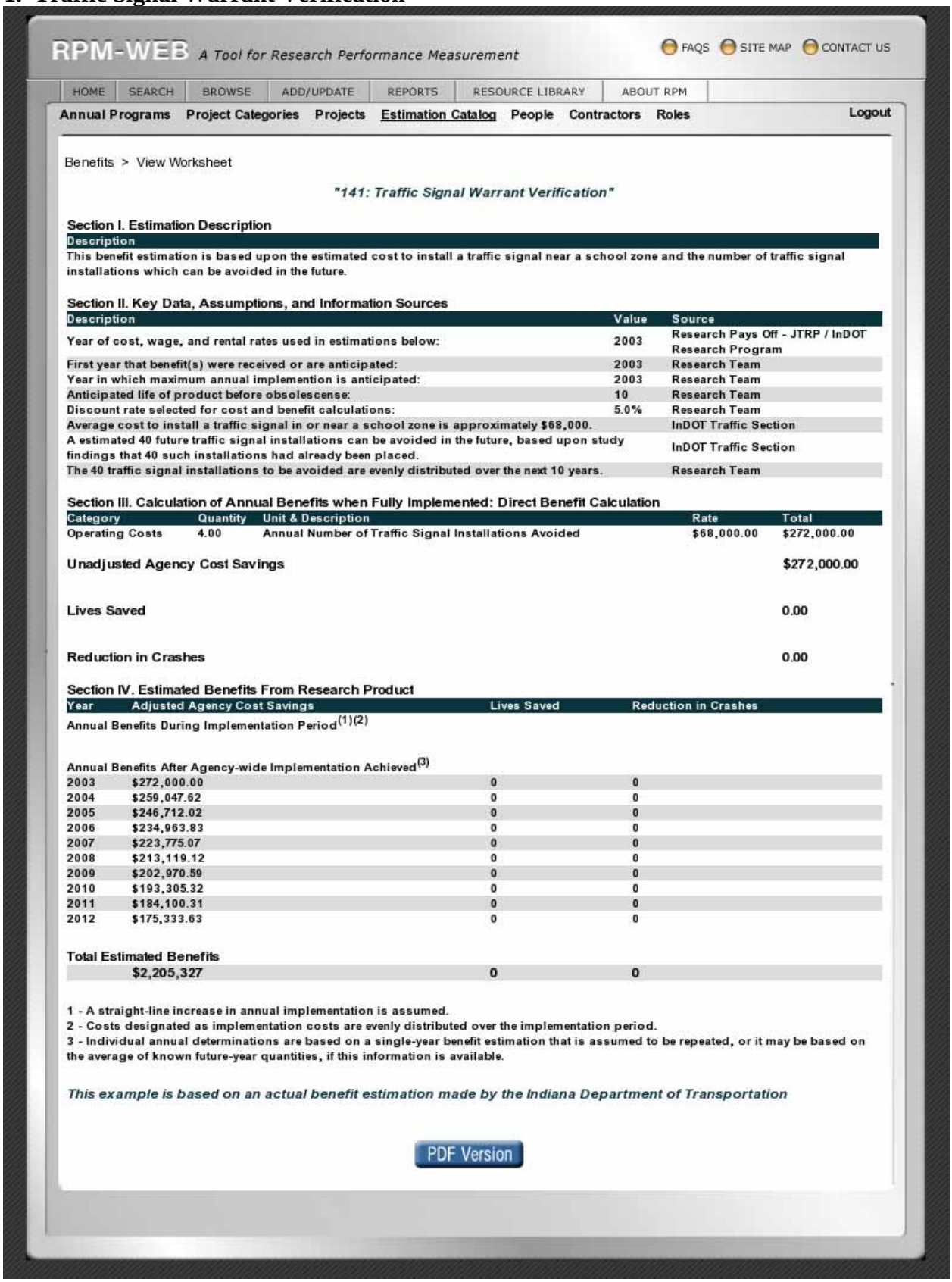
Publisher U.S. Army Corps of Engineers, Waterborne Commerce Statistics Center

Description Includes commodity tonnage (Total Tons, Domestic, Foreign, Imports, Exports) for principal U.S. ports by Port Name and Port Tons and waterborne tonnages for Domestic, Foreign, Imports, Exports and Intra-State waterborne traffic by State Name and State Tons.

Data URL http://www.iwr.usace.army.mil/ndc/wcsc/wcsc.htm

APPENDIX J – Standard Benefit Estimation Examples

1. Traffic Signal Warrant Verification



RPM-WEB *A Tool for Research Performance Measurement*

FAQS | SITE MAP | CONTACT US

HOME | SEARCH | BROWSE | ADD/UPDATE | REPORTS | RESOURCE LIBRARY | ABOUT RPM

Annual Programs | Project Categories | Projects | Estimation Catalog | People | Contractors | Roles | Logout

Benefits > View Worksheet

"141: Traffic Signal Warrant Verification"

Section I. Estimation Description

Description
This benefit estimation is based upon the estimated cost to install a traffic signal near a school zone and the number of traffic signal installations which can be avoided in the future.

Section II. Key Data, Assumptions, and Information Sources

Description	Value	Source
Year of cost, wage, and rental rates used in estimations below:	2003	Research Pays Off - JTRP / InDOT Research Program
First year that benefit(s) were received or are anticipated:	2003	Research Team
Year in which maximum annual implemention is anticipated:	2003	Research Team
Anticipated life of product before obsolescense:	10	Research Team
Discount rate selected for cost and benefit calculations:	5.0%	Research Team
Average cost to install a traffic signal in or near a school zone is approximately $68,000.		InDOT Traffic Section
A estimated 40 future traffic signal installations can be avoided in the future, based upon study findings that 40 such installations had already been placed.		InDOT Traffic Section
The 40 traffic signal installations to be avoided are evenly distributed over the next 10 years.		Research Team

Section III. Calculation of Annual Benefits when Fully Implemented: Direct Benefit Calculation

Category	Quantity	Unit & Description	Rate	Total
Operating Costs	4.00	Annual Number of Traffic Signal Installations Avoided	$68,000.00	$272,000.00
Unadjusted Agency Cost Savings				**$272,000.00**
Lives Saved				**0.00**
Reduction in Crashes				**0.00**

Section IV. Estimated Benefits From Research Product

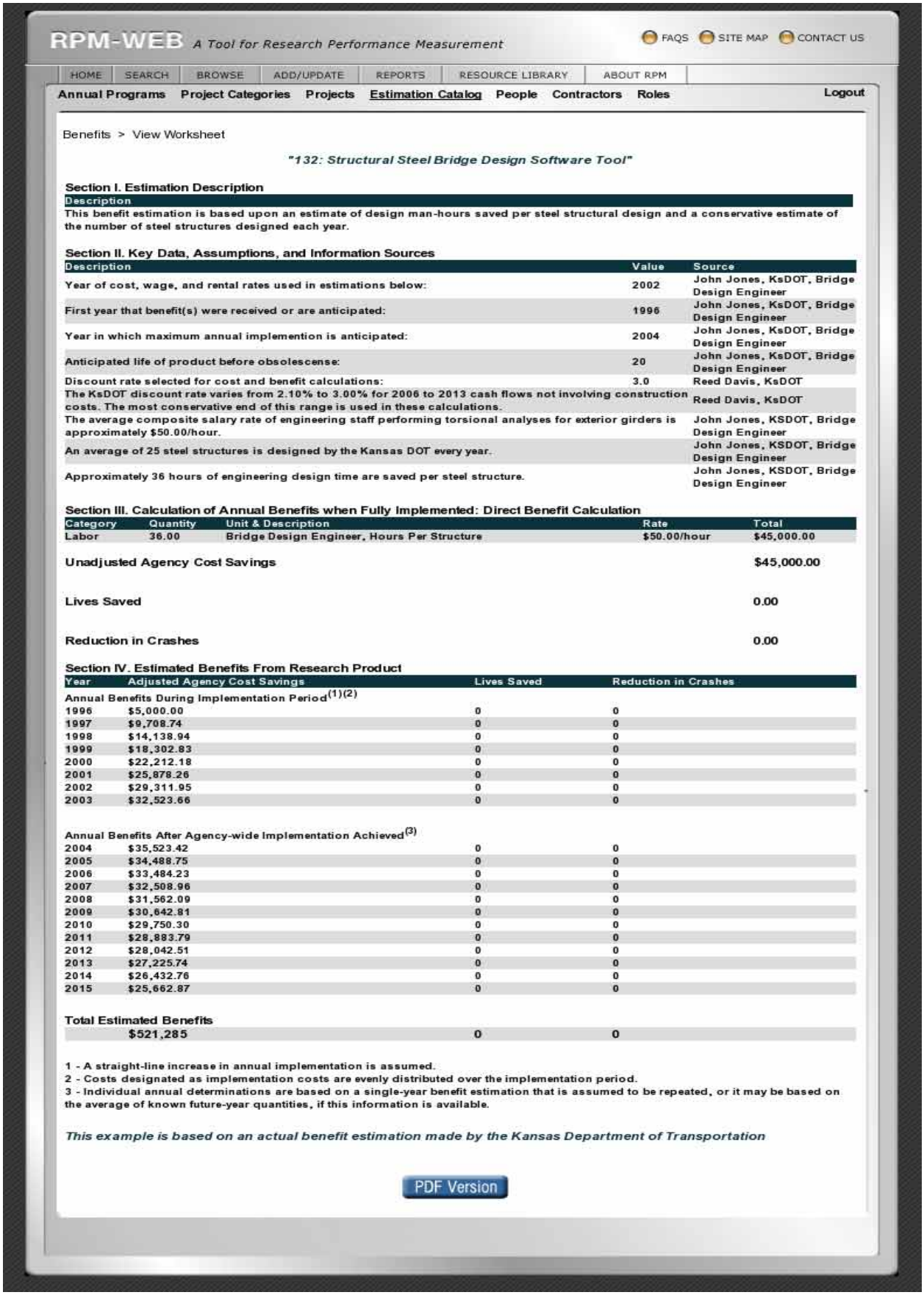
Year	Adjusted Agency Cost Savings	Lives Saved	Reduction in Crashes
Annual Benefits During Implementation Period[1][2]			
Annual Benefits After Agency-wide Implementation Achieved[3]			
2003	$272,000.00	0	0
2004	$259,047.62	0	0
2005	$246,712.02	0	0
2006	$234,963.83	0	0
2007	$223,775.07	0	0
2008	$213,119.12	0	0
2009	$202,970.59	0	0
2010	$193,305.32	0	0
2011	$184,100.31	0	0
2012	$175,333.63	0	0
Total Estimated Benefits			
	$2,205,327	**0**	**0**

1 - A straight-line increase in annual implementation is assumed.
2 - Costs designated as implementation costs are evenly distributed over the implementation period.
3 - Individual annual determinations are based on a single-year benefit estimation that is assumed to be repeated, or it may be based on the average of known future-year quantities, if this information is available.

This example is based on an actual benefit estimation made by the Indiana Department of Transportation

PDF Version

2. Structural Steel Bridge Design Software Tool



RPM-WEB *A Tool for Research Performance Measurement*

FAQS | SITE MAP | CONTACT US

HOME | SEARCH | BROWSE | ADD/UPDATE | REPORTS | RESOURCE LIBRARY | ABOUT RPM

Annual Programs | Project Categories | Projects | Estimation Catalog | People | Contractors | Roles | Logout

Benefits > View Worksheet

"132: Structural Steel Bridge Design Software Tool"

Section I. Estimation Description

Description
This benefit estimation is based upon an estimate of design man-hours saved per steel structural design and a conservative estimate of the number of steel structures designed each year.

Section II. Key Data, Assumptions, and Information Sources

Description	Value	Source
Year of cost, wage, and rental rates used in estimations below:	2002	John Jones, KsDOT, Bridge Design Engineer
First year that benefit(s) were received or are anticipated:	1996	John Jones, KsDOT, Bridge Design Engineer
Year in which maximum annual implemention is anticipated:	2004	John Jones, KsDOT, Bridge Design Engineer
Anticipated life of product before obsolescense:	20	John Jones, KsDOT, Bridge Design Engineer
Discount rate selected for cost and benefit calculations:	3.0	Reed Davis, KsDOT
The KsDOT discount rate varies from 2.10% to 3.00% for 2006 to 2013 cash flows not involving construction costs. The most conservative end of this range is used in these calculations.		Reed Davis, KsDOT
The average composite salary rate of engineering staff performing torsional analyses for exterior girders is approximately $50.00/hour.		John Jones, KSDOT, Bridge Design Engineer
An average of 25 steel structures is designed by the Kansas DOT every year.		John Jones, KSDOT, Bridge Design Engineer
Approximately 36 hours of engineering design time are saved per steel structure.		John Jones, KSDOT, Bridge Design Engineer

Section III. Calculation of Annual Benefits when Fully Implemented: Direct Benefit Calculation

Category	Quantity	Unit & Description	Rate	Total
Labor	36.00	Bridge Design Engineer, Hours Per Structure	$50.00/hour	$45,000.00

Unadjusted Agency Cost Savings $45,000.00

Lives Saved 0.00

Reduction in Crashes 0.00

Section IV. Estimated Benefits From Research Product

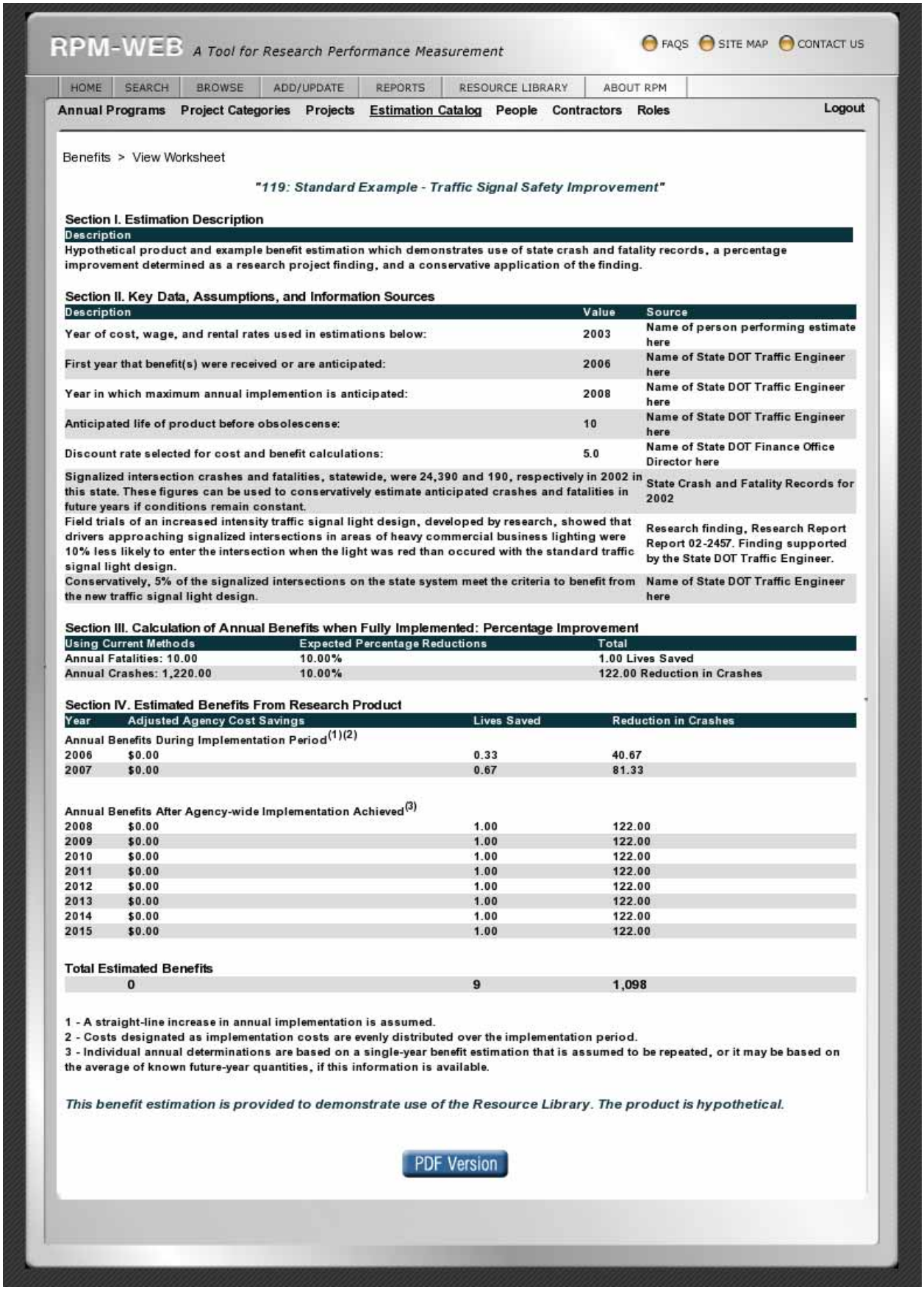
Year	Adjusted Agency Cost Savings	Lives Saved	Reduction in Crashes
Annual Benefits During Implementation Period[1][2]			
1996	$5,000.00	0	0
1997	$9,708.74	0	0
1998	$14,138.94	0	0
1999	$18,302.83	0	0
2000	$22,212.18	0	0
2001	$25,878.26	0	0
2002	$29,311.95	0	0
2003	$32,523.66	0	0
Annual Benefits After Agency-wide Implementation Achieved[3]			
2004	$35,523.42	0	0
2005	$34,488.75	0	0
2006	$33,484.23	0	0
2007	$32,508.96	0	0
2008	$31,562.09	0	0
2009	$30,642.81	0	0
2010	$29,750.30	0	0
2011	$28,883.79	0	0
2012	$28,042.51	0	0
2013	$27,225.74	0	0
2014	$26,432.76	0	0
2015	$25,662.87	0	0
Total Estimated Benefits			
	$521,285	0	0

1 - A straight-line increase in annual implementation is assumed.
2 - Costs designated as implementation costs are evenly distributed over the implementation period.
3 - Individual annual determinations are based on a single-year benefit estimation that is assumed to be repeated, or it may be based on the average of known future-year quantities, if this information is available.

This example is based on an actual benefit estimation made by the Kansas Department of Transportation

PDF Version

3. Traffic Signal Safety Improvement (Hypothetical Example)



RPM-WEB *A Tool for Research Performance Measurement*

FAQS | SITE MAP | CONTACT US

HOME | SEARCH | BROWSE | ADD/UPDATE | REPORTS | RESOURCE LIBRARY | ABOUT RPM

Annual Programs | Project Categories | Projects | Estimation Catalog | People | Contractors | Roles | Logout

Benefits > View Worksheet

"119: Standard Example - Traffic Signal Safety Improvement"

Section I. Estimation Description

Description
Hypothetical product and example benefit estimation which demonstrates use of state crash and fatality records, a percentage improvement determined as a research project finding, and a conservative application of the finding.

Section II. Key Data, Assumptions, and Information Sources

Description	Value	Source
Year of cost, wage, and rental rates used in estimations below:	2003	Name of person performing estimate here
First year that benefit(s) were received or are anticipated:	2006	Name of State DOT Traffic Engineer here
Year in which maximum annual implemention is anticipated:	2008	Name of State DOT Traffic Engineer here
Anticipated life of product before obsolescense:	10	Name of State DOT Traffic Engineer here
Discount rate selected for cost and benefit calculations:	5.0	Name of State DOT Finance Office Director here
Signalized intersection crashes and fatalities, statewide, were 24,390 and 190, respectively in 2002 in this state. These figures can be used to conservatively estimate anticipated crashes and fatalities in future years if conditions remain constant.		State Crash and Fatality Records for 2002
Field trials of an increased intensity traffic signal light design, developed by research, showed that drivers approaching signalized intersections in areas of heavy commercial business lighting were 10% less likely to enter the intersection when the light was red than occured with the standard traffic signal light design.		Research finding, Research Report Report 02-2457. Finding supported by the State DOT Traffic Engineer.
Conservatively, 5% of the signalized intersections on the state system meet the criteria to benefit from the new traffic signal light design.		Name of State DOT Traffic Engineer here

Section III. Calculation of Annual Benefits when Fully Implemented: Percentage Improvement

Using Current Methods	Expected Percentage Reductions	Total
Annual Fatalities: 10.00	10.00%	1.00 Lives Saved
Annual Crashes: 1,220.00	10.00%	122.00 Reduction in Crashes

Section IV. Estimated Benefits From Research Product

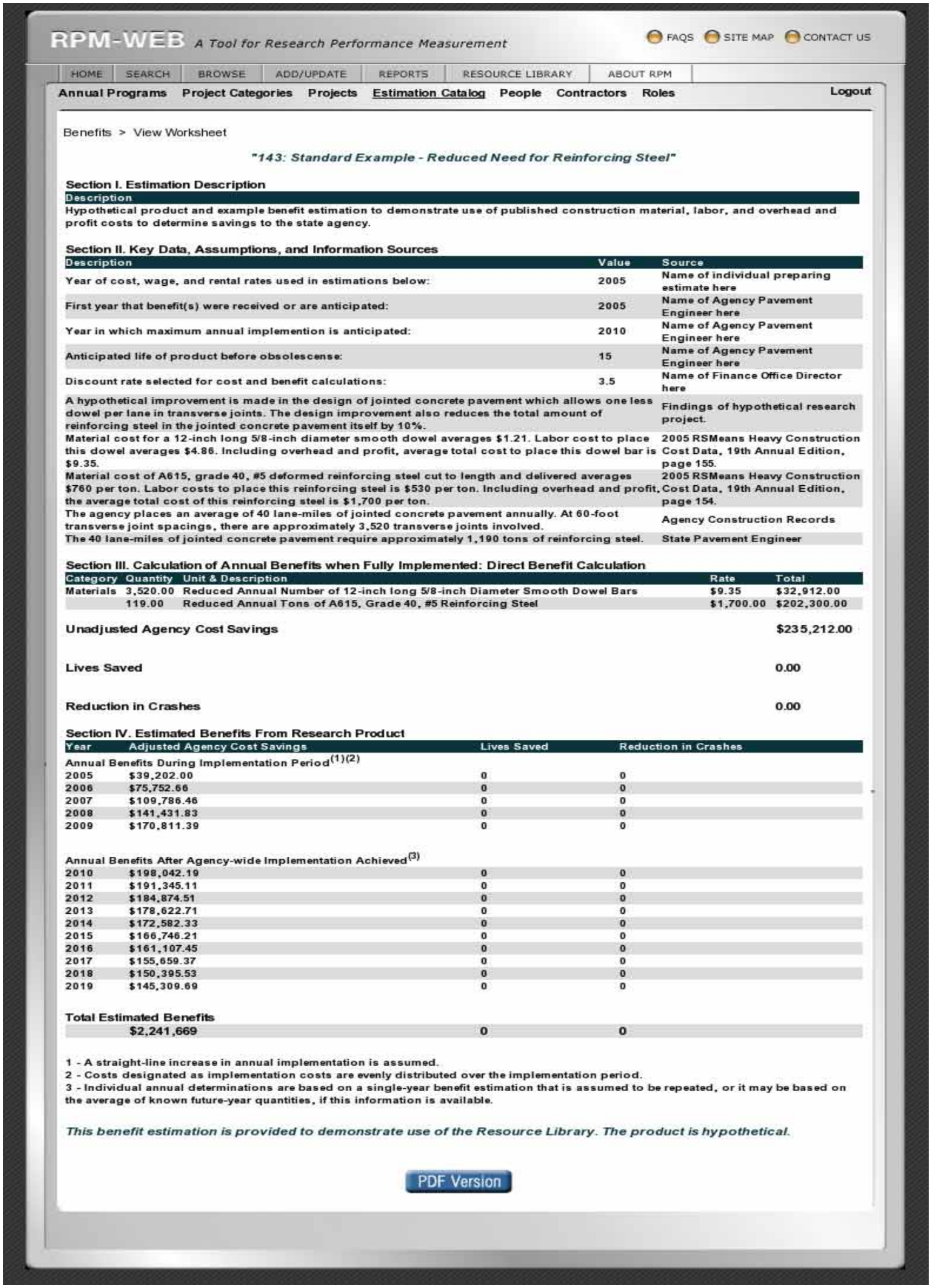
Year	Adjusted Agency Cost Savings	Lives Saved	Reduction in Crashes
Annual Benefits During Implementation Period[1][2]			
2006	$0.00	0.33	40.67
2007	$0.00	0.67	81.33
Annual Benefits After Agency-wide Implementation Achieved[3]			
2008	$0.00	1.00	122.00
2009	$0.00	1.00	122.00
2010	$0.00	1.00	122.00
2011	$0.00	1.00	122.00
2012	$0.00	1.00	122.00
2013	$0.00	1.00	122.00
2014	$0.00	1.00	122.00
2015	$0.00	1.00	122.00
Total Estimated Benefits			
	0	9	1,098

1 - A straight-line increase in annual implementation is assumed.
2 - Costs designated as implementation costs are evenly distributed over the implementation period.
3 - Individual annual determinations are based on a single-year benefit estimation that is assumed to be repeated, or it may be based on the average of known future-year quantities, if this information is available.

This benefit estimation is provided to demonstrate use of the Resource Library. The product is hypothetical.

PDF Version

4. Reduced Need for Reinforcing Steel (Hypothetical Example)



RPM-WEB *A Tool for Research Performance Measurement*

FAQS | SITE MAP | CONTACT US

HOME | SEARCH | BROWSE | ADD/UPDATE | REPORTS | RESOURCE LIBRARY | ABOUT RPM

Annual Programs | Project Categories | Projects | Estimation Catalog | People | Contractors | Roles | Logout

Benefits > View Worksheet

"143: Standard Example - Reduced Need for Reinforcing Steel"

Section I. Estimation Description

Description
Hypothetical product and example benefit estimation to demonstrate use of published construction material, labor, and overhead and profit costs to determine savings to the state agency.

Section II. Key Data, Assumptions, and Information Sources

Description	Value	Source
Year of cost, wage, and rental rates used in estimations below:	2005	Name of individual preparing estimate here
First year that benefit(s) were received or are anticipated:	2005	Name of Agency Pavement Engineer here
Year in which maximum annual implemention is anticipated:	2010	Name of Agency Pavement Engineer here
Anticipated life of product before obsolescense:	15	Name of Agency Pavement Engineer here
Discount rate selected for cost and benefit calculations:	3.5	Name of Finance Office Director here
A hypothetical improvement is made in the design of jointed concrete pavement which allows one less dowel per lane in transverse joints. The design improvement also reduces the total amount of reinforcing steel in the jointed concrete pavement itself by 10%.		Findings of hypothetical research project.
Material cost for a 12-inch long 5/8-inch diameter smooth dowel averages $1.21. Labor cost to place this dowel averages $4.86. Including overhead and profit, average total cost to place this dowel bar is $9.35.		2005 RSMeans Heavy Construction Cost Data, 19th Annual Edition, page 155.
Material cost of A615, grade 40, #5 deformed reinforcing steel cut to length and delivered averages $760 per ton. Labor costs to place this reinforcing steel is $530 per ton. Including overhead and profit, the average total cost of this reinforcing steel is $1,700 per ton.		2005 RSMeans Heavy Construction Cost Data, 19th Annual Edition, page 154.
The agency places an average of 40 lane-miles of jointed concrete pavement annually. At 60-foot transverse joint spacings, there are approximately 3,520 transverse joints involved.		Agency Construction Records
The 40 lane-miles of jointed concrete pavement require approximately 1,190 tons of reinforcing steel.		State Pavement Engineer

Section III. Calculation of Annual Benefits when Fully Implemented: Direct Benefit Calculation

Category	Quantity	Unit & Description	Rate	Total
Materials	3,520.00	Reduced Annual Number of 12-inch long 5/8-inch Diameter Smooth Dowel Bars	$9.35	$32,912.00
	119.00	Reduced Annual Tons of A615, Grade 40, #5 Reinforcing Steel	$1,700.00	$202,300.00

Unadjusted Agency Cost Savings $235,212.00

Lives Saved 0.00

Reduction in Crashes 0.00

Section IV. Estimated Benefits From Research Product

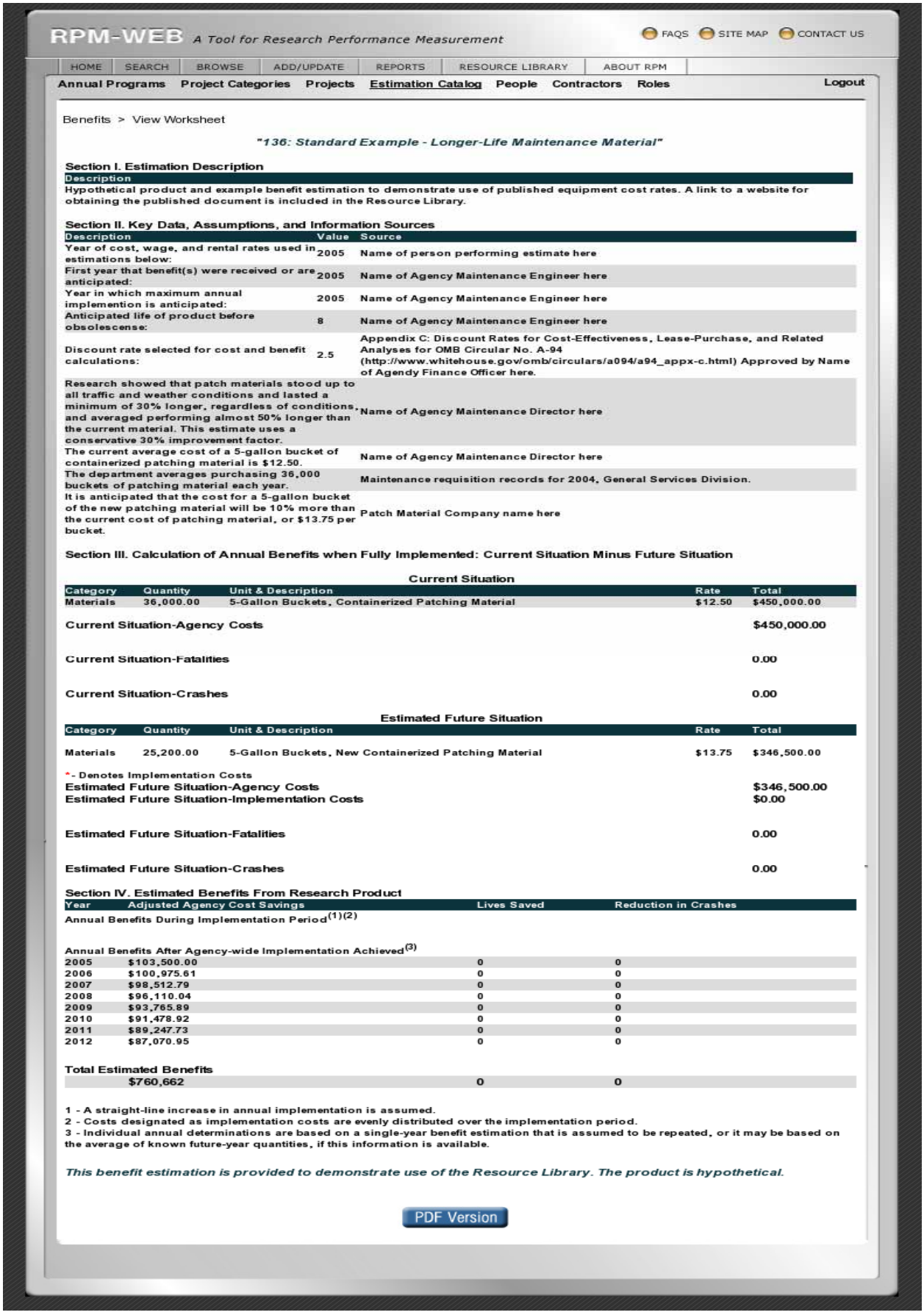
Year	Adjusted Agency Cost Savings	Lives Saved	Reduction in Crashes
Annual Benefits During Implementation Period[1][2]			
2005	$39,202.00	0	0
2006	$75,752.66	0	0
2007	$109,786.46	0	0
2008	$141,431.83	0	0
2009	$170,811.39	0	0
Annual Benefits After Agency-wide Implementation Achieved[3]			
2010	$198,042.19	0	0
2011	$191,345.11	0	0
2012	$184,874.51	0	0
2013	$178,622.71	0	0
2014	$172,582.33	0	0
2015	$166,746.21	0	0
2016	$161,107.45	0	0
2017	$155,659.37	0	0
2018	$150,395.53	0	0
2019	$145,309.69	0	0
Total Estimated Benefits			
	$2,241,669	0	0

1 - A straight-line increase in annual implementation is assumed.
2 - Costs designated as implementation costs are evenly distributed over the implementation period.
3 - Individual annual determinations are based on a single-year benefit estimation that is assumed to be repeated, or it may be based on the average of known future-year quantities, if this information is available.

This benefit estimation is provided to demonstrate use of the Resource Library. The product is hypothetical.

PDF Version

5. Longer-Life Maintenance Material (Hypothetical Example)



RPM-WEB *A Tool for Research Performance Measurement*

FAQS | SITE MAP | CONTACT US

HOME | SEARCH | BROWSE | ADD/UPDATE | REPORTS | RESOURCE LIBRARY | ABOUT RPM

Annual Programs | Project Categories | Projects | Estimation Catalog | People | Contractors | Roles | Logout

Benefits > View Worksheet

"136: Standard Example - Longer-Life Maintenance Material"

Section I. Estimation Description

Description
Hypothetical product and example benefit estimation to demonstrate use of published equipment cost rates. A link to a website for obtaining the published document is included in the Resource Library.

Section II. Key Data, Assumptions, and Information Sources

Description	Value	Source
Year of cost, wage, and rental rates used in estimations below:	2005	Name of person performing estimate here
First year that benefit(s) were received or are anticipated:	2005	Name of Agency Maintenance Engineer here
Year in which maximum annual implemention is anticipated:	2005	Name of Agency Maintenance Engineer here
Anticipated life of product before obsolescense:	8	Name of Agency Maintenance Engineer here
Discount rate selected for cost and benefit calculations:	2.5	Appendix C: Discount Rates for Cost-Effectiveness, Lease-Purchase, and Related Analyses for OMB Circular No. A-94 (http://www.whitehouse.gov/omb/circulars/a094/a94_appx-c.html) Approved by Name of Agendy Finance Officer here.
Research showed that patch materials stood up to all traffic and weather conditions and lasted a minimum of 30% longer, regardless of conditions, and averaged performing almost 50% longer than the current material. This estimate uses a conservative 30% improvement factor.		Name of Agency Maintenance Director here
The current average cost of a 5-gallon bucket of containerized patching material is $12.50.		Name of Agency Maintenance Director here
The department averages purchasing 36,000 buckets of patching material each year.		Maintenance requisition records for 2004, General Services Division.
It is anticipated that the cost for a 5-gallon bucket of the new patching material will be 10% more than the current cost of patching material, or $13.75 per bucket.		Patch Material Company name here

Section III. Calculation of Annual Benefits when Fully Implemented: Current Situation Minus Future Situation

Current Situation

Category	Quantity	Unit & Description	Rate	Total
Materials	36,000.00	5-Gallon Buckets, Containerized Patching Material	$12.50	$450,000.00

Current Situation-Agency Costs $450,000.00

Current Situation-Fatalities 0.00

Current Situation-Crashes 0.00

Estimated Future Situation

Category	Quantity	Unit & Description	Rate	Total
Materials	25,200.00	5-Gallon Buckets, New Containerized Patching Material	$13.75	$346,500.00

*- Denotes Implementation Costs

Estimated Future Situation-Agency Costs $346,500.00

Estimated Future Situation-Implementation Costs $0.00

Estimated Future Situation-Fatalities 0.00

Estimated Future Situation-Crashes 0.00

Section IV. Estimated Benefits From Research Product

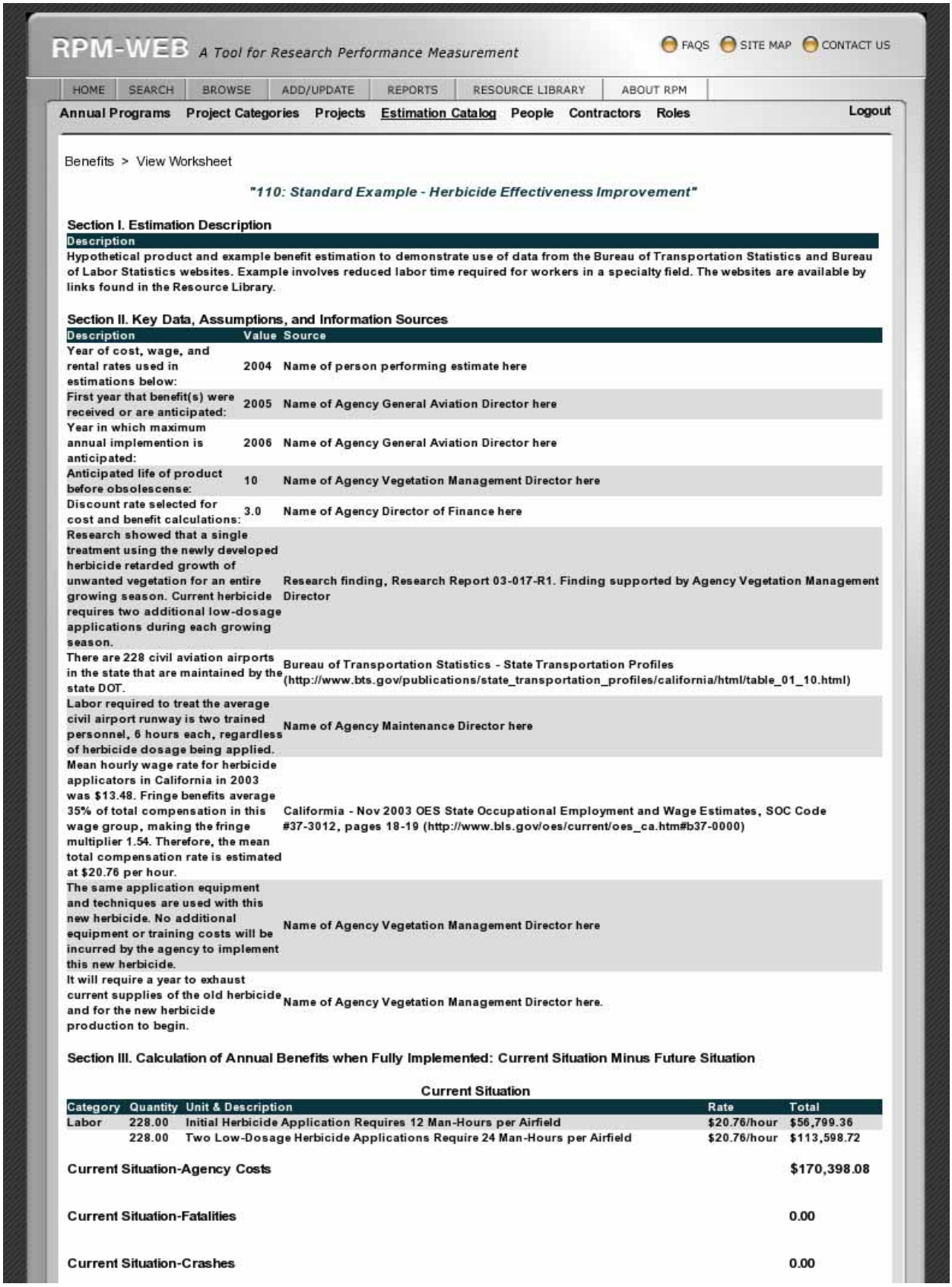
Year	Adjusted Agency Cost Savings	Lives Saved	Reduction in Crashes
Annual Benefits During Implementation Period[1][2]			
Annual Benefits After Agency-wide Implementation Achieved[3]			
2005	$103,500.00	0	0
2006	$100,975.61	0	0
2007	$98,512.79	0	0
2008	$96,110.04	0	0
2009	$93,765.89	0	0
2010	$91,478.92	0	0
2011	$89,247.73	0	0
2012	$87,070.95	0	0
Total Estimated Benefits			
	$760,662	0	0

1 - A straight-line increase in annual implementation is assumed.
2 - Costs designated as implementation costs are evenly distributed over the implementation period.
3 - Individual annual determinations are based on a single-year benefit estimation that is assumed to be repeated, or it may be based on the average of known future-year quantities, if this information is available.

This benefit estimation is provided to demonstrate use of the Resource Library. The product is hypothetical.

PDF Version

6. Herbicide Effectiveness Improvement (Hypothetical Example)



RPM-WEB *A Tool for Research Performance Measurement*

FAQS | SITE MAP | CONTACT US

HOME | SEARCH | BROWSE | ADD/UPDATE | REPORTS | RESOURCE LIBRARY | ABOUT RPM

Annual Programs | Project Categories | Projects | Estimation Catalog | People | Contractors | Roles | Logout

Benefits > View Worksheet

"110: Standard Example - Herbicide Effectiveness Improvement"

Section I. Estimation Description

Description
Hypothetical product and example benefit estimation to demonstrate use of data from the Bureau of Transportation Statistics and Bureau of Labor Statistics websites. Example involves reduced labor time required for workers in a specialty field. The websites are available by links found in the Resource Library.

Section II. Key Data, Assumptions, and Information Sources

Description	Value	Source
Year of cost, wage, and rental rates used in estimations below:	2004	Name of person performing estimate here
First year that benefit(s) were received or are anticipated:	2005	Name of Agency General Aviation Director here
Year in which maximum annual implemention is anticipated:	2006	Name of Agency General Aviation Director here
Anticipated life of product before obsolescense:	10	Name of Agency Vegetation Management Director here
Discount rate selected for cost and benefit calculations:	3.0	Name of Agency Director of Finance here
Research showed that a single treatment using the newly developed herbicide retarded growth of unwanted vegetation for an entire growing season. Current herbicide requires two additional low-dosage applications during each growing season.		Research finding, Research Report 03-017-R1. Finding supported by Agency Vegetation Management Director
There are 228 civil aviation airports in the state that are maintained by the state DOT.		Bureau of Transportation Statistics - State Transportation Profiles (http://www.bts.gov/publications/state_transportation_profiles/california/html/table_01_10.html)
Labor required to treat the average civil airport runway is two trained personnel, 6 hours each, regardless of herbicide dosage being applied.		Name of Agency Maintenance Director here
Mean hourly wage rate for herbicide applicators in California in 2003 was $13.48. Fringe benefits average 35% of total compensation in this wage group, making the fringe multiplier 1.54. Therefore, the mean total compensation rate is estimated at $20.76 per hour.		California - Nov 2003 OES State Occupational Employment and Wage Estimates, SOC Code #37-3012, pages 18-19 (http://www.bls.gov/oes/current/oes_ca.htm#b37-0000)
The same application equipment and techniques are used with this new herbicide. No additional equipment or training costs will be incurred by the agency to implement this new herbicide.		Name of Agency Vegetation Management Director here
It will require a year to exhaust current supplies of the old herbicide and for the new herbicide production to begin.		Name of Agency Vegetation Management Director here.

Section III. Calculation of Annual Benefits when Fully Implemented: Current Situation Minus Future Situation

Current Situation

Category	Quantity	Unit & Description	Rate	Total
Labor	228.00	Initial Herbicide Application Requires 12 Man-Hours per Airfield	$20.76/hour	$56,799.36
	228.00	Two Low-Dosage Herbicide Applications Require 24 Man-Hours per Airfield	$20.76/hour	$113,598.72

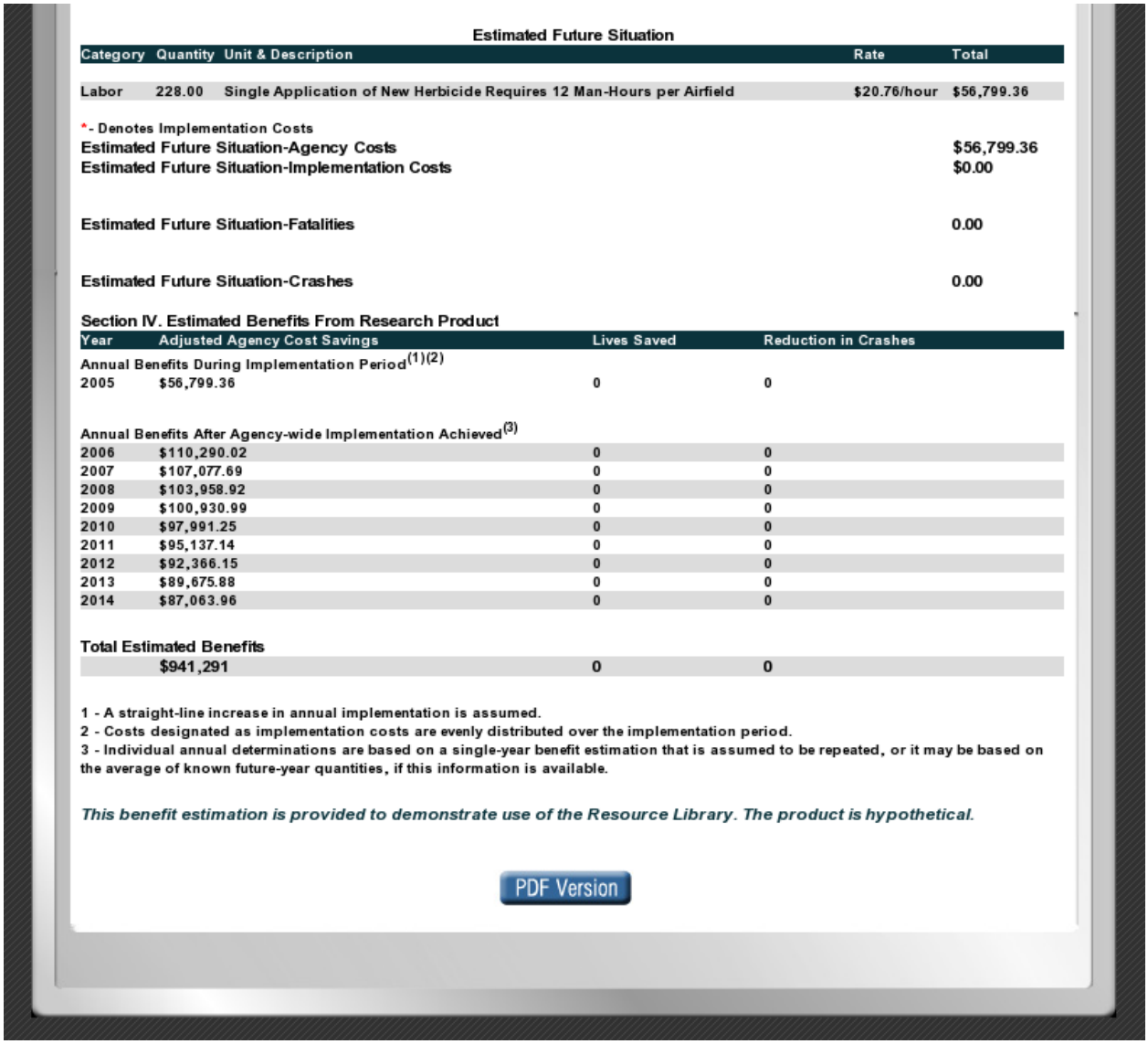
Current Situation-Agency Costs $170,398.08

Current Situation-Fatalities 0.00

Current Situation-Crashes 0.00

(This example is continued on next page)

6. Herbicide Effectiveness Improvement (Hypothetical Example) - continued



Estimated Future Situation

Category	Quantity	Unit & Description	Rate	Total
Labor	228.00	Single Application of New Herbicide Requires 12 Man-Hours per Airfield	$20.76/hour	$56,799.36

*- Denotes Implementation Costs

Estimated Future Situation-Agency Costs $56,799.36

Estimated Future Situation-Implementation Costs $0.00

Estimated Future Situation-Fatalities 0.00

Estimated Future Situation-Crashes 0.00

Section IV. Estimated Benefits From Research Product

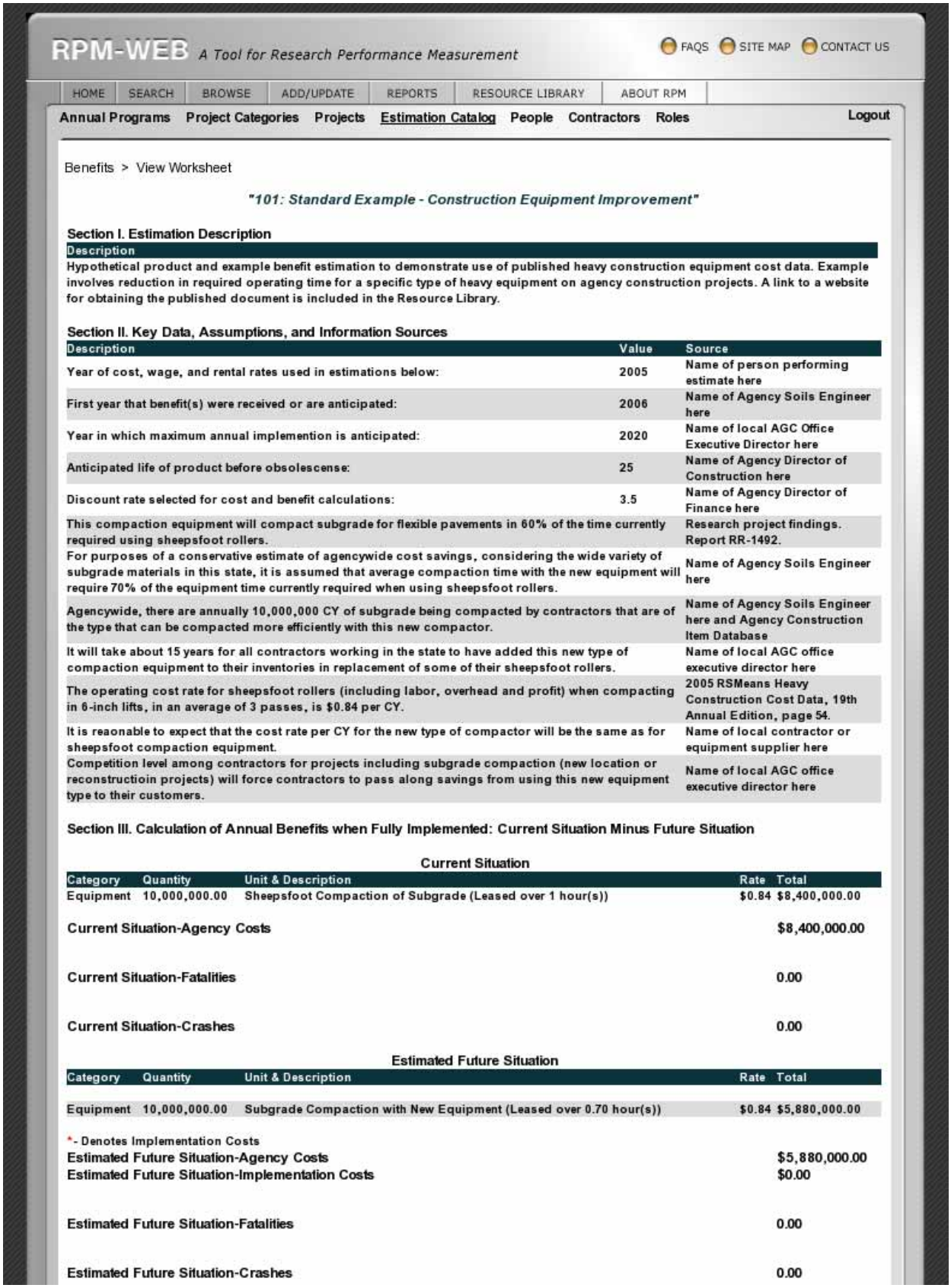
Year	Adjusted Agency Cost Savings	Lives Saved	Reduction in Crashes
Annual Benefits During Implementation Period[1][2]			
2005	$56,799.36	0	0
Annual Benefits After Agency-wide Implementation Achieved[3]			
2006	$110,290.02	0	0
2007	$107,077.69	0	0
2008	$103,958.92	0	0
2009	$100,930.99	0	0
2010	$97,991.25	0	0
2011	$95,137.14	0	0
2012	$92,366.15	0	0
2013	$89,675.88	0	0
2014	$87,063.96	0	0
Total Estimated Benefits			
	$941,291	**0**	**0**

1 - A straight-line increase in annual implementation is assumed.
2 - Costs designated as implementation costs are evenly distributed over the implementation period.
3 - Individual annual determinations are based on a single-year benefit estimation that is assumed to be repeated, or it may be based on the average of known future-year quantities, if this information is available.

This benefit estimation is provided to demonstrate use of the Resource Library. The product is hypothetical.

PDF Version

7. Construction Equipment Improvement (Hypothetical Example)



RPM-WEB *A Tool for Research Performance Measurement*

FAQS | SITE MAP | CONTACT US

HOME | SEARCH | BROWSE | ADD/UPDATE | REPORTS | RESOURCE LIBRARY | ABOUT RPM

Annual Programs | Project Categories | Projects | Estimation Catalog | People | Contractors | Roles | Logout

Benefits > View Worksheet

"101: Standard Example - Construction Equipment Improvement"

Section I. Estimation Description

Description
Hypothetical product and example benefit estimation to demonstrate use of published heavy construction equipment cost data. Example involves reduction in required operating time for a specific type of heavy equipment on agency construction projects. A link to a website for obtaining the published document is included in the Resource Library.

Section II. Key Data, Assumptions, and Information Sources

Description	Value	Source
Year of cost, wage, and rental rates used in estimations below:	2005	Name of person performing estimate here
First year that benefit(s) were received or are anticipated:	2006	Name of Agency Soils Engineer here
Year in which maximum annual implemention is anticipated:	2020	Name of local AGC Office Executive Director here
Anticipated life of product before obsolescense:	25	Name of Agency Director of Construction here
Discount rate selected for cost and benefit calculations:	3.5	Name of Agency Director of Finance here
This compaction equipment will compact subgrade for flexible pavements in 60% of the time currently required using sheepsfoot rollers.		Research project findings. Report RR-1492.
For purposes of a conservative estimate of agencywide cost savings, considering the wide variety of subgrade materials in this state, it is assumed that average compaction time with the new equipment will require 70% of the equipment time currently required when using sheepsfoot rollers.		Name of Agency Soils Engineer here
Agencywide, there are annually 10,000,000 CY of subgrade being compacted by contractors that are of the type that can be compacted more efficiently with this new compactor.		Name of Agency Soils Engineer here and Agency Construction Item Database
It will take about 15 years for all contractors working in the state to have added this new type of compaction equipment to their inventories in replacement of some of their sheepsfoot rollers.		Name of local AGC office executive director here
The operating cost rate for sheepsfoot rollers (including labor, overhead and profit) when compacting in 6-inch lifts, in an average of 3 passes, is $0.84 per CY.		2005 RSMeans Heavy Construction Cost Data, 19th Annual Edition, page 54.
It is reaonable to expect that the cost rate per CY for the new type of compactor will be the same as for sheepsfoot compaction equipment.		Name of local contractor or equipment supplier here
Competition level among contractors for projects including subgrade compaction (new location or reconstructioin projects) will force contractors to pass along savings from using this new equipment type to their customers.		Name of local AGC office executive director here

Section III. Calculation of Annual Benefits when Fully Implemented: Current Situation Minus Future Situation

Current Situation

Category	Quantity	Unit & Description	Rate	Total
Equipment	10,000,000.00	Sheepsfoot Compaction of Subgrade (Leased over 1 hour(s))	$0.84	$8,400,000.00

Current Situation-Agency Costs $8,400,000.00

Current Situation-Fatalities 0.00

Current Situation-Crashes 0.00

Estimated Future Situation

Category	Quantity	Unit & Description	Rate	Total
Equipment	10,000,000.00	Subgrade Compaction with New Equipment (Leased over 0.70 hour(s))	$0.84	$5,880,000.00

*- Denotes Implementation Costs

Estimated Future Situation-Agency Costs $5,880,000.00

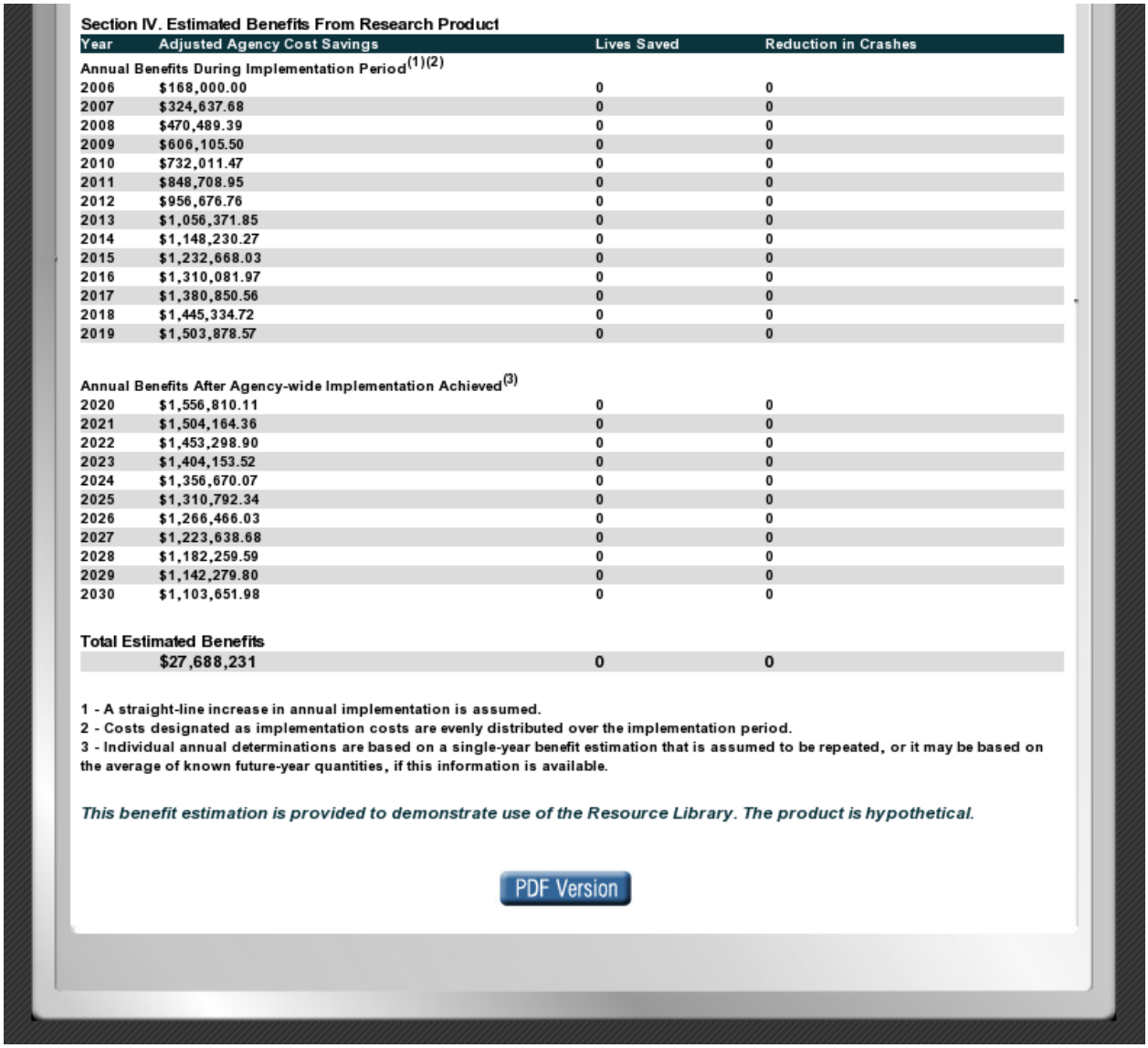
Estimated Future Situation-Implementation Costs $0.00

Estimated Future Situation-Fatalities 0.00

Estimated Future Situation-Crashes 0.00

(This example is continued on next page)

7. Construction Equipment Improvement (Hypothetical Example) - continued



Section IV. Estimated Benefits From Research Product

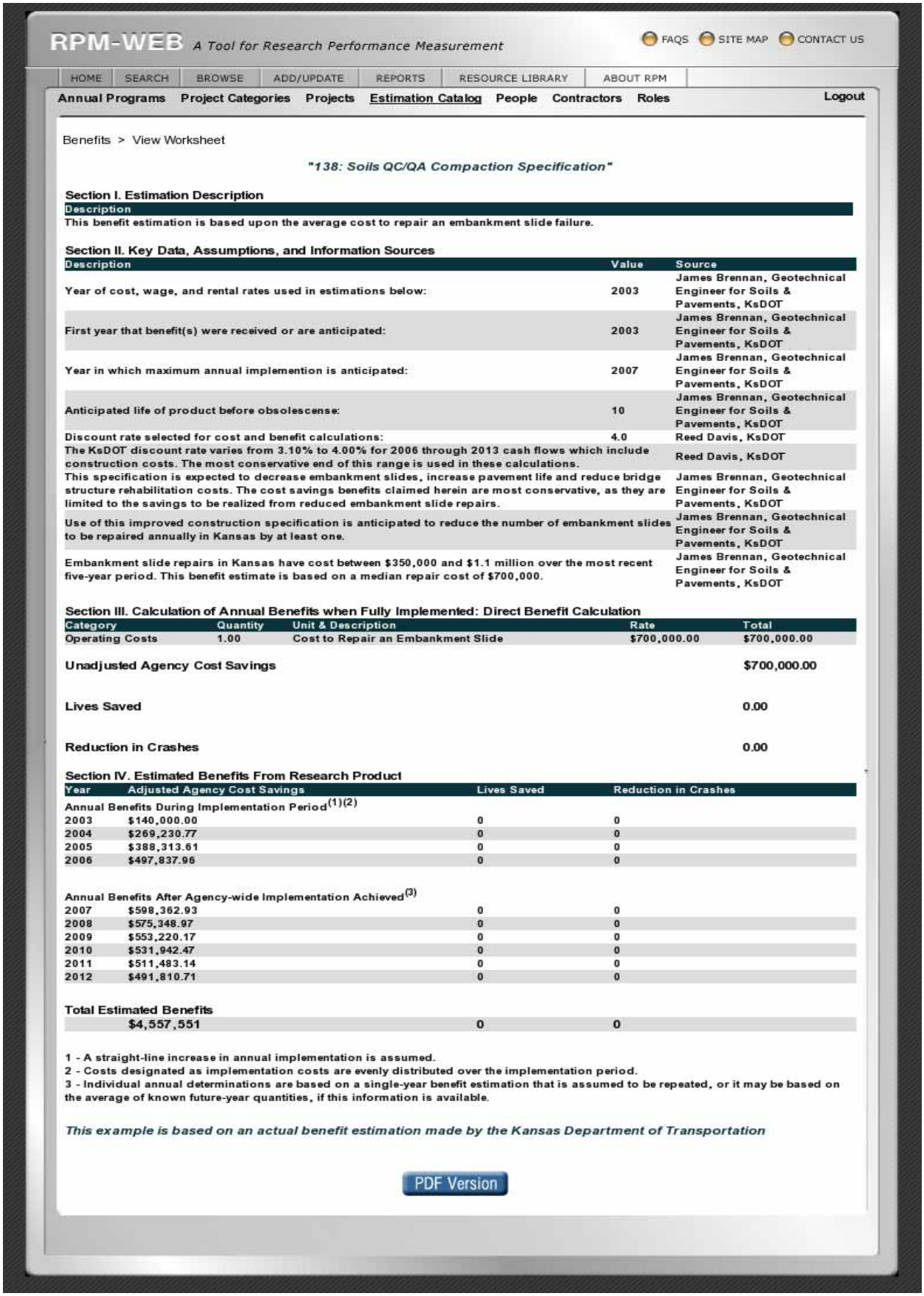
Year	Adjusted Agency Cost Savings	Lives Saved	Reduction in Crashes
Annual Benefits During Implementation Period[1][2]			
2006	$168,000.00	0	0
2007	$324,637.68	0	0
2008	$470,489.39	0	0
2009	$606,105.50	0	0
2010	$732,011.47	0	0
2011	$848,708.95	0	0
2012	$956,676.76	0	0
2013	$1,056,371.85	0	0
2014	$1,148,230.27	0	0
2015	$1,232,668.03	0	0
2016	$1,310,081.97	0	0
2017	$1,380,850.56	0	0
2018	$1,445,334.72	0	0
2019	$1,503,878.57	0	0
Annual Benefits After Agency-wide Implementation Achieved[3]			
2020	$1,556,810.11	0	0
2021	$1,504,164.36	0	0
2022	$1,453,298.90	0	0
2023	$1,404,153.52	0	0
2024	$1,356,670.07	0	0
2025	$1,310,792.34	0	0
2026	$1,266,466.03	0	0
2027	$1,223,638.68	0	0
2028	$1,182,259.59	0	0
2029	$1,142,279.80	0	0
2030	$1,103,651.98	0	0
Total Estimated Benefits			
	$27,688,231	0	0

1 - A straight-line increase in annual implementation is assumed.
2 - Costs designated as implementation costs are evenly distributed over the implementation period.
3 - Individual annual determinations are based on a single-year benefit estimation that is assumed to be repeated, or it may be based on the average of known future-year quantities, if this information is available.

This benefit estimation is provided to demonstrate use of the Resource Library. The product is hypothetical.

PDF Version

8. Soils QC/QA Compaction Specification



RPM-WEB *A Tool for Research Performance Measurement*

FAQS | SITE MAP | CONTACT US

HOME | SEARCH | BROWSE | ADD/UPDATE | REPORTS | RESOURCE LIBRARY | ABOUT RPM

Annual Programs | Project Categories | Projects | Estimation Catalog | People | Contractors | Roles | Logout

Benefits > View Worksheet

"138: Soils QC/QA Compaction Specification"

Section I. Estimation Description

Description
This benefit estimation is based upon the average cost to repair an embankment slide failure.

Section II. Key Data, Assumptions, and Information Sources

Description	Value	Source
Year of cost, wage, and rental rates used in estimations below:	2003	James Brennan, Geotechnical Engineer for Soils & Pavements, KsDOT
First year that benefit(s) were received or are anticipated:	2003	James Brennan, Geotechnical Engineer for Soils & Pavements, KsDOT
Year in which maximum annual implemention is anticipated:	2007	James Brennan, Geotechnical Engineer for Soils & Pavements, KsDOT
Anticipated life of product before obsolescense:	10	James Brennan, Geotechnical Engineer for Soils & Pavements, KsDOT
Discount rate selected for cost and benefit calculations:	4.0	Reed Davis, KsDOT
The KsDOT discount rate varies from 3.10% to 4.00% for 2006 through 2013 cash flows which include construction costs. The most conservative end of this range is used in these calculations.		Reed Davis, KsDOT
This specification is expected to decrease embankment slides, increase pavement life and reduce bridge structure rehabilitation costs. The cost savings benefits claimed herein are most conservative, as they are limited to the savings to be realized from reduced embankment slide repairs.		James Brennan, Geotechnical Engineer for Soils & Pavements, KsDOT
Use of this improved construction specification is anticipated to reduce the number of embankment slides to be repaired annually in Kansas by at least one.		James Brennan, Geotechnical Engineer for Soils & Pavements, KsDOT
Embankment slide repairs in Kansas have cost between $350,000 and $1.1 million over the most recent five-year period. This benefit estimate is based on a median repair cost of $700,000.		James Brennan, Geotechnical Engineer for Soils & Pavements, KsDOT

Section III. Calculation of Annual Benefits when Fully Implemented: Direct Benefit Calculation

Category	Quantity	Unit & Description	Rate	Total
Operating Costs	1.00	Cost to Repair an Embankment Slide	$700,000.00	$700,000.00

Unadjusted Agency Cost Savings $700,000.00

Lives Saved 0.00

Reduction in Crashes 0.00

Section IV. Estimated Benefits From Research Product

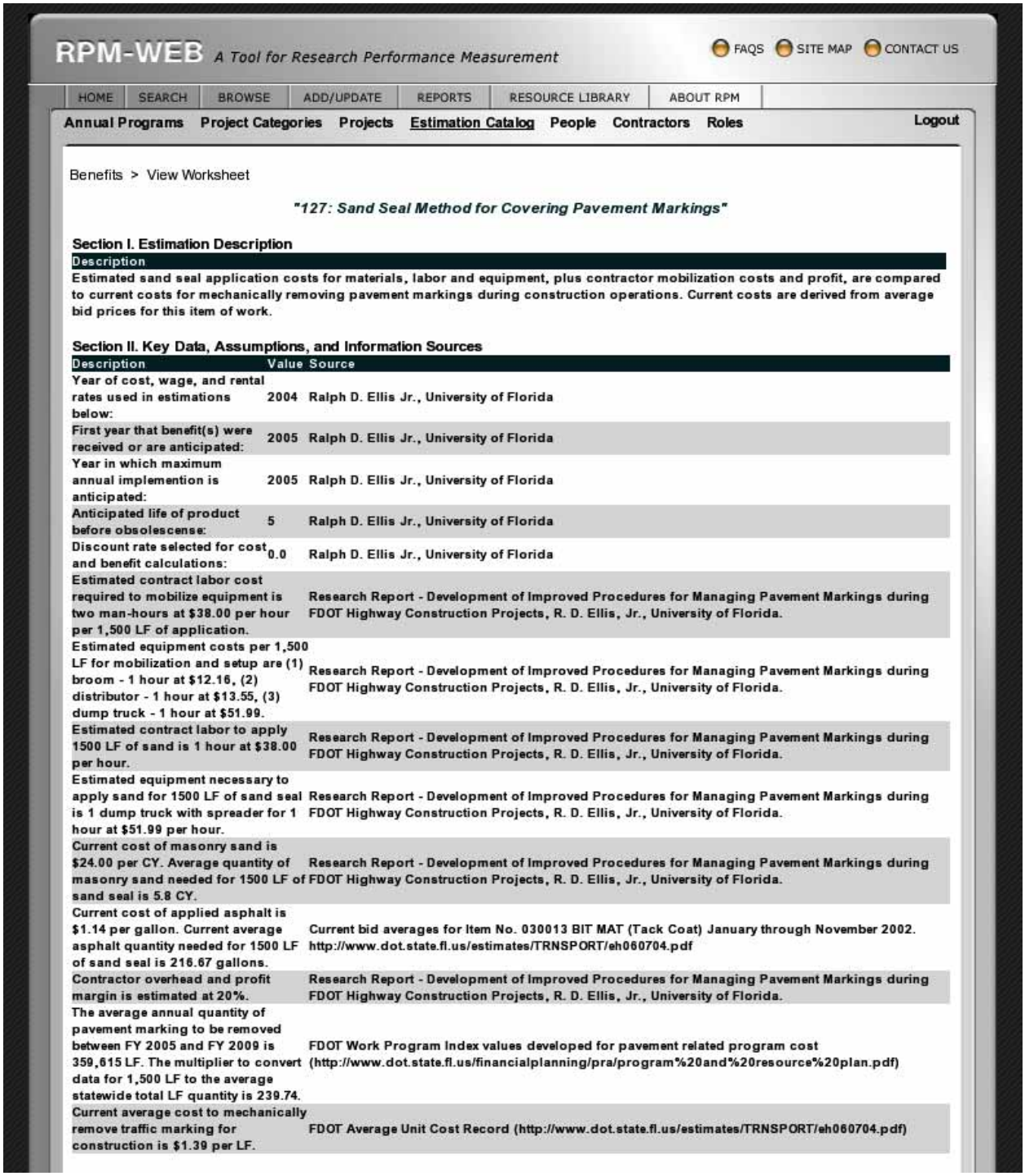
Year	Adjusted Agency Cost Savings	Lives Saved	Reduction in Crashes
Annual Benefits During Implementation Period[1][2]			
2003	$140,000.00	0	0
2004	$269,230.77	0	0
2005	$388,313.61	0	0
2006	$497,837.96	0	0
Annual Benefits After Agency-wide Implementation Achieved[3]			
2007	$598,362.93	0	0
2008	$575,348.97	0	0
2009	$553,220.17	0	0
2010	$531,942.47	0	0
2011	$511,483.14	0	0
2012	$491,810.71	0	0
Total Estimated Benefits			
	$4,557,551	0	0

1 - A straight-line increase in annual implementation is assumed.
2 - Costs designated as implementation costs are evenly distributed over the implementation period.
3 - Individual annual determinations are based on a single-year benefit estimation that is assumed to be repeated, or it may be based on the average of known future-year quantities, if this information is available.

This example is based on an actual benefit estimation made by the Kansas Department of Transportation

PDF Version

9. Sand Seal Method of Covering Pavement Markings



RPM-WEB *A Tool for Research Performance Measurement*

FAQS | SITE MAP | CONTACT US

HOME | SEARCH | BROWSE | ADD/UPDATE | REPORTS | RESOURCE LIBRARY | ABOUT RPM

Annual Programs | Project Categories | Projects | Estimation Catalog | People | Contractors | Roles | Logout

Benefits > View Worksheet

"127: Sand Seal Method for Covering Pavement Markings"

Section I. Estimation Description

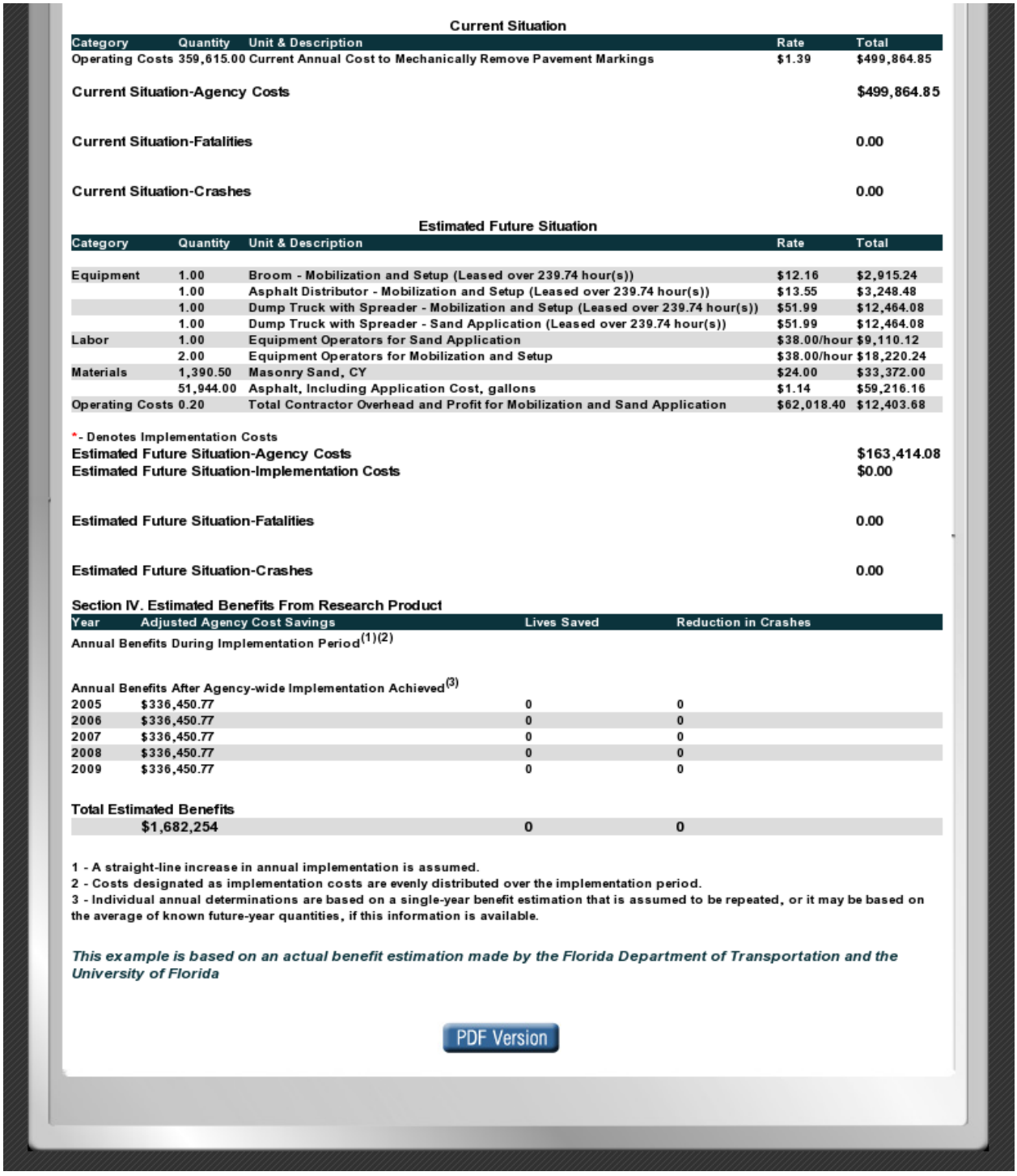
Description
Estimated sand seal application costs for materials, labor and equipment, plus contractor mobilization costs and profit, are compared to current costs for mechanically removing pavement markings during construction operations. Current costs are derived from average bid prices for this item of work.

Section II. Key Data, Assumptions, and Information Sources

Description	Value	Source
Year of cost, wage, and rental rates used in estimations below:	2004	Ralph D. Ellis Jr., University of Florida
First year that benefit(s) were received or are anticipated:	2005	Ralph D. Ellis Jr., University of Florida
Year in which maximum annual implemention is anticipated:	2005	Ralph D. Ellis Jr., University of Florida
Anticipated life of product before obsolescense:	5	Ralph D. Ellis Jr., University of Florida
Discount rate selected for cost and benefit calculations:	0.0	Ralph D. Ellis Jr., University of Florida
Estimated contract labor cost required to mobilize equipment is two man-hours at $38.00 per hour per 1,500 LF of application.		Research Report - Development of Improved Procedures for Managing Pavement Markings during FDOT Highway Construction Projects, R. D. Ellis, Jr., University of Florida.
Estimated equipment costs per 1,500 LF for mobilization and setup are (1) broom - 1 hour at $12.16, (2) distributor - 1 hour at $13.55, (3) dump truck - 1 hour at $51.99.		Research Report - Development of Improved Procedures for Managing Pavement Markings during FDOT Highway Construction Projects, R. D. Ellis, Jr., University of Florida.
Estimated contract labor to apply 1500 LF of sand is 1 hour at $38.00 per hour.		Research Report - Development of Improved Procedures for Managing Pavement Markings during FDOT Highway Construction Projects, R. D. Ellis, Jr., University of Florida.
Estimated equipment necessary to apply sand for 1500 LF of sand seal is 1 dump truck with spreader for 1 hour at $51.99 per hour.		Research Report - Development of Improved Procedures for Managing Pavement Markings during FDOT Highway Construction Projects, R. D. Ellis, Jr., University of Florida.
Current cost of masonry sand is $24.00 per CY. Average quantity of masonry sand needed for 1500 LF of sand seal is 5.8 CY.		Research Report - Development of Improved Procedures for Managing Pavement Markings during FDOT Highway Construction Projects, R. D. Ellis, Jr., University of Florida.
Current cost of applied asphalt is $1.14 per gallon. Current average asphalt quantity needed for 1500 LF of sand seal is 216.67 gallons.		Current bid averages for Item No. 030013 BIT MAT (Tack Coat) January through November 2002. http://www.dot.state.fl.us/estimates/TRNSPORT/eh060704.pdf
Contractor overhead and profit margin is estimated at 20%.		Research Report - Development of Improved Procedures for Managing Pavement Markings during FDOT Highway Construction Projects, R. D. Ellis, Jr., University of Florida.
The average annual quantity of pavement marking to be removed between FY 2005 and FY 2009 is 359,615 LF. The multiplier to convert data for 1,500 LF to the average statewide total LF quantity is 239.74.		FDOT Work Program Index values developed for pavement related program cost (http://www.dot.state.fl.us/financialplanning/pra/program%20and%20resource%20plan.pdf)
Current average cost to mechanically remove traffic marking for construction is $1.39 per LF.		FDOT Average Unit Cost Record (http://www.dot.state.fl.us/estimates/TRNSPORT/eh060704.pdf)

(This example is continued on the next page)

9. Sand Seal Method of Covering Pavement Markings – continued



Current Situation

Category	Quantity	Unit & Description	Rate	Total
Operating Costs	359,615.00	Current Annual Cost to Mechanically Remove Pavement Markings	$1.39	$499,864.85

Current Situation-Agency Costs $499,864.85

Current Situation-Fatalities 0.00

Current Situation-Crashes 0.00

Estimated Future Situation

Category	Quantity	Unit & Description	Rate	Total
Equipment	1.00	Broom - Mobilization and Setup (Leased over 239.74 hour(s))	$12.16	$2,915.24
	1.00	Asphalt Distributor - Mobilization and Setup (Leased over 239.74 hour(s))	$13.55	$3,248.48
	1.00	Dump Truck with Spreader - Mobilization and Setup (Leased over 239.74 hour(s))	$51.99	$12,464.08
	1.00	Dump Truck with Spreader - Sand Application (Leased over 239.74 hour(s))	$51.99	$12,464.08
Labor	1.00	Equipment Operators for Sand Application	$38.00/hour	$9,110.12
	2.00	Equipment Operators for Mobilization and Setup	$38.00/hour	$18,220.24
Materials	1,390.50	Masonry Sand, CY	$24.00	$33,372.00
	51,944.00	Asphalt, Including Application Cost, gallons	$1.14	$59,216.16
Operating Costs	0.20	Total Contractor Overhead and Profit for Mobilization and Sand Application	$62,018.40	$12,403.68

*- Denotes Implementation Costs

Estimated Future Situation-Agency Costs $163,414.08
Estimated Future Situation-Implementation Costs $0.00

Estimated Future Situation-Fatalities 0.00

Estimated Future Situation-Crashes 0.00

Section IV. Estimated Benefits From Research Product

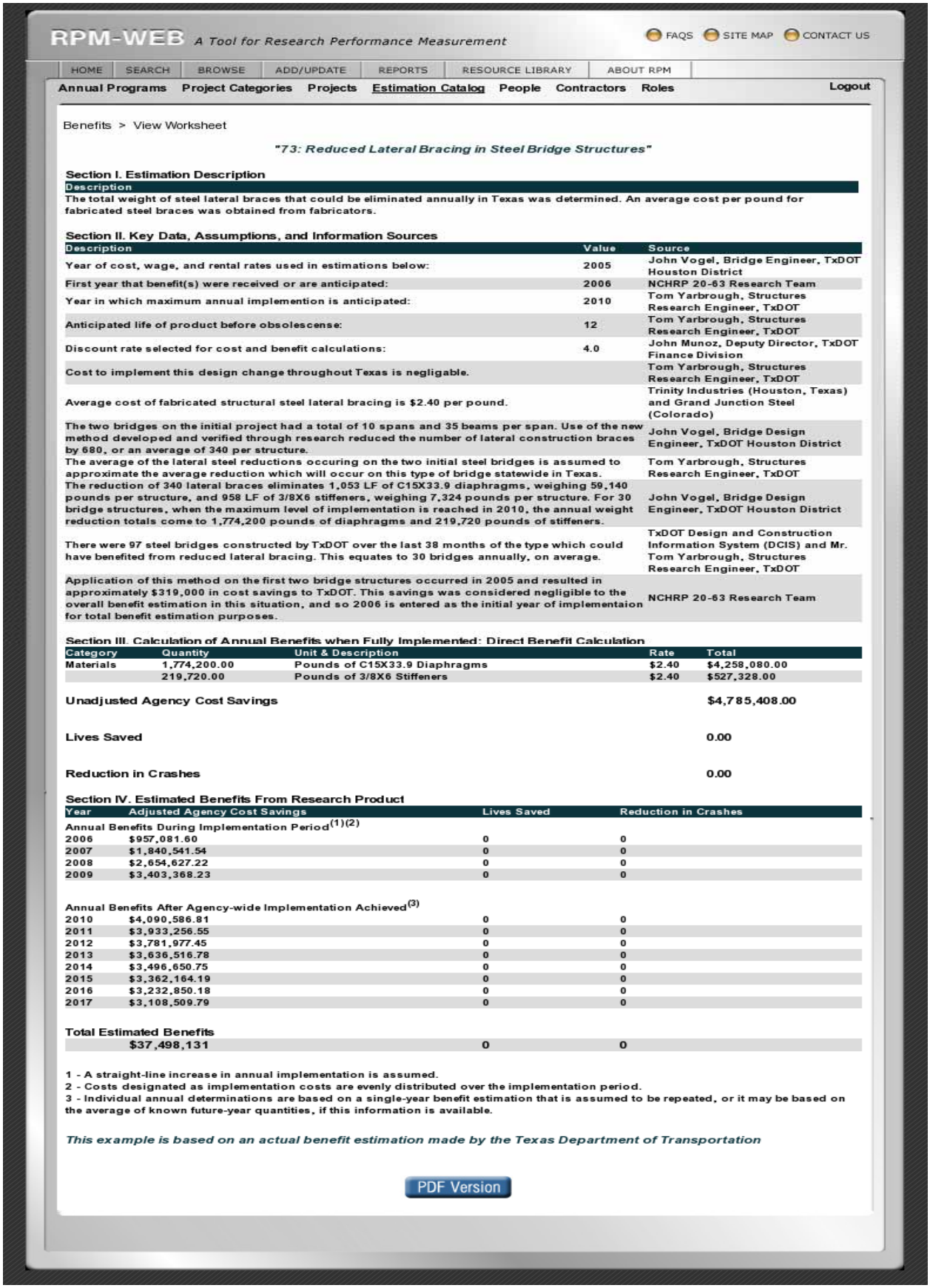
Year	Adjusted Agency Cost Savings	Lives Saved	Reduction in Crashes
Annual Benefits During Implementation Period[1][2]			
Annual Benefits After Agency-wide Implementation Achieved[3]			
2005	$336,450.77	0	0
2006	$336,450.77	0	0
2007	$336,450.77	0	0
2008	$336,450.77	0	0
2009	$336,450.77	0	0
Total Estimated Benefits			
	$1,682,254	0	0

1 - A straight-line increase in annual implementation is assumed.
2 - Costs designated as implementation costs are evenly distributed over the implementation period.
3 - Individual annual determinations are based on a single-year benefit estimation that is assumed to be repeated, or it may be based on the average of known future-year quantities, if this information is available.

This example is based on an actual benefit estimation made by the Florida Department of Transportation and the University of Florida

PDF Version

10. Reduced Lateral Bracing in Steel Bridge Structures



RPM-WEB *A Tool for Research Performance Measurement*

FAQS | SITE MAP | CONTACT US

HOME | SEARCH | BROWSE | ADD/UPDATE | REPORTS | RESOURCE LIBRARY | ABOUT RPM

Annual Programs | Project Categories | Projects | Estimation Catalog | People | Contractors | Roles | Logout

Benefits > View Worksheet

"73: Reduced Lateral Bracing in Steel Bridge Structures"

Section I. Estimation Description

Description

The total weight of steel lateral braces that could be eliminated annually in Texas was determined. An average cost per pound for fabricated steel braces was obtained from fabricators.

Section II. Key Data, Assumptions, and Information Sources

Description	Value	Source
Year of cost, wage, and rental rates used in estimations below:	2005	John Vogel, Bridge Engineer, TxDOT Houston District
First year that benefit(s) were received or are anticipated:	2006	NCHRP 20-63 Research Team
Year in which maximum annual implemention is anticipated:	2010	Tom Yarbrough, Structures Research Engineer, TxDOT
Anticipated life of product before obsolescense:	12	Tom Yarbrough, Structures Research Engineer, TxDOT
Discount rate selected for cost and benefit calculations:	4.0	John Munoz, Deputy Director, TxDOT Finance Division
Cost to implement this design change throughout Texas is negligable.		Tom Yarbrough, Structures Research Engineer, TxDOT
Average cost of fabricated structural steel lateral bracing is $2.40 per pound.		Trinity Industries (Houston, Texas) and Grand Junction Steel (Colorado)
The two bridges on the initial project had a total of 10 spans and 35 beams per span. Use of the new method developed and verified through research reduced the number of lateral construction braces by 680, or an average of 340 per structure.		John Vogel, Bridge Design Engineer, TxDOT Houston District
The average of the lateral steel reductions occuring on the two initial steel bridges is assumed to approximate the average reduction which will occur on this type of bridge statewide in Texas.		Tom Yarbrough, Structures Research Engineer, TxDOT
The reduction of 340 lateral braces eliminates 1,053 LF of C15X33.9 diaphragms, weighing 59,140 pounds per structure, and 958 LF of 3/8X6 stiffeners, weighing 7,324 pounds per structure. For 30 bridge structures, when the maximum level of implementation is reached in 2010, the annual weight reduction totals come to 1,774,200 pounds of diaphragms and 219,720 pounds of stiffeners.		John Vogel, Bridge Design Engineer, TxDOT Houston District
There were 97 steel bridges constructed by TxDOT over the last 38 months of the type which could have benefited from reduced lateral bracing. This equates to 30 bridges annually, on average.		TxDOT Design and Construction Information System (DCIS) and Mr. Tom Yarbrough, Structures Research Engineer, TxDOT
Application of this method on the first two bridge structures occurred in 2005 and resulted in approximately $319,000 in cost savings to TxDOT. This savings was considered negligible to the overall benefit estimation in this situation, and so 2006 is entered as the initial year of implementaion for total benefit estimation purposes.		NCHRP 20-63 Research Team

Section III. Calculation of Annual Benefits when Fully Implemented: Direct Benefit Calculation

Category	Quantity	Unit & Description	Rate	Total
Materials	1,774,200.00	Pounds of C15X33.9 Diaphragms	$2.40	$4,258,080.00
	219,720.00	Pounds of 3/8X6 Stiffeners	$2.40	$527,328.00

Unadjusted Agency Cost Savings $4,785,408.00

Lives Saved 0.00

Reduction in Crashes 0.00

Section IV. Estimated Benefits From Research Product

Year	Adjusted Agency Cost Savings	Lives Saved	Reduction in Crashes
Annual Benefits During Implementation Period[1][2]			
2006	$957,081.60	0	0
2007	$1,840,541.54	0	0
2008	$2,654,627.22	0	0
2009	$3,403,368.23	0	0
Annual Benefits After Agency-wide Implementation Achieved[3]			
2010	$4,090,586.81	0	0
2011	$3,933,256.55	0	0
2012	$3,781,977.45	0	0
2013	$3,636,516.78	0	0
2014	$3,496,650.75	0	0
2015	$3,362,164.19	0	0
2016	$3,232,850.18	0	0
2017	$3,108,509.79	0	0

Total Estimated Benefits

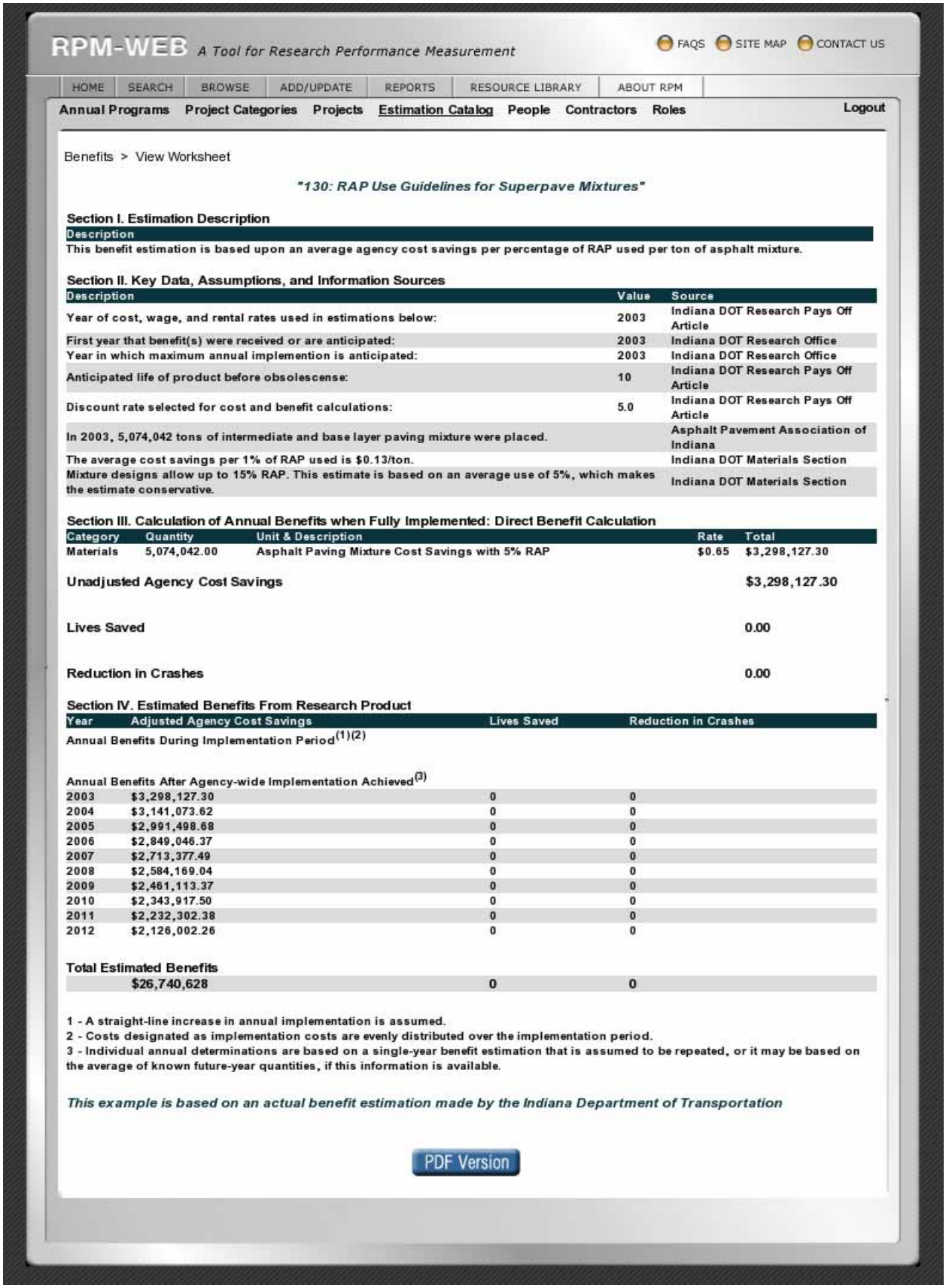
$37,498,131 | 0 | 0

1 - A straight-line increase in annual implementation is assumed.
2 - Costs designated as implementation costs are evenly distributed over the implementation period.
3 - Individual annual determinations are based on a single-year benefit estimation that is assumed to be repeated, or it may be based on the average of known future-year quantities, if this information is available.

This example is based on an actual benefit estimation made by the Texas Department of Transportation

PDF Version

11. RAP Use Guidelines for Superpave Mixtures



RPM-WEB *A Tool for Research Performance Measurement*

FAQS | SITE MAP | CONTACT US

HOME | SEARCH | BROWSE | ADD/UPDATE | REPORTS | RESOURCE LIBRARY | ABOUT RPM

Annual Programs | Project Categories | Projects | Estimation Catalog | People | Contractors | Roles | Logout

Benefits > View Worksheet

"130: RAP Use Guidelines for Superpave Mixtures"

Section I. Estimation Description

Description
This benefit estimation is based upon an average agency cost savings per percentage of RAP used per ton of asphalt mixture.

Section II. Key Data, Assumptions, and Information Sources

Description	Value	Source
Year of cost, wage, and rental rates used in estimations below:	2003	Indiana DOT Research Pays Off Article
First year that benefit(s) were received or are anticipated:	2003	Indiana DOT Research Office
Year in which maximum annual implemention is anticipated:	2003	Indiana DOT Research Office
Anticipated life of product before obsolescense:	10	Indiana DOT Research Pays Off Article
Discount rate selected for cost and benefit calculations:	5.0	Indiana DOT Research Pays Off Article
In 2003, 5,074,042 tons of intermediate and base layer paving mixture were placed.		Asphalt Pavement Association of Indiana
The average cost savings per 1% of RAP used is $0.13/ton.		Indiana DOT Materials Section
Mixture designs allow up to 15% RAP. This estimate is based on an average use of 5%, which makes the estimate conservative.		Indiana DOT Materials Section

Section III. Calculation of Annual Benefits when Fully Implemented: Direct Benefit Calculation

Category	Quantity	Unit & Description	Rate	Total
Materials	5,074,042.00	Asphalt Paving Mixture Cost Savings with 5% RAP	$0.65	$3,298,127.30

Unadjusted Agency Cost Savings	**$3,298,127.30**
Lives Saved	**0.00**
Reduction in Crashes	**0.00**

Section IV. Estimated Benefits From Research Product

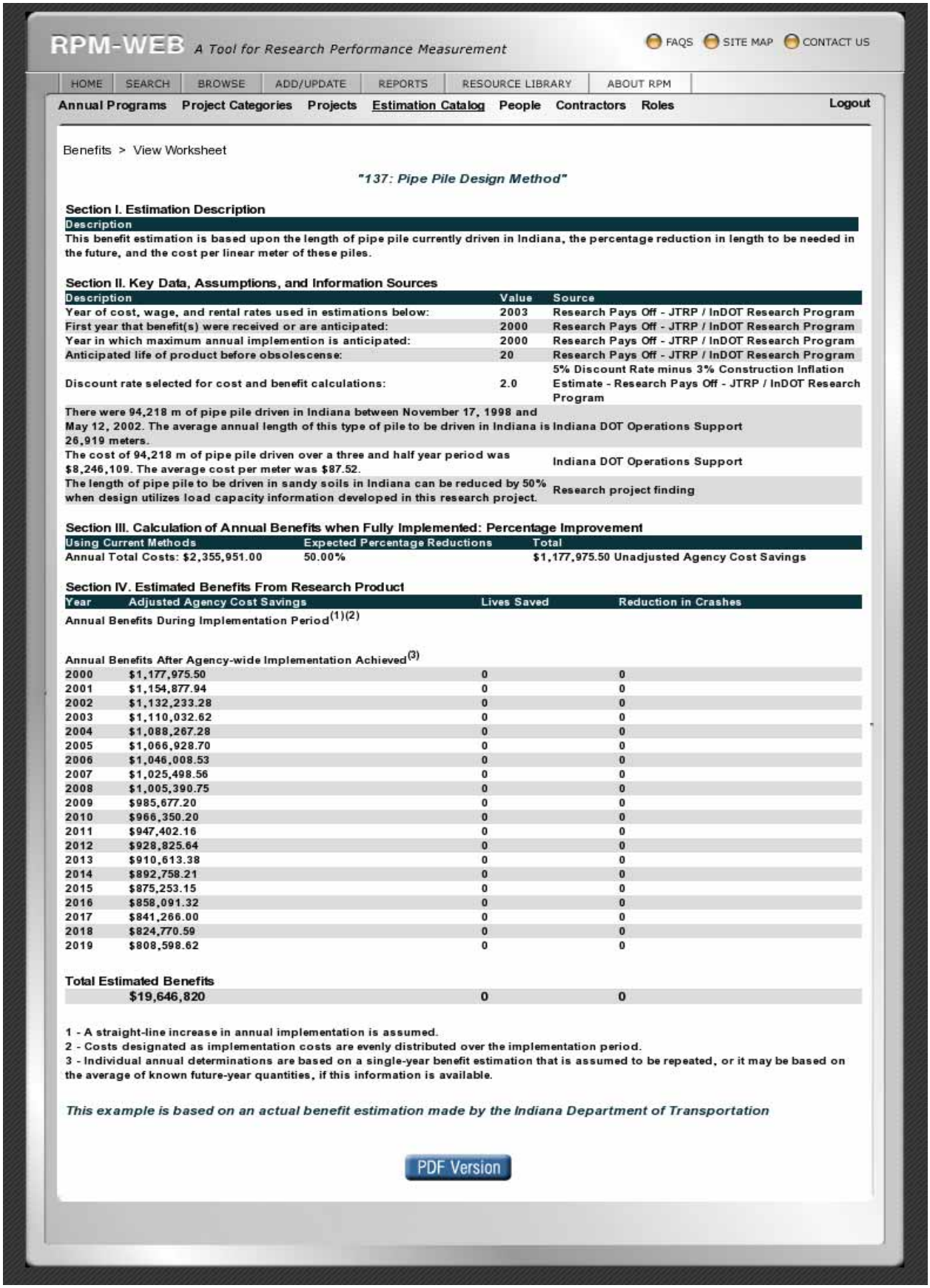
Year	Adjusted Agency Cost Savings	Lives Saved	Reduction in Crashes
Annual Benefits During Implementation Period[1][2]			
Annual Benefits After Agency-wide Implementation Achieved[3]			
2003	$3,298,127.30	0	0
2004	$3,141,073.62	0	0
2005	$2,991,498.68	0	0
2006	$2,849,046.37	0	0
2007	$2,713,377.49	0	0
2008	$2,584,169.04	0	0
2009	$2,461,113.37	0	0
2010	$2,343,917.50	0	0
2011	$2,232,302.38	0	0
2012	$2,126,002.26	0	0
Total Estimated Benefits			
	$26,740,628	**0**	**0**

1 - A straight-line increase in annual implementation is assumed.
2 - Costs designated as implementation costs are evenly distributed over the implementation period.
3 - Individual annual determinations are based on a single-year benefit estimation that is assumed to be repeated, or it may be based on the average of known future-year quantities, if this information is available.

This example is based on an actual benefit estimation made by the Indiana Department of Transportation

PDF Version

12. Pipe Pile Design Method



RPM-WEB *A Tool for Research Performance Measurement*

FAQS | SITE MAP | CONTACT US

HOME | SEARCH | BROWSE | ADD/UPDATE | REPORTS | RESOURCE LIBRARY | ABOUT RPM

Annual Programs | Project Categories | Projects | Estimation Catalog | People | Contractors | Roles | Logout

Benefits > View Worksheet

"137: Pipe Pile Design Method"

Section I. Estimation Description

Description
This benefit estimation is based upon the length of pipe pile currently driven in Indiana, the percentage reduction in length to be needed in the future, and the cost per linear meter of these piles.

Section II. Key Data, Assumptions, and Information Sources

Description	Value	Source
Year of cost, wage, and rental rates used in estimations below:	2003	Research Pays Off - JTRP / InDOT Research Program
First year that benefit(s) were received or are anticipated:	2000	Research Pays Off - JTRP / InDOT Research Program
Year in which maximum annual implemention is anticipated:	2000	Research Pays Off - JTRP / InDOT Research Program
Anticipated life of product before obsolescense:	20	Research Pays Off - JTRP / InDOT Research Program
Discount rate selected for cost and benefit calculations:	2.0	5% Discount Rate minus 3% Construction Inflation Estimate - Research Pays Off - JTRP / InDOT Research Program
There were 94,218 m of pipe pile driven in Indiana between November 17, 1998 and May 12, 2002. The average annual length of this type of pile to be driven in Indiana is 26,919 meters.		Indiana DOT Operations Support
The cost of 94,218 m of pipe pile driven over a three and half year period was $8,246,109. The average cost per meter was $87.52.		Indiana DOT Operations Support
The length of pipe pile to be driven in sandy soils in Indiana can be reduced by 50% when design utilizes load capacity information developed in this research project.		Research project finding

Section III. Calculation of Annual Benefits when Fully Implemented: Percentage Improvement

Using Current Methods	Expected Percentage Reductions	Total
Annual Total Costs: $2,355,951.00	50.00%	$1,177,975.50 Unadjusted Agency Cost Savings

Section IV. Estimated Benefits From Research Product

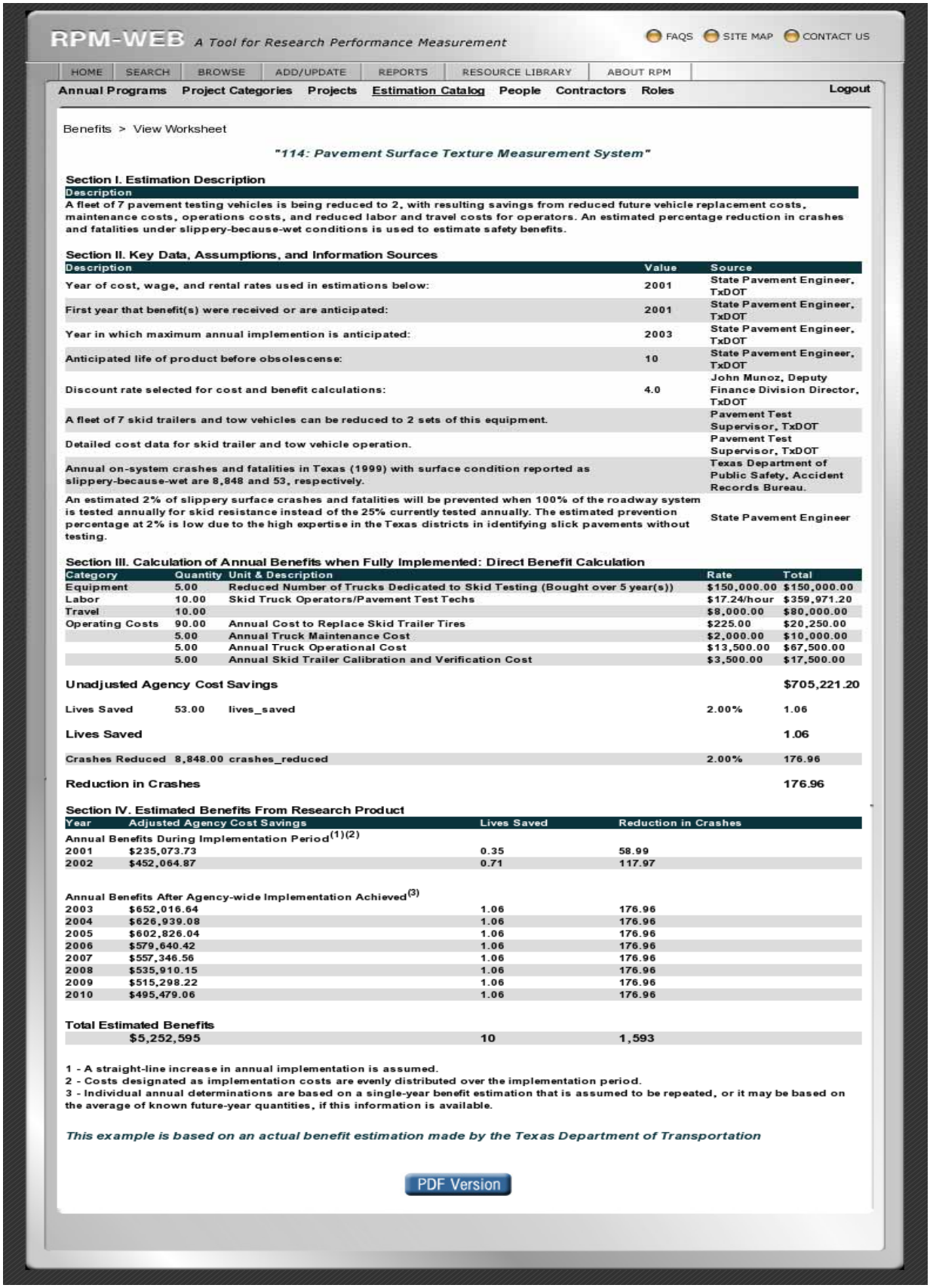
Year	Adjusted Agency Cost Savings	Lives Saved	Reduction in Crashes
Annual Benefits During Implementation Period[1][2]			
Annual Benefits After Agency-wide Implementation Achieved[3]			
2000	$1,177,975.50	0	0
2001	$1,154,877.94	0	0
2002	$1,132,233.28	0	0
2003	$1,110,032.62	0	0
2004	$1,088,267.28	0	0
2005	$1,066,928.70	0	0
2006	$1,046,008.53	0	0
2007	$1,025,498.56	0	0
2008	$1,005,390.75	0	0
2009	$985,677.20	0	0
2010	$966,350.20	0	0
2011	$947,402.16	0	0
2012	$928,825.64	0	0
2013	$910,613.38	0	0
2014	$892,758.21	0	0
2015	$875,253.15	0	0
2016	$858,091.32	0	0
2017	$841,266.00	0	0
2018	$824,770.59	0	0
2019	$808,598.62	0	0
Total Estimated Benefits			
	$19,646,820	**0**	**0**

1 - A straight-line increase in annual implementation is assumed.
2 - Costs designated as implementation costs are evenly distributed over the implementation period.
3 - Individual annual determinations are based on a single-year benefit estimation that is assumed to be repeated, or it may be based on the average of known future-year quantities, if this information is available.

This example is based on an actual benefit estimation made by the Indiana Department of Transportation

PDF Version

13. Pavement Surface Texture Measurement System



RPM-WEB *A Tool for Research Performance Measurement*

FAQS | SITE MAP | CONTACT US

HOME | SEARCH | BROWSE | ADD/UPDATE | REPORTS | RESOURCE LIBRARY | ABOUT RPM

Annual Programs | Project Categories | Projects | Estimation Catalog | People | Contractors | Roles | Logout

Benefits > View Worksheet

"114: Pavement Surface Texture Measurement System"

Section I. Estimation Description

Description

A fleet of 7 pavement testing vehicles is being reduced to 2, with resulting savings from reduced future vehicle replacement costs, maintenance costs, operations costs, and reduced labor and travel costs for operators. An estimated percentage reduction in crashes and fatalities under slippery-because-wet conditions is used to estimate safety benefits.

Section II. Key Data, Assumptions, and Information Sources

Description	Value	Source
Year of cost, wage, and rental rates used in estimations below:	2001	State Pavement Engineer, TxDOT
First year that benefit(s) were received or are anticipated:	2001	State Pavement Engineer, TxDOT
Year in which maximum annual implemention is anticipated:	2003	State Pavement Engineer, TxDOT
Anticipated life of product before obsolescense:	10	State Pavement Engineer, TxDOT
Discount rate selected for cost and benefit calculations:	4.0	John Munoz, Deputy Finance Division Director, TxDOT
A fleet of 7 skid trailers and tow vehicles can be reduced to 2 sets of this equipment.		Pavement Test Supervisor, TxDOT
Detailed cost data for skid trailer and tow vehicle operation.		Pavement Test Supervisor, TxDOT
Annual on-system crashes and fatalities in Texas (1999) with surface condition reported as slippery-because-wet are 8,848 and 53, respectively.		Texas Department of Public Safety, Accident Records Bureau.
An estimated 2% of slippery surface crashes and fatalities will be prevented when 100% of the roadway system is tested annually for skid resistance instead of the 25% currently tested annually. The estimated prevention percentage at 2% is low due to the high expertise in the Texas districts in identifying slick pavements without testing.		State Pavement Engineer

Section III. Calculation of Annual Benefits when Fully Implemented: Direct Benefit Calculation

Category	Quantity	Unit & Description	Rate	Total
Equipment	5.00	Reduced Number of Trucks Dedicated to Skid Testing (Bought over 5 year(s))	$150,000.00	$150,000.00
Labor	10.00	Skid Truck Operators/Pavement Test Techs	$17.24/hour	$359,971.20
Travel	10.00		$8,000.00	$80,000.00
Operating Costs	90.00	Annual Cost to Replace Skid Trailer Tires	$225.00	$20,250.00
	5.00	Annual Truck Maintenance Cost	$2,000.00	$10,000.00
	5.00	Annual Truck Operational Cost	$13,500.00	$67,500.00
	5.00	Annual Skid Trailer Calibration and Verification Cost	$3,500.00	$17,500.00
Unadjusted Agency Cost Savings				**$705,221.20**
Lives Saved	53.00	lives_saved	2.00%	1.06
Lives Saved				**1.06**
Crashes Reduced	8,848.00	crashes_reduced	2.00%	176.96
Reduction in Crashes				**176.96**

Section IV. Estimated Benefits From Research Product

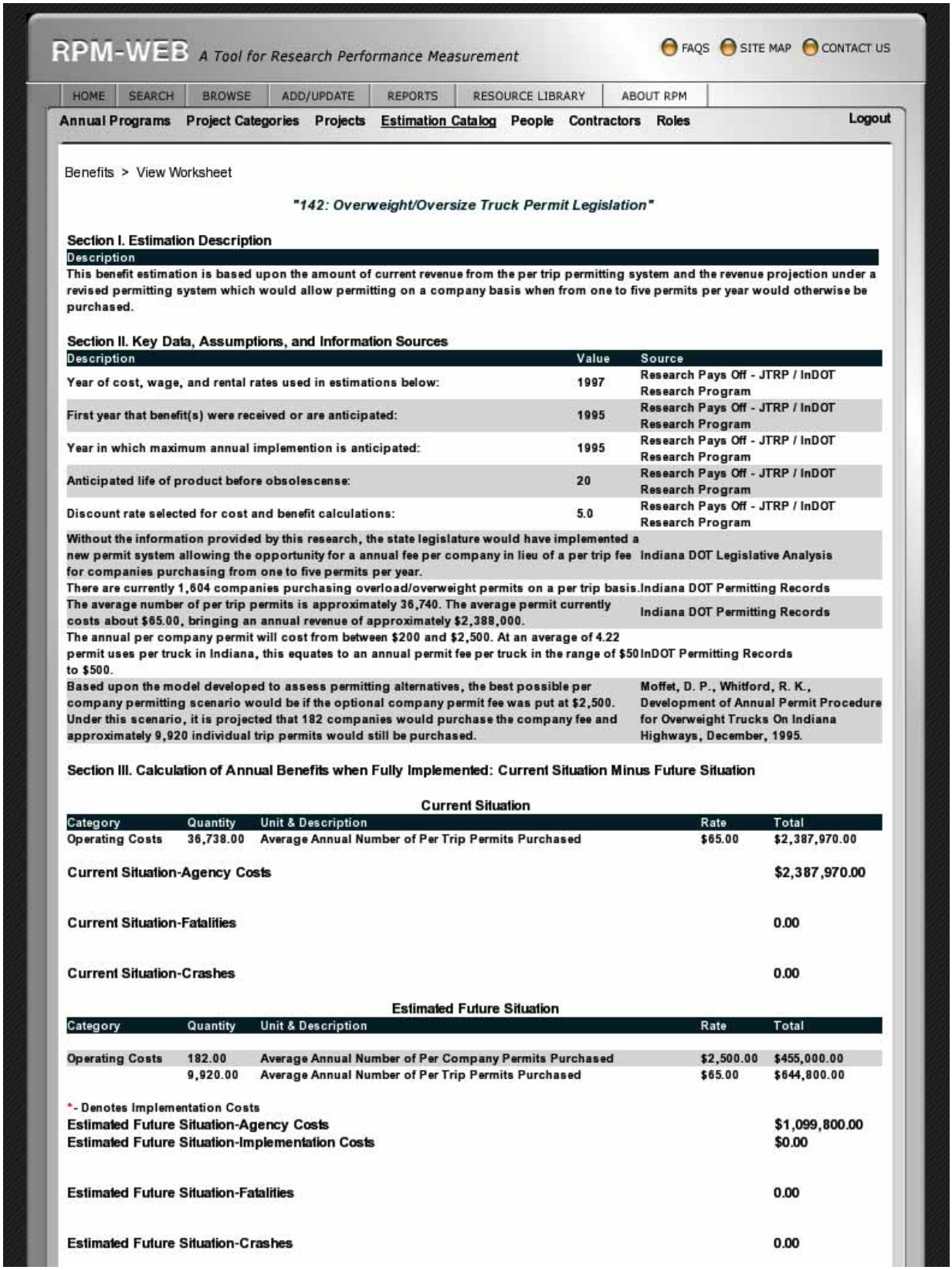
Year	Adjusted Agency Cost Savings	Lives Saved	Reduction in Crashes
Annual Benefits During Implementation Period[1][2]			
2001	$235,073.73	0.35	58.99
2002	$452,064.87	0.71	117.97
Annual Benefits After Agency-wide Implementation Achieved[3]			
2003	$652,016.64	1.06	176.96
2004	$626,939.08	1.06	176.96
2005	$602,826.04	1.06	176.96
2006	$579,640.42	1.06	176.96
2007	$557,346.56	1.06	176.96
2008	$535,910.15	1.06	176.96
2009	$515,298.22	1.06	176.96
2010	$495,479.06	1.06	176.96
Total Estimated Benefits			
	$5,252,595	10	1,593

1 - A straight-line increase in annual implementation is assumed.
2 - Costs designated as implementation costs are evenly distributed over the implementation period.
3 - Individual annual determinations are based on a single-year benefit estimation that is assumed to be repeated, or it may be based on the average of known future-year quantities, if this information is available.

This example is based on an actual benefit estimation made by the Texas Department of Transportation

PDF Version

14. Overweight/Oversize Truck Permit Legislation



RPM-WEB *A Tool for Research Performance Measurement*

FAQS | SITE MAP | CONTACT US

HOME | SEARCH | BROWSE | ADD/UPDATE | REPORTS | RESOURCE LIBRARY | ABOUT RPM

Annual Programs | Project Categories | Projects | Estimation Catalog | People | Contractors | Roles | Logout

Benefits > View Worksheet

"142: Overweight/Oversize Truck Permit Legislation"

Section I. Estimation Description

Description
This benefit estimation is based upon the amount of current revenue from the per trip permitting system and the revenue projection under a revised permitting system which would allow permitting on a company basis when from one to five permits per year would otherwise be purchased.

Section II. Key Data, Assumptions, and Information Sources

Description	Value	Source
Year of cost, wage, and rental rates used in estimations below:	1997	Research Pays Off - JTRP / InDOT Research Program
First year that benefit(s) were received or are anticipated:	1995	Research Pays Off - JTRP / InDOT Research Program
Year in which maximum annual implemention is anticipated:	1995	Research Pays Off - JTRP / InDOT Research Program
Anticipated life of product before obsolescense:	20	Research Pays Off - JTRP / InDOT Research Program
Discount rate selected for cost and benefit calculations:	5.0	Research Pays Off - JTRP / InDOT Research Program
Without the information provided by this research, the state legislature would have implemented a new permit system allowing the opportunity for a annual fee per company in lieu of a per trip fee for companies purchasing from one to five permits per year.		Indiana DOT Legislative Analysis
There are currently 1,604 companies purchasing overload/overweight permits on a per trip basis.		Indiana DOT Permitting Records
The average number of per trip permits is approximately 36,740. The average permit currently costs about $65.00, bringing an annual revenue of approximately $2,388,000.		Indiana DOT Permitting Records
The annual per company permit will cost from between $200 and $2,500. At an average of 4.22 permit uses per truck in Indiana, this equates to an annual permit fee per truck in the range of $50 to $500.		InDOT Permitting Records
Based upon the model developed to assess permitting alternatives, the best possible per company permitting scenario would be if the optional company permit fee was put at $2,500. Under this scenario, it is projected that 182 companies would purchase the company fee and approximately 9,920 individual trip permits would still be purchased.		Moffet, D. P., Whitford, R. K., Development of Annual Permit Procedure for Overweight Trucks On Indiana Highways, December, 1995.

Section III. Calculation of Annual Benefits when Fully Implemented: Current Situation Minus Future Situation

Current Situation

Category	Quantity	Unit & Description	Rate	Total
Operating Costs	36,738.00	Average Annual Number of Per Trip Permits Purchased	$65.00	$2,387,970.00

Current Situation-Agency Costs $2,387,970.00

Current Situation-Fatalities 0.00

Current Situation-Crashes 0.00

Estimated Future Situation

Category	Quantity	Unit & Description	Rate	Total
Operating Costs	182.00	Average Annual Number of Per Company Permits Purchased	$2,500.00	$455,000.00
	9,920.00	Average Annual Number of Per Trip Permits Purchased	$65.00	$644,800.00

*- Denotes Implementation Costs

Estimated Future Situation-Agency Costs $1,099,800.00

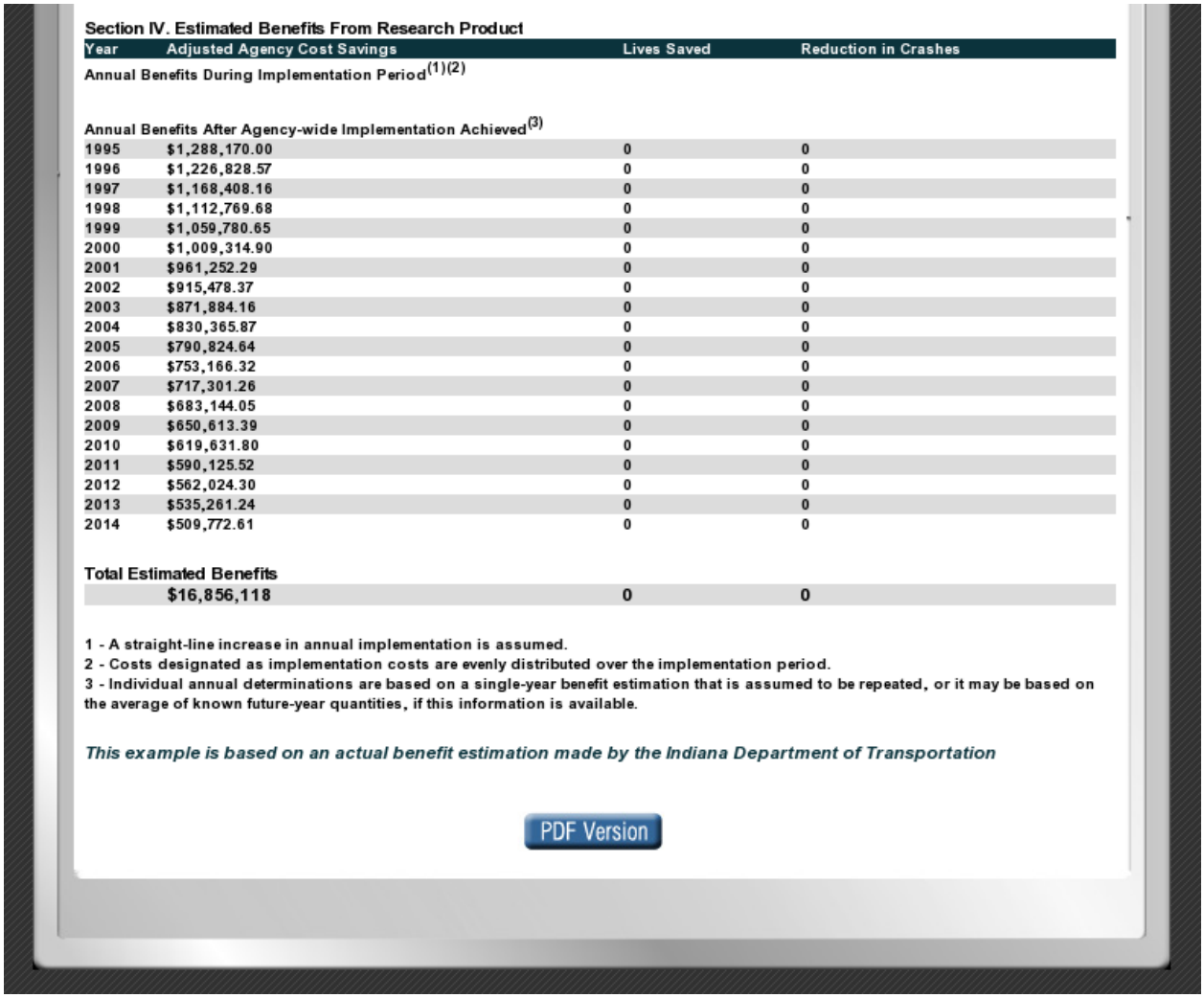
Estimated Future Situation-Implementation Costs $0.00

Estimated Future Situation-Fatalities 0.00

Estimated Future Situation-Crashes 0.00

(This example is continued on the next page)

14. Overweight/Oversize Truck Permit Legislation – continued



Section IV. Estimated Benefits From Research Product

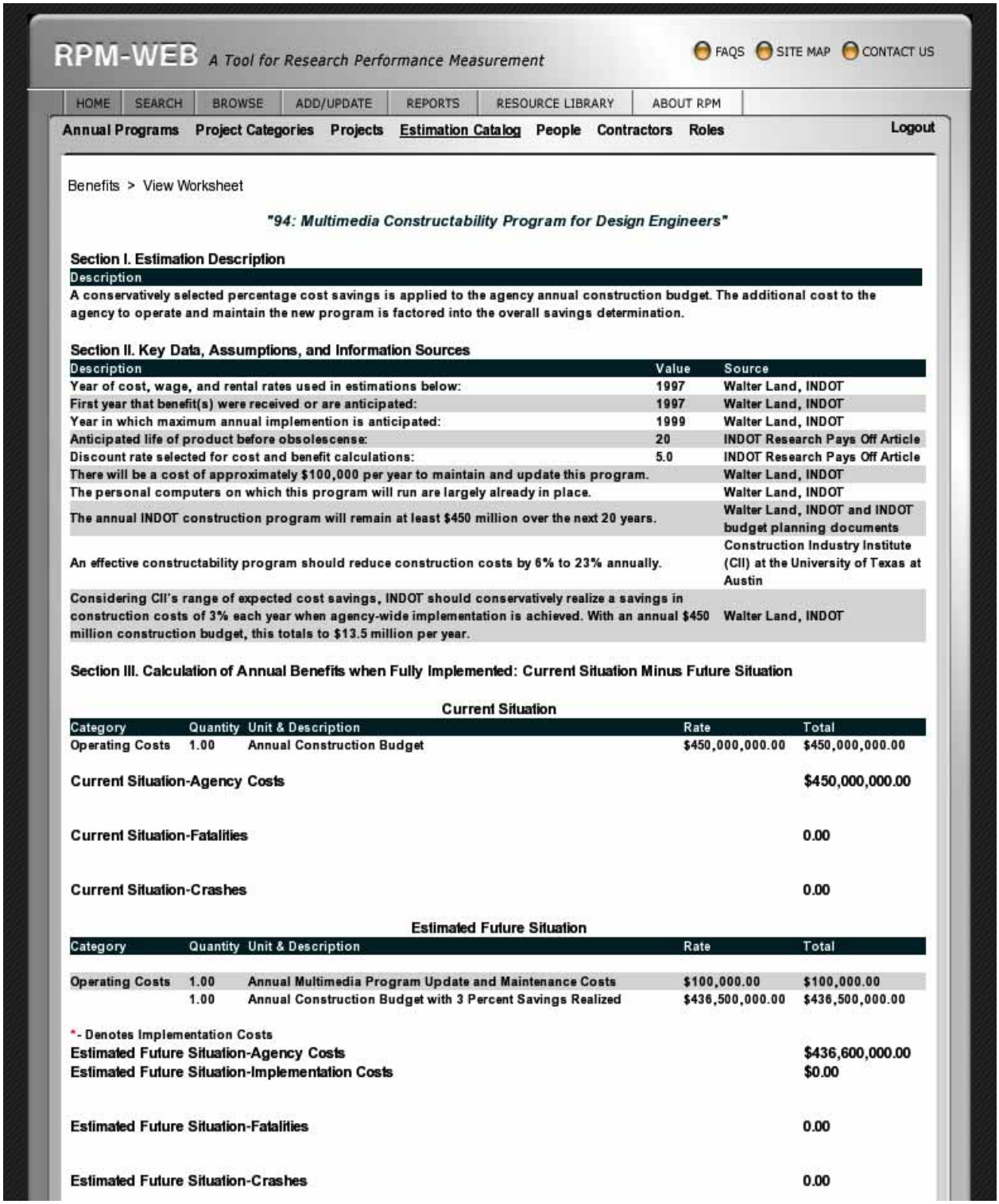
Year	Adjusted Agency Cost Savings	Lives Saved	Reduction in Crashes
Annual Benefits During Implementation Period[1][2]			
Annual Benefits After Agency-wide Implementation Achieved[3]			
1995	$1,288,170.00	0	0
1996	$1,226,828.57	0	0
1997	$1,168,408.16	0	0
1998	$1,112,769.68	0	0
1999	$1,059,780.65	0	0
2000	$1,009,314.90	0	0
2001	$961,252.29	0	0
2002	$915,478.37	0	0
2003	$871,884.16	0	0
2004	$830,365.87	0	0
2005	$790,824.64	0	0
2006	$753,166.32	0	0
2007	$717,301.26	0	0
2008	$683,144.05	0	0
2009	$650,613.39	0	0
2010	$619,631.80	0	0
2011	$590,125.52	0	0
2012	$562,024.30	0	0
2013	$535,261.24	0	0
2014	$509,772.61	0	0
Total Estimated Benefits			
	$16,856,118	0	0

1 - A straight-line increase in annual implementation is assumed.
2 - Costs designated as implementation costs are evenly distributed over the implementation period.
3 - Individual annual determinations are based on a single-year benefit estimation that is assumed to be repeated, or it may be based on the average of known future-year quantities, if this information is available.

This example is based on an actual benefit estimation made by the Indiana Department of Transportation

PDF Version

15. Multimedia Constructability Program for Design Engineers



RPM-WEB *A Tool for Research Performance Measurement*

FAQS | SITE MAP | CONTACT US

HOME | SEARCH | BROWSE | ADD/UPDATE | REPORTS | RESOURCE LIBRARY | ABOUT RPM

Annual Programs | Project Categories | Projects | Estimation Catalog | People | Contractors | Roles | Logout

Benefits > View Worksheet

"94: Multimedia Constructability Program for Design Engineers"

Section I. Estimation Description

Description
A conservatively selected percentage cost savings is applied to the agency annual construction budget. The additional cost to the agency to operate and maintain the new program is factored into the overall savings determination.

Section II. Key Data, Assumptions, and Information Sources

Description	Value	Source
Year of cost, wage, and rental rates used in estimations below:	1997	Walter Land, INDOT
First year that benefit(s) were received or are anticipated:	1997	Walter Land, INDOT
Year in which maximum annual implemention is anticipated:	1999	Walter Land, INDOT
Anticipated life of product before obsolescense:	20	INDOT Research Pays Off Article
Discount rate selected for cost and benefit calculations:	5.0	INDOT Research Pays Off Article
There will be a cost of approximately $100,000 per year to maintain and update this program.		Walter Land, INDOT
The personal computers on which this program will run are largely already in place.		Walter Land, INDOT
The annual INDOT construction program will remain at least $450 million over the next 20 years.		Walter Land, INDOT and INDOT budget planning documents
An effective constructability program should reduce construction costs by 6% to 23% annually.		Construction Industry Institute (CII) at the University of Texas at Austin
Considering CII's range of expected cost savings, INDOT should conservatively realize a savings in construction costs of 3% each year when agency-wide implementation is achieved. With an annual $450 million construction budget, this totals to $13.5 million per year.		Walter Land, INDOT

Section III. Calculation of Annual Benefits when Fully Implemented: Current Situation Minus Future Situation

Current Situation

Category	Quantity	Unit & Description	Rate	Total
Operating Costs	1.00	Annual Construction Budget	$450,000,000.00	$450,000,000.00

Current Situation-Agency Costs $450,000,000.00

Current Situation-Fatalities 0.00

Current Situation-Crashes 0.00

Estimated Future Situation

Category	Quantity	Unit & Description	Rate	Total
Operating Costs	1.00	Annual Multimedia Program Update and Maintenance Costs	$100,000.00	$100,000.00
	1.00	Annual Construction Budget with 3 Percent Savings Realized	$436,500,000.00	$436,500,000.00

*- Denotes Implementation Costs

Estimated Future Situation-Agency Costs $436,600,000.00

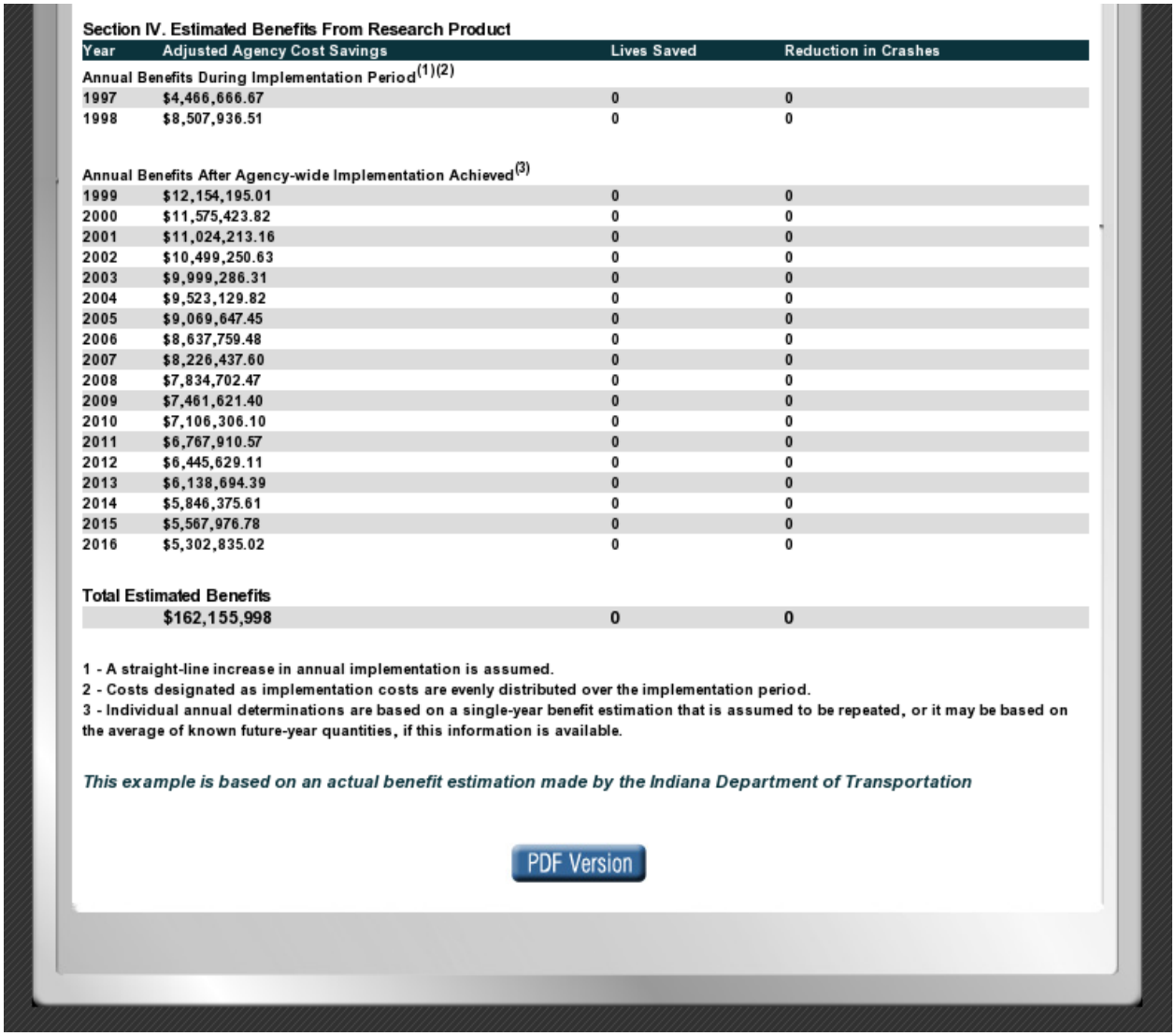
Estimated Future Situation-Implementation Costs $0.00

Estimated Future Situation-Fatalities 0.00

Estimated Future Situation-Crashes 0.00

(This example is continued on the next page)

15. Multimedia Constructability Program for Design Engineers – continued



Section IV. Estimated Benefits From Research Product

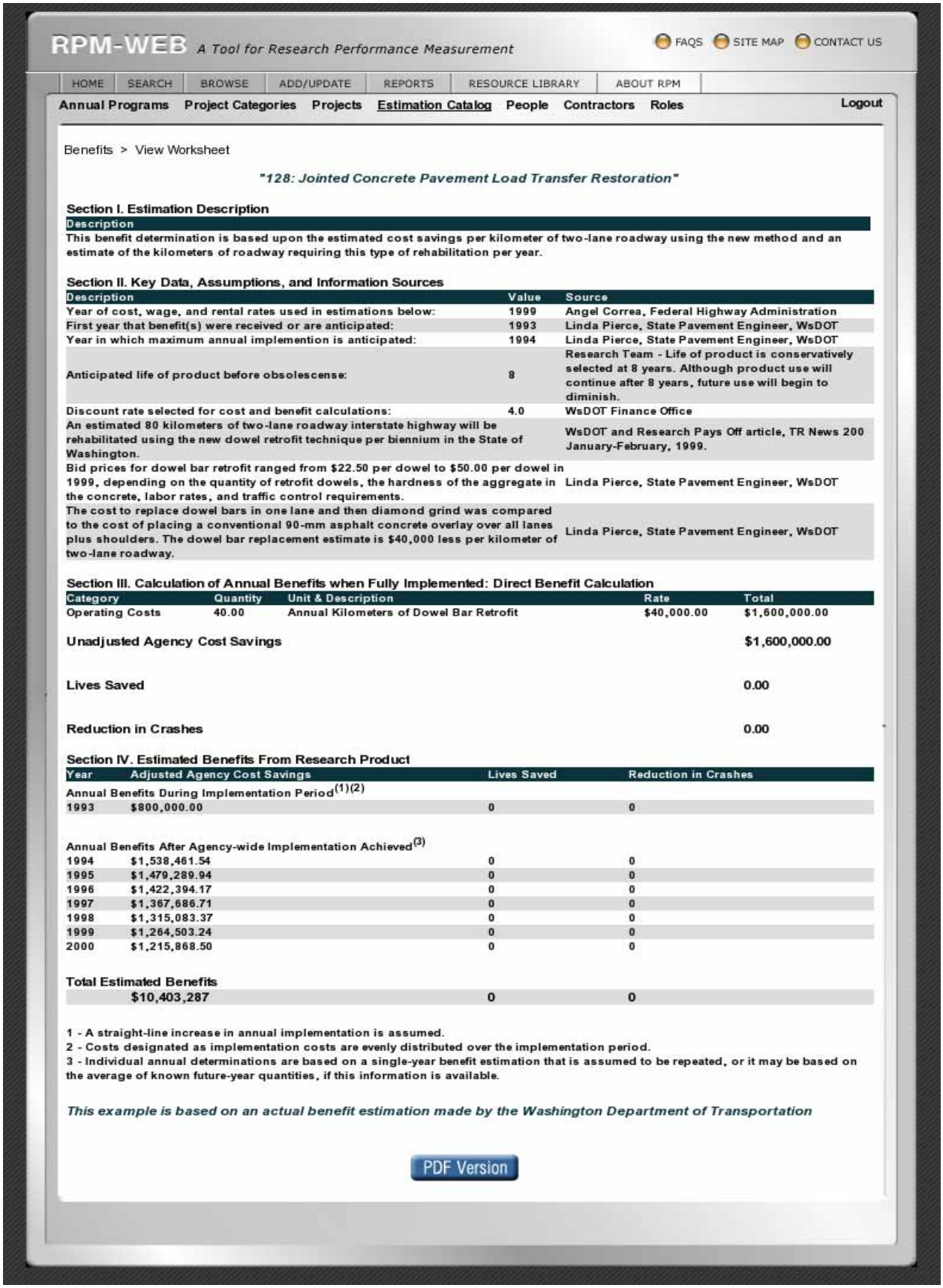
Year	Adjusted Agency Cost Savings	Lives Saved	Reduction in Crashes
Annual Benefits During Implementation Period[1][2]			
1997	$4,466,666.67	0	0
1998	$8,507,936.51	0	0
Annual Benefits After Agency-wide Implementation Achieved[3]			
1999	$12,154,195.01	0	0
2000	$11,575,423.82	0	0
2001	$11,024,213.16	0	0
2002	$10,499,250.63	0	0
2003	$9,999,286.31	0	0
2004	$9,523,129.82	0	0
2005	$9,069,647.45	0	0
2006	$8,637,759.48	0	0
2007	$8,226,437.60	0	0
2008	$7,834,702.47	0	0
2009	$7,461,621.40	0	0
2010	$7,106,306.10	0	0
2011	$6,767,910.57	0	0
2012	$6,445,629.11	0	0
2013	$6,138,694.39	0	0
2014	$5,846,375.61	0	0
2015	$5,567,976.78	0	0
2016	$5,302,835.02	0	0
Total Estimated Benefits			
	$162,155,998	**0**	**0**

1 - A straight-line increase in annual implementation is assumed.
2 - Costs designated as implementation costs are evenly distributed over the implementation period.
3 - Individual annual determinations are based on a single-year benefit estimation that is assumed to be repeated, or it may be based on the average of known future-year quantities, if this information is available.

This example is based on an actual benefit estimation made by the Indiana Department of Transportation

PDF Version

16. Jointed Concrete Pavement Load Transfer Restoration



RPM-WEB *A Tool for Research Performance Measurement*

FAQS | SITE MAP | CONTACT US

HOME | SEARCH | BROWSE | ADD/UPDATE | REPORTS | RESOURCE LIBRARY | ABOUT RPM

Annual Programs | Project Categories | Projects | Estimation Catalog | People | Contractors | Roles | Logout

Benefits > View Worksheet

"128: Jointed Concrete Pavement Load Transfer Restoration"

Section I. Estimation Description

Description
This benefit determination is based upon the estimated cost savings per kilometer of two-lane roadway using the new method and an estimate of the kilometers of roadway requiring this type of rehabilitation per year.

Section II. Key Data, Assumptions, and Information Sources

Description	Value	Source
Year of cost, wage, and rental rates used in estimations below:	1999	Angel Correa, Federal Highway Administration
First year that benefit(s) were received or are anticipated:	1993	Linda Pierce, State Pavement Engineer, WsDOT
Year in which maximum annual implemention is anticipated:	1994	Linda Pierce, State Pavement Engineer, WsDOT
Anticipated life of product before obsolescense:	8	Research Team - Life of product is conservatively selected at 8 years. Although product use will continue after 8 years, future use will begin to diminish.
Discount rate selected for cost and benefit calculations:	4.0	WsDOT Finance Office
An estimated 80 kilometers of two-lane roadway interstate highway will be rehabilitated using the new dowel retrofit technique per biennium in the State of Washington.		WsDOT and Research Pays Off article, TR News 200 January-February, 1999.
Bid prices for dowel bar retrofit ranged from $22.50 per dowel to $50.00 per dowel in 1999, depending on the quantity of retrofit dowels, the hardness of the aggregate in the concrete, labor rates, and traffic control requirements.		Linda Pierce, State Pavement Engineer, WsDOT
The cost to replace dowel bars in one lane and then diamond grind was compared to the cost of placing a conventional 90-mm asphalt concrete overlay over all lanes plus shoulders. The dowel bar replacement estimate is $40,000 less per kilometer of two-lane roadway.		Linda Pierce, State Pavement Engineer, WsDOT

Section III. Calculation of Annual Benefits when Fully Implemented: Direct Benefit Calculation

Category	Quantity	Unit & Description	Rate	Total
Operating Costs	40.00	Annual Kilometers of Dowel Bar Retrofit	$40,000.00	$1,600,000.00
Unadjusted Agency Cost Savings				**$1,600,000.00**
Lives Saved				**0.00**
Reduction in Crashes				**0.00**

Section IV. Estimated Benefits From Research Product

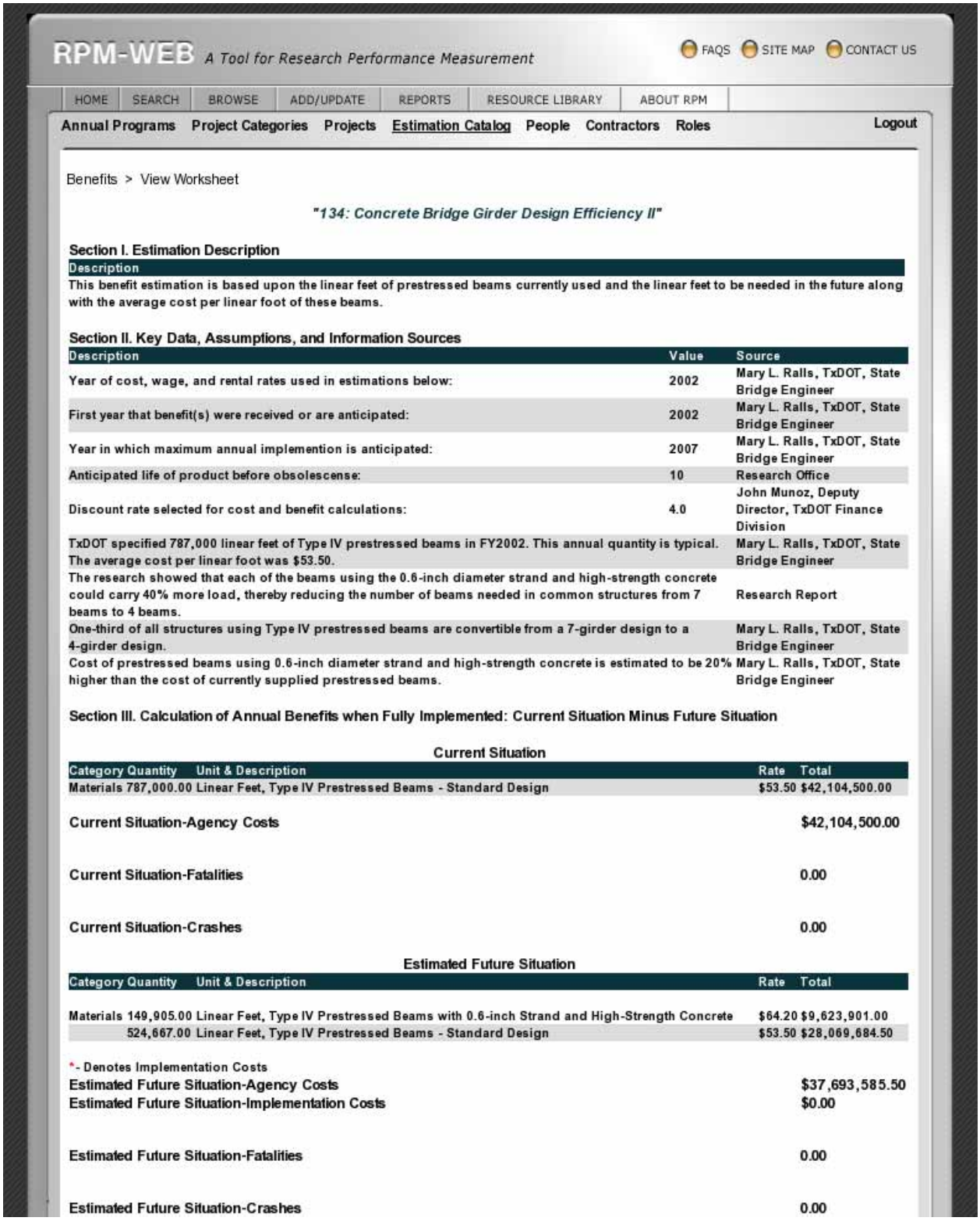
Year	Adjusted Agency Cost Savings	Lives Saved	Reduction in Crashes
Annual Benefits During Implementation Period[1][2]			
1993	$800,000.00	0	0
Annual Benefits After Agency-wide Implementation Achieved[3]			
1994	$1,538,461.54	0	0
1995	$1,479,289.94	0	0
1996	$1,422,394.17	0	0
1997	$1,367,686.71	0	0
1998	$1,315,083.37	0	0
1999	$1,264,503.24	0	0
2000	$1,215,868.50	0	0
Total Estimated Benefits			
	$10,403,287	**0**	**0**

1 - A straight-line increase in annual implementation is assumed.
2 - Costs designated as implementation costs are evenly distributed over the implementation period.
3 - Individual annual determinations are based on a single-year benefit estimation that is assumed to be repeated, or it may be based on the average of known future-year quantities, if this information is available.

This example is based on an actual benefit estimation made by the Washington Department of Transportation

PDF Version

17. Concrete Bridge Girder Design Efficiency II



RPM-WEB *A Tool for Research Performance Measurement*

FAQS | SITE MAP | CONTACT US

HOME | SEARCH | BROWSE | ADD/UPDATE | REPORTS | RESOURCE LIBRARY | ABOUT RPM

Annual Programs | Project Categories | Projects | Estimation Catalog | People | Contractors | Roles | Logout

Benefits > View Worksheet

"134: Concrete Bridge Girder Design Efficiency II"

Section I. Estimation Description

Description

This benefit estimation is based upon the linear feet of prestressed beams currently used and the linear feet to be needed in the future along with the average cost per linear foot of these beams.

Section II. Key Data, Assumptions, and Information Sources

Description	Value	Source
Year of cost, wage, and rental rates used in estimations below:	2002	Mary L. Ralls, TxDOT, State Bridge Engineer
First year that benefit(s) were received or are anticipated:	2002	Mary L. Ralls, TxDOT, State Bridge Engineer
Year in which maximum annual implemention is anticipated:	2007	Mary L. Ralls, TxDOT, State Bridge Engineer
Anticipated life of product before obsolescense:	10	Research Office
Discount rate selected for cost and benefit calculations:	4.0	John Munoz, Deputy Director, TxDOT Finance Division
TxDOT specified 787,000 linear feet of Type IV prestressed beams in FY2002. This annual quantity is typical. The average cost per linear foot was $53.50.		Mary L. Ralls, TxDOT, State Bridge Engineer
The research showed that each of the beams using the 0.6-inch diameter strand and high-strength concrete could carry 40% more load, thereby reducing the number of beams needed in common structures from 7 beams to 4 beams.		Research Report
One-third of all structures using Type IV prestressed beams are convertible from a 7-girder design to a 4-girder design.		Mary L. Ralls, TxDOT, State Bridge Engineer
Cost of prestressed beams using 0.6-inch diameter strand and high-strength concrete is estimated to be 20% higher than the cost of currently supplied prestressed beams.		Mary L. Ralls, TxDOT, State Bridge Engineer

Section III. Calculation of Annual Benefits when Fully Implemented: Current Situation Minus Future Situation

Current Situation

Category Quantity	Unit & Description	Rate	Total
Materials 787,000.00	Linear Feet, Type IV Prestressed Beams - Standard Design	$53.50	$42,104,500.00

Current Situation-Agency Costs $42,104,500.00

Current Situation-Fatalities 0.00

Current Situation-Crashes 0.00

Estimated Future Situation

Category Quantity	Unit & Description	Rate	Total
Materials 149,905.00	Linear Feet, Type IV Prestressed Beams with 0.6-inch Strand and High-Strength Concrete	$64.20	$9,623,901.00
524,667.00	Linear Feet, Type IV Prestressed Beams - Standard Design	$53.50	$28,069,684.50

*- Denotes Implementation Costs

Estimated Future Situation-Agency Costs $37,693,585.50

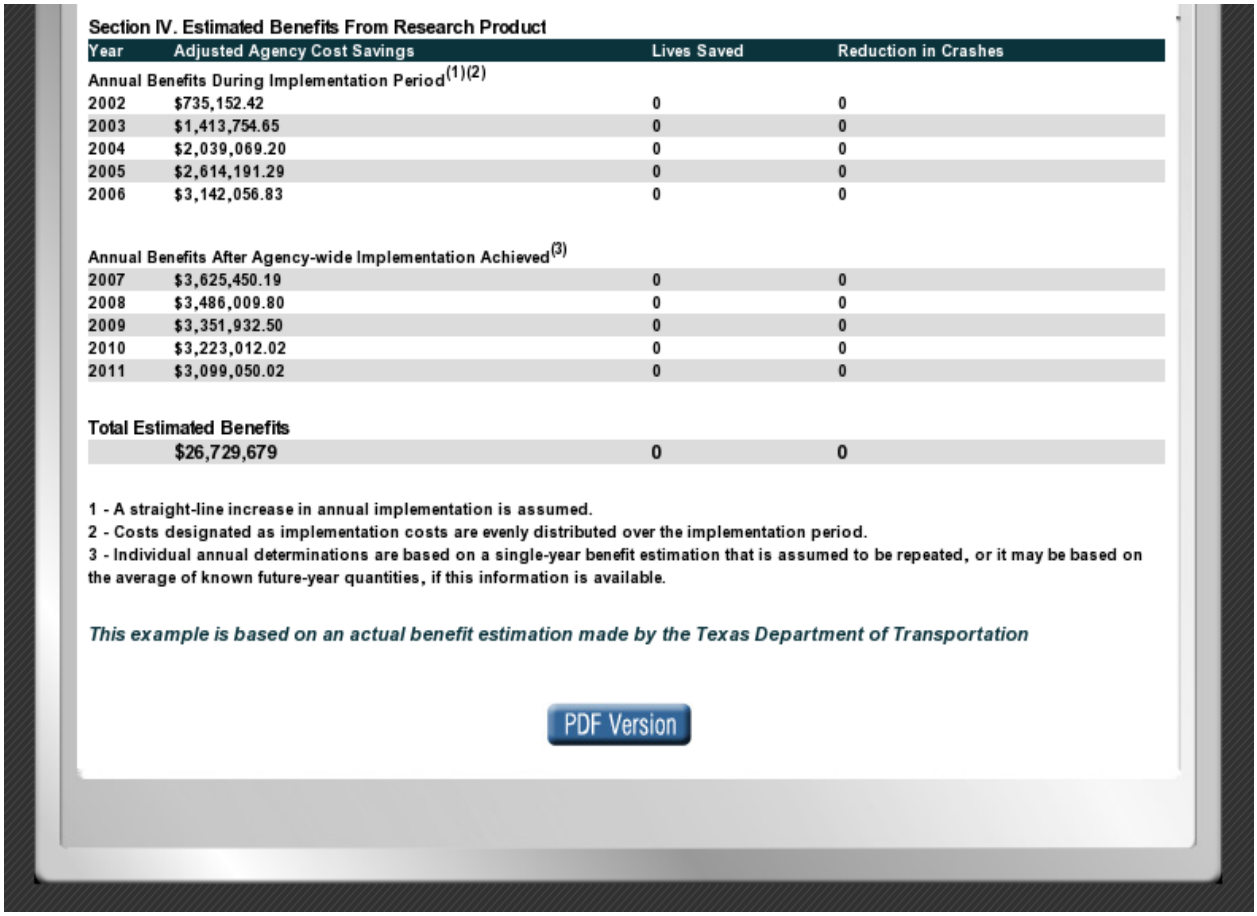
Estimated Future Situation-Implementation Costs $0.00

Estimated Future Situation-Fatalities 0.00

Estimated Future Situation-Crashes 0.00

(This example is continued on the next page)

17. Concrete Bridge Girder Design Efficiency II – continued



Section IV. Estimated Benefits From Research Product

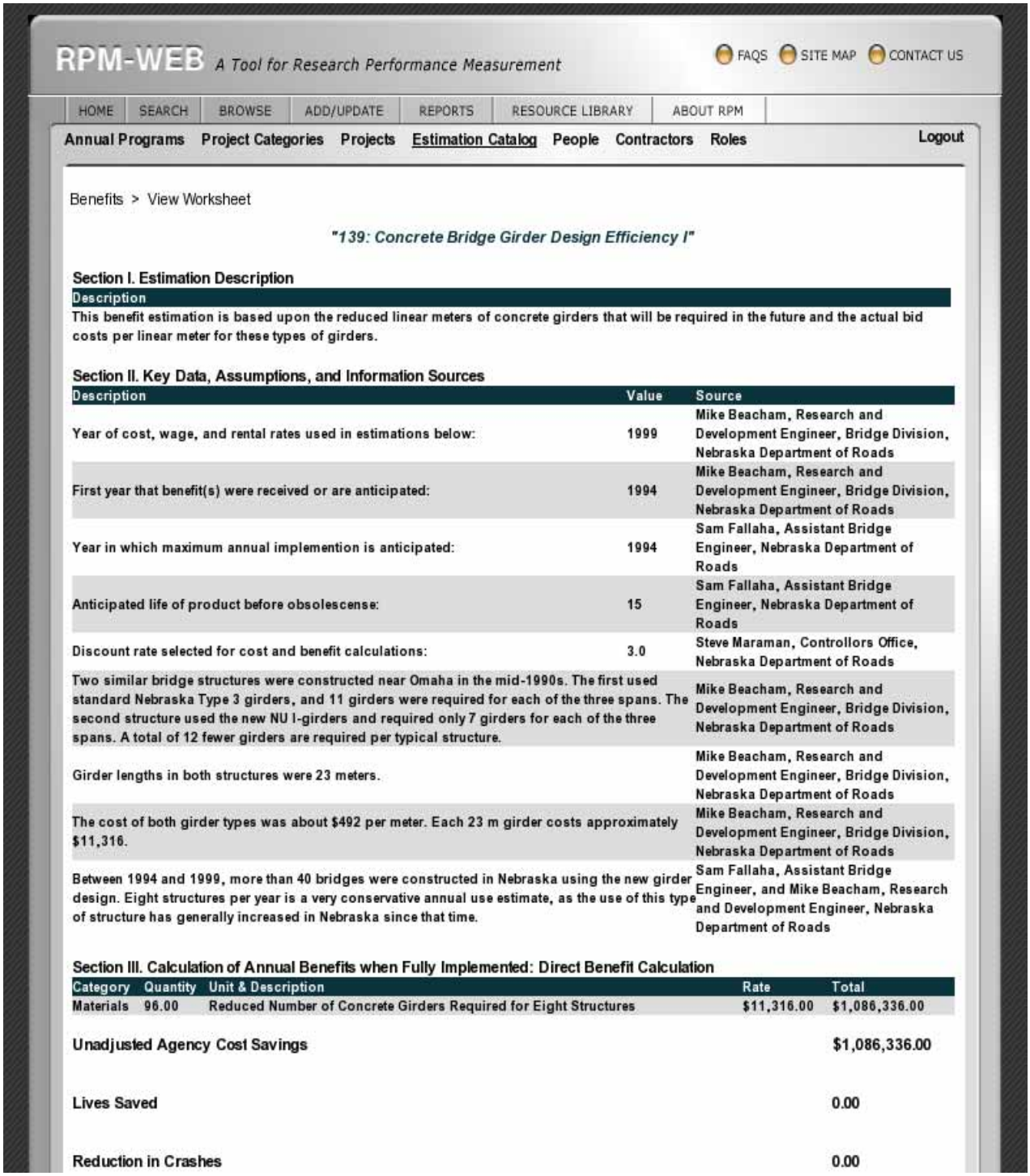
Year	Adjusted Agency Cost Savings	Lives Saved	Reduction in Crashes
Annual Benefits During Implementation Period[1][2]			
2002	$735,152.42	0	0
2003	$1,413,754.65	0	0
2004	$2,039,069.20	0	0
2005	$2,614,191.29	0	0
2006	$3,142,056.83	0	0
Annual Benefits After Agency-wide Implementation Achieved[3]			
2007	$3,625,450.19	0	0
2008	$3,486,009.80	0	0
2009	$3,351,932.50	0	0
2010	$3,223,012.02	0	0
2011	$3,099,050.02	0	0
Total Estimated Benefits			
	$26,729,679	**0**	**0**

1 - A straight-line increase in annual implementation is assumed.
2 - Costs designated as implementation costs are evenly distributed over the implementation period.
3 - Individual annual determinations are based on a single-year benefit estimation that is assumed to be repeated, or it may be based on the average of known future-year quantities, if this information is available.

This example is based on an actual benefit estimation made by the Texas Department of Transportation

PDF Version

18. Concrete Bridge Girder Design Efficiency I



RPM-WEB *A Tool for Research Performance Measurement*

FAQS | SITE MAP | CONTACT US

HOME | SEARCH | BROWSE | ADD/UPDATE | REPORTS | RESOURCE LIBRARY | ABOUT RPM

Annual Programs | Project Categories | Projects | Estimation Catalog | People | Contractors | Roles | Logout

Benefits > View Worksheet

"139: Concrete Bridge Girder Design Efficiency I"

Section I. Estimation Description

Description
This benefit estimation is based upon the reduced linear meters of concrete girders that will be required in the future and the actual bid costs per linear meter for these types of girders.

Section II. Key Data, Assumptions, and Information Sources

Description	Value	Source
Year of cost, wage, and rental rates used in estimations below:	1999	Mike Beacham, Research and Development Engineer, Bridge Division, Nebraska Department of Roads
First year that benefit(s) were received or are anticipated:	1994	Mike Beacham, Research and Development Engineer, Bridge Division, Nebraska Department of Roads
Year in which maximum annual implemention is anticipated:	1994	Sam Fallaha, Assistant Bridge Engineer, Nebraska Department of Roads
Anticipated life of product before obsolescense:	15	Sam Fallaha, Assistant Bridge Engineer, Nebraska Department of Roads
Discount rate selected for cost and benefit calculations:	3.0	Steve Maraman, Controllors Office, Nebraska Department of Roads
Two similar bridge structures were constructed near Omaha in the mid-1990s. The first used standard Nebraska Type 3 girders, and 11 girders were required for each of the three spans. The second structure used the new NU I-girders and required only 7 girders for each of the three spans. A total of 12 fewer girders are required per typical structure.		Mike Beacham, Research and Development Engineer, Bridge Division, Nebraska Department of Roads
Girder lengths in both structures were 23 meters.		Mike Beacham, Research and Development Engineer, Bridge Division, Nebraska Department of Roads
The cost of both girder types was about $492 per meter. Each 23 m girder costs approximately $11,316.		Mike Beacham, Research and Development Engineer, Bridge Division, Nebraska Department of Roads
Between 1994 and 1999, more than 40 bridges were constructed in Nebraska using the new girder design. Eight structures per year is a very conservative annual use estimate, as the use of this type of structure has generally increased in Nebraska since that time.		Sam Fallaha, Assistant Bridge Engineer, and Mike Beacham, Research and Development Engineer, Nebraska Department of Roads

Section III. Calculation of Annual Benefits when Fully Implemented: Direct Benefit Calculation

Category	Quantity	Unit & Description	Rate	Total
Materials	96.00	Reduced Number of Concrete Girders Required for Eight Structures	$11,316.00	$1,086,336.00

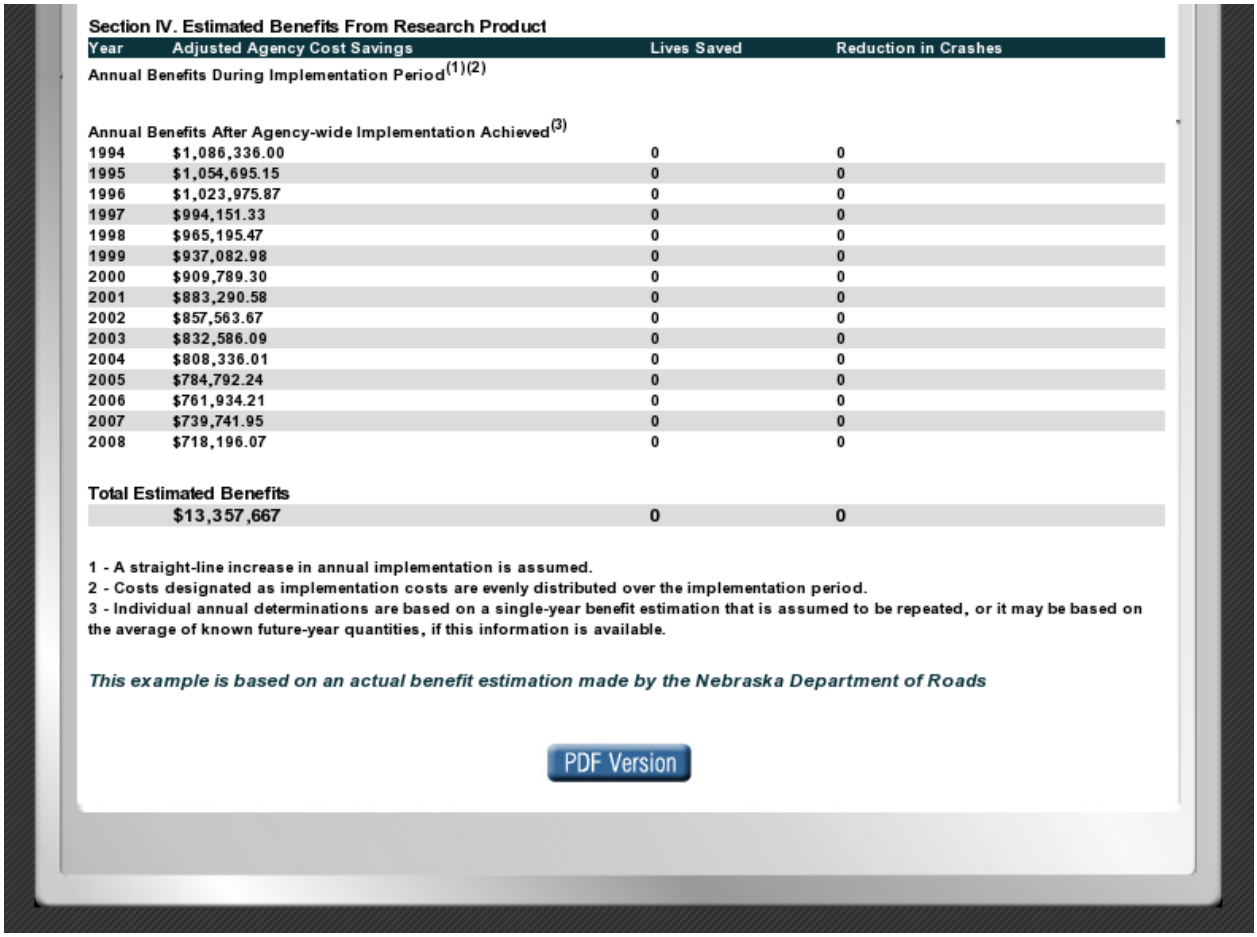
Unadjusted Agency Cost Savings $1,086,336.00

Lives Saved 0.00

Reduction in Crashes 0.00

(This example is continued on the next page)

18. Concrete Bridge Girder Design Efficiency I – continued



Section IV. Estimated Benefits From Research Product

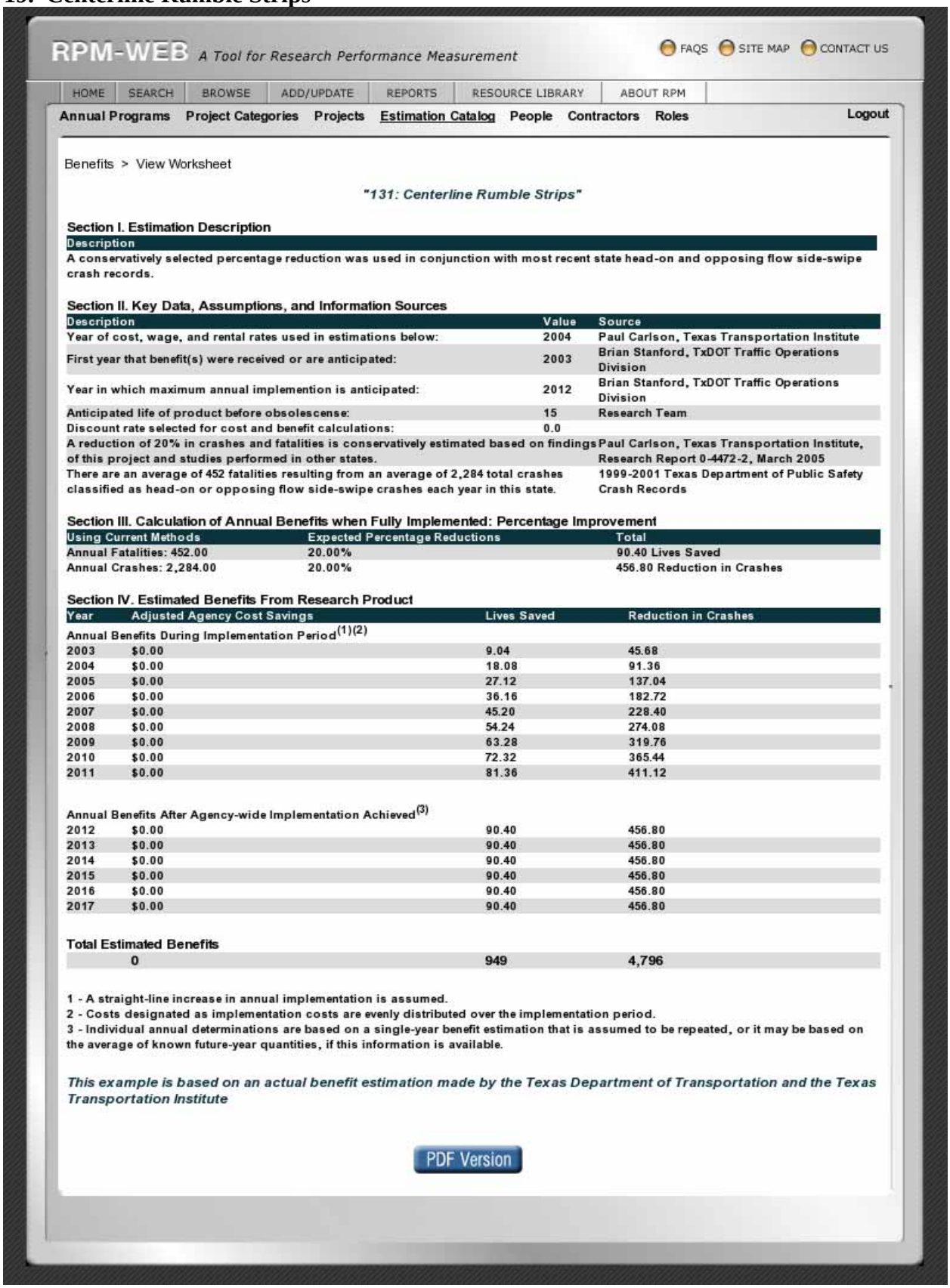
Year	Adjusted Agency Cost Savings	Lives Saved	Reduction in Crashes
Annual Benefits During Implementation Period[1][2]			
Annual Benefits After Agency-wide Implementation Achieved[3]			
1994	$1,086,336.00	0	0
1995	$1,054,695.15	0	0
1996	$1,023,975.87	0	0
1997	$994,151.33	0	0
1998	$965,195.47	0	0
1999	$937,082.98	0	0
2000	$909,789.30	0	0
2001	$883,290.58	0	0
2002	$857,563.67	0	0
2003	$832,586.09	0	0
2004	$808,336.01	0	0
2005	$784,792.24	0	0
2006	$761,934.21	0	0
2007	$739,741.95	0	0
2008	$718,196.07	0	0
Total Estimated Benefits			
	$13,357,667	**0**	**0**

1 - A straight-line increase in annual implementation is assumed.
2 - Costs designated as implementation costs are evenly distributed over the implementation period.
3 - Individual annual determinations are based on a single-year benefit estimation that is assumed to be repeated, or it may be based on the average of known future-year quantities, if this information is available.

This example is based on an actual benefit estimation made by the Nebraska Department of Roads

PDF Version

19. Centerline Rumble Strips



RPM-WEB *A Tool for Research Performance Measurement*

FAQS | SITE MAP | CONTACT US

HOME | SEARCH | BROWSE | ADD/UPDATE | REPORTS | RESOURCE LIBRARY | ABOUT RPM

Annual Programs | Project Categories | Projects | Estimation Catalog | People | Contractors | Roles | Logout

Benefits > View Worksheet

"131: Centerline Rumble Strips"

Section I. Estimation Description

Description
A conservatively selected percentage reduction was used in conjunction with most recent state head-on and opposing flow side-swipe crash records.

Section II. Key Data, Assumptions, and Information Sources

Description	Value	Source
Year of cost, wage, and rental rates used in estimations below:	2004	Paul Carlson, Texas Transportation Institute
First year that benefit(s) were received or are anticipated:	2003	Brian Stanford, TxDOT Traffic Operations Division
Year in which maximum annual implemention is anticipated:	2012	Brian Stanford, TxDOT Traffic Operations Division
Anticipated life of product before obsolescense:	15	Research Team
Discount rate selected for cost and benefit calculations:	0.0	
A reduction of 20% in crashes and fatalities is conservatively estimated based on findings of this project and studies performed in other states.		Paul Carlson, Texas Transportation Institute, Research Report 0-4472-2, March 2005
There are an average of 452 fatalities resulting from an average of 2,284 total crashes classified as head-on or opposing flow side-swipe crashes each year in this state.		1999-2001 Texas Department of Public Safety Crash Records

Section III. Calculation of Annual Benefits when Fully Implemented: Percentage Improvement

Using Current Methods	Expected Percentage Reductions	Total
Annual Fatalities: 452.00	20.00%	90.40 Lives Saved
Annual Crashes: 2,284.00	20.00%	456.80 Reduction in Crashes

Section IV. Estimated Benefits From Research Product

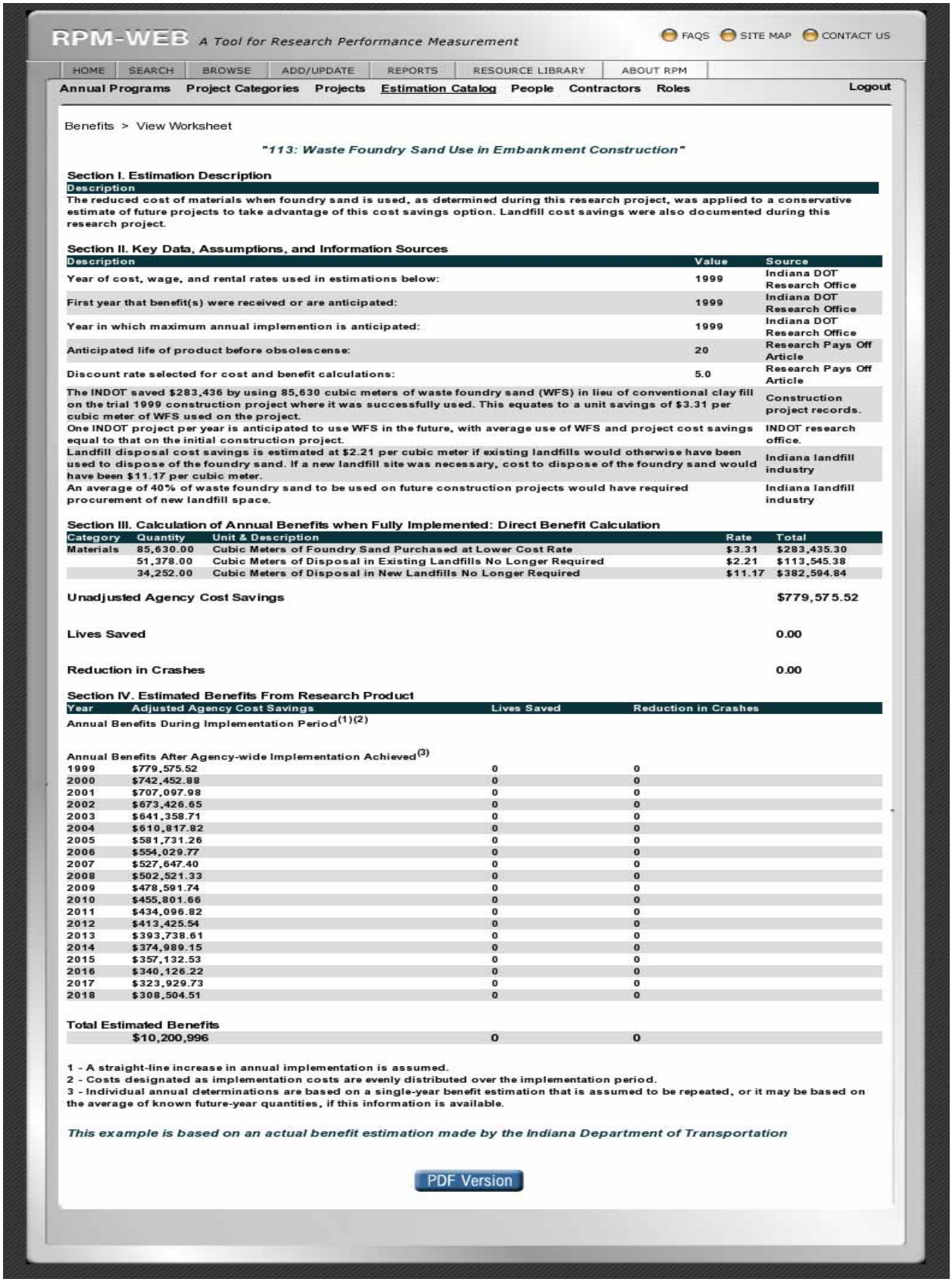
Year	Adjusted Agency Cost Savings	Lives Saved	Reduction in Crashes
Annual Benefits During Implementation Period[1][2]			
2003	$0.00	9.04	45.68
2004	$0.00	18.08	91.36
2005	$0.00	27.12	137.04
2006	$0.00	36.16	182.72
2007	$0.00	45.20	228.40
2008	$0.00	54.24	274.08
2009	$0.00	63.28	319.76
2010	$0.00	72.32	365.44
2011	$0.00	81.36	411.12
Annual Benefits After Agency-wide Implementation Achieved[3]			
2012	$0.00	90.40	456.80
2013	$0.00	90.40	456.80
2014	$0.00	90.40	456.80
2015	$0.00	90.40	456.80
2016	$0.00	90.40	456.80
2017	$0.00	90.40	456.80
Total Estimated Benefits			
	0	949	4,796

1 - A straight-line increase in annual implementation is assumed.
2 - Costs designated as implementation costs are evenly distributed over the implementation period.
3 - Individual annual determinations are based on a single-year benefit estimation that is assumed to be repeated, or it may be based on the average of known future-year quantities, if this information is available.

This example is based on an actual benefit estimation made by the Texas Department of Transportation and the Texas Transportation Institute

PDF Version

20. Waste Foundry Sand Use in Embankment Construction



RPM-WEB A Tool for Research Performance Measurement

FAQS SITE MAP CONTACT US

HOME | SEARCH | BROWSE | ADD/UPDATE | REPORTS | RESOURCE LIBRARY | ABOUT RPM

Annual Programs | Project Categories | Projects | Estimation Catalog | People | Contractors | Roles | Logout

Benefits > View Worksheet

"113: Waste Foundry Sand Use in Embankment Construction"

Section I. Estimation Description

Description
The reduced cost of materials when foundry sand is used, as determined during this research project, was applied to a conservative estimate of future projects to take advantage of this cost savings option. Landfill cost savings were also documented during this research project.

Section II. Key Data, Assumptions, and Information Sources

Description	Value	Source
Year of cost, wage, and rental rates used in estimations below:	1999	Indiana DOT Research Office
First year that benefit(s) were received or are anticipated:	1999	Indiana DOT Research Office
Year in which maximum annual implemention is anticipated:	1999	Indiana DOT Research Office
Anticipated life of product before obsolescense:	20	Research Pays Off Article
Discount rate selected for cost and benefit calculations:	5.0	Research Pays Off Article
The INDOT saved $283,436 by using 85,630 cubic meters of waste foundry sand (WFS) in lieu of conventional clay fill on the trial 1999 construction project where it was successfully used. This equates to a unit savings of $3.31 per cubic meter of WFS used on the project.		Construction project records.
One INDOT project per year is anticipated to use WFS in the future, with average use of WFS and project cost savings equal to that on the initial construction project.		INDOT research office.
Landfill disposal cost savings is estimated at $2.21 per cubic meter if existing landfills would otherwise have been used to dispose of the foundry sand. If a new landfill site was necessary, cost to dispose of the foundry sand would have been $11.17 per cubic meter.		Indiana landfill industry
An average of 40% of waste foundry sand to be used on future construction projects would have required procurement of new landfill space.		Indiana landfill industry

Section III. Calculation of Annual Benefits when Fully Implemented: Direct Benefit Calculation

Category	Quantity	Unit & Description	Rate	Total
Materials	85,630.00	Cubic Meters of Foundry Sand Purchased at Lower Cost Rate	$3.31	$283,435.30
	51,378.00	Cubic Meters of Disposal in Existing Landfills No Longer Required	$2.21	$113,545.38
	34,252.00	Cubic Meters of Disposal in New Landfills No Longer Required	$11.17	$382,594.84

Unadjusted Agency Cost Savings $779,575.52

Lives Saved 0.00

Reduction in Crashes 0.00

Section IV. Estimated Benefits From Research Product

Year	Adjusted Agency Cost Savings	Lives Saved	Reduction in Crashes
Annual Benefits During Implementation Period[1][2]			
Annual Benefits After Agency-wide Implementation Achieved[3]			
1999	$779,575.52	0	0
2000	$742,452.88	0	0
2001	$707,097.98	0	0
2002	$673,426.65	0	0
2003	$641,358.71	0	0
2004	$610,817.82	0	0
2005	$581,731.26	0	0
2006	$554,029.77	0	0
2007	$527,647.40	0	0
2008	$502,521.33	0	0
2009	$478,591.74	0	0
2010	$455,801.66	0	0
2011	$434,096.82	0	0
2012	$413,425.54	0	0
2013	$393,738.61	0	0
2014	$374,989.15	0	0
2015	$357,132.53	0	0
2016	$340,126.22	0	0
2017	$323,929.73	0	0
2018	$308,504.51	0	0
Total Estimated Benefits			
	$10,200,996	0	0

1 - A straight-line increase in annual implementation is assumed.
2 - Costs designated as implementation costs are evenly distributed over the implementation period.
3 - Individual annual determinations are based on a single-year benefit estimation that is assumed to be repeated, or it may be based on the average of known future-year quantities, if this information is available.

This example is based on an actual benefit estimation made by the Indiana Department of Transportation

PDF Version

APPENDIX K – Useful Product Life Guidance

2004 AASHTO RAC Meeting Survey Form – The Number of Responses Received for Each Category of Useful Research Product Life Is Indicated

Please check the box that in your opinion best represents the useful life of most research products in that category. Useful life is the period of time before the product is either significantly improved by later research or in some way becomes obsolete.

There can be considerable variation in useful life between individual products within each category. The purpose of this exercise is to determine the usual or most frequent useful life occurrence for each general category of product.

Categories of Research Products – Products may be entirely new approaches or may be an improvement to existing methods or standards	Useful Life Estimate						Optional Comment
	< 3 Years	3-6 Years	7-10 Years	11-15 Years	16-20 Years	> 20 Years	
Laboratory Test Methods		1	6	3	3	1	
Field Test Methods for Pavements	1	1	7	3	1	1	
Pavement Design Methods		1	5	3	3	2	
Geometric Roadway Design Standards			3	5	4	1	
Structural Bridge Element Design Standards			4	5	2	2	
Standard Construction and Maintenance Specifications		6	5	1	2		
Quality Control - Quality Assurance Methods	1	6	5	1		1	
Equipment Purchase Specifications	7	1	4	1			
Inspection Training Videos	1	9	4				
On-line or CD-Rom Inspection Training Courses	3	10	1				

Categories of Research Products – Products may be entirely new approaches or may be an improvement to existing methods or standards	Useful Life Estimate						Optional Comment
	< 3 Years	3-6 Years	7-10 Years	11-15 Years	16-20 Years	> 20 Years	
Construction Inspection Manuals	**2**	**7**	**5**				
Signing Designs and Materials	**1**	**4**	**7**	**1**			
Roadway Lighting Design and Hardware	**1**	**1**	**11**				
Traffic Management Center Software	**6**	**4**	**2**				
Traffic Control Device Equipment and Methods	**1**	**6**	**5**	**1**			
Roadside Safety Appurtenances	**1**	**2**	**6**	**2**	**2**		
Policies Which Protect the Environment	**1**	**5**	**4**	**1**	**1**	**1**	
Vegetation Management Methods and Systems	**2**	**3**	**4**	**1**	**1**	**1**	
Work Zone Safety Devises and Systems	**2**	**4**	**6**				
Hydraulics and Hydrology Design Standards			**5**	**2**	**3**		
Automated Engineering Design Tool	**3**	**4**	**1**	**3**			
Automated Administrative or Business Tool	**3**	**7**	**0**	**2**			

Thank you for providing your opinions. This National RAC Meeting workshop provides a wonderful opportunity to determine consensus opinions from R&D professionals on this subject. This information will be used in the performance measurement tool box to be developed.

This work sheet may be left on the handout table or may be given to the researchers after the workshop.

Useful Product Life Guidance Included in the RPM System

Categories of Research Products – Products may be entirely new approaches or may be an improvement to existing methods or standards	Useful Life Guidance
Traffic Management Center Software	**1 to 6**
Automated Administrative or Business Tool	**2 to 6**
Automated Engineering Design Tool	**2 to 6**
On-line or CD-Rom Inspection Training Courses	**2 to 6**
Inspection Training Videos	**3 to 7**
Construction Inspection Manuals	**3 to 8**
Work Zone Safety Devises and Systems	**3 to 9**
Vegetation Management Methods and Systems	**3 to 10**
Quality Control - Quality Assurance Methods	**4 to 8**
Signing Designs and Materials	**4 to 8**
Traffic Control Device Equipment and Methods	**4 to 8**
Policies Which Protect the Environment	**4 to 10**
Standard Construction and Maintenance Specifications	**4 to 10**
Roadway Lighting Design and Hardware	**7 to 10**
Field Test Methods for Pavements	**7 to 12**
Roadside Safety Appurtenances	**7 to 12**
Hydraulics and Hydrology Design Standards	**7 to 15**
Laboratory Test Methods	**7 to 15**
Pavement Design Methods	**7 to 15**
Geometric Roadway Design Standards	**10 to 15**
Structural Bridge Element Design Standards	**10 to 15**
Equipment Purchase Specifications	**1 to 3 or 7 to 10**