# RESEARCH IMPLEMENTATION MANAGEMENT SYSTEM FOR THE OKLAHOMA DEPARTMENT OF TRANSPORTATION

**Final Report**
**December 1996**

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# TECHNICAL REPORT DOCUMENTATION PAGE

| 1. REPORT NO. | 2. GOVERNMENT ACCESSION NO. | 3. RECIPIENT'S CATALOG NO. |
|---|---|---|
| FHWA\OK 97(01) | | |

| 4. TITLE AND SUBTITLE | 5. REPORT DATE |
|---|---|
| RESEARCH IMPLEMENTATION MANAGEMENT SYSTEM FOR THE OKLAHOMA DEPARTMENT OF TRANSPORTATION | December 1996 |
| | 6. PERFORMING ORGANIZATION CODE |
| 7. AUTHOR(S)<br>Ginger McGovern, David A. Ooten, and Lawrence J. Senkowski | 8. PERFORMING ORGANIZATION REPORT |
| 9. PERFORMING ORGANIZATION NAME AND ADDRESS<br>Oklahoma Department of Transportation<br>Research, Development & Technology Transfer<br>200 N.E. 21st Street, Room 2A2<br>Oklahoma City, OK 73105 | 10. WORK UNIT NO. |
| | 11. CONTRACT OR GRANT NO.<br>Item 2110 |
| 12. SPONSORING AGENCY NAME AND ADDRESS<br>U.S. Department of Transportation<br>Federal Highway Administration<br>715 S. Metropolitan Avenue, Suite 700<br>Oklahoma City, OK 73108 | 13. TYPE OF REPORT AND PERIOD COVERED<br>Final Report<br>September 1995 to December 1996 |
| | 14. SPONSORING AGENCY CODE |

15. SUPPLEMENTARY NOTES


16. ABSTRACT

In the past, implementation of research project findings has been an informal process at the Oklahoma Department of Transportation. New federal requirements and Department needs have prompted the Office of Research to establish a formal set of standard procedures for implementation. The resulting Research Implementation Management System (RIMS) is a systematic process designed to improve the implementation of research project findings. This report presents a review of the literature, survey of states, and needs analysis performed to define the requirements of the system, then describes the procedures which comprise the RIMS.

The RIMS procedures are categorized according to planning, execution, and evaluation phases. In the planning stage, proposals are evaluated for potential to produce practical, useful results, and acceptable projects have an estimated benefit/cost ratio calculated. After project completion, an implementation planning meeting is held where the strategies/tasks needed to achieve implementation are determined. A formal implementation plan is developed which includes the strategies, assigns responsibilities for tasks, and projects the time/resources needed to achieve the objectives. As the implementation plan is carried out (execution phase), activity is documented by responsible parties and progress is monitored/reported by the Project Manager and Implementation Manager.

After three years, a Research Project Cost and Savings Report is prepared to summarize how the research findings were used, the total costs of the project and the implementation effort, and the estimated tangible benefits. The final benefit/cost ratio is compared to a preliminary estimate. The effectiveness of the implementation effort is evaluated annually by the Implementation Manager and recommendations for improvement made.


| 17. KEY WORDS | 18. DISTRIBUTION STATEMENT |
|---|---|
| Implementation, research, management system, benefit cost analysis | No restrictions. This publication is available from the office of Research, Development & Technology Transfer, Oklahoma DOT. |

| 19. SECURITY CLASSIF. (OF THIS REPORT) | 20. SECURITY CLASSIF. (OF THIS PAGE) | 21. NO. OF PAGES | 22. PRICE |
|---|---|---|---|
| Unclassified | Unclassified | 77 | |

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# SI (METRIC) CONVERSION FACTORS

## *Approximate Conversions to SI Units*

| Symbol | When you know | Multiply by | To Find | Symbol |
|---|---|---|---|---|
| | **LENGTH** | | | |
| in | inches | 25.40 | millimeters | mm |
| ft | feet | 0.3048 | meters | m |
| yd | yards | 0.9144 | meters | m |
| mi | miles | 1.069 | kilometers | km |
| | **AREA** | | | |
| $in^2$ | square inches | 645.2 | square millimeters | $mm^2$ |
| $ft^2$ | square feet | 0.0929 | square meters | $m^2$ |
| $yd^2$ | square yards | 0.8361 | square meters | $m^2$ |
| ac | acres | 0.4047 | hectacres | ha |
| $mi^2$ | square miles | 2.590 | square kilometers | $km^2$ |
| | **VOLUME** | | | |
| fl oz | fluid ounces | 29.57 | milliliters | mL |
| gal | gallon | 3.785 | liters | L |
| $ft^3$ | cubic feet | 0.0283 | cubic meters | $m^3$ |
| $yd^3$ | cubic yards | 0.7645 | cubic meters | $m^3$ |
| | **MASS** | | | |
| oz | ounces | 28.35 | grams | g |
| lb | pounds | 0.4536 | kilograms | kg |
| T | short tons (2000 lb) | 0.907 | megagrams | Mg |
| | **TEMPERATURE (exact)** | | | |
| °F | degrees Fahrenheit | (°F-32)/1.8 | degrees Celsius | °C |
| | **FORCE and PRESSURE or STRESS** | | | |
| lbf | poundforce | 4.448 | Newtons | N |
| $lbf/in^2$ | poundforce per square inch | 6.895 | kilopascals | kPa |

## *Approximate Conversions from SI Units*

| Symbol | When you know | Multiply by | To Find | Symbol |
|---|---|---|---|---|
| | **LENGTH** | | | |
| mm | millimeters | 0.0394 | inches | in |
| m | meters | 3.281 | feet | ft |
| m | meters | 1.094 | yards | yds |
| km | kilometers | 0.6214 | miles | mi |
| | **AREA** | | | |
| $mm^2$ | square millimeters | 0.00155 | square inches | $in^2$ |
| $m^2$ | square meters | 10.764 | square feet | $ft^2$ |
| $m^2$ | square meters | 1.196 | square yards | $yd^2$ |
| ha | hectasres | 2.471 | acres | ac |
| $km^2$ | square kilometers | 0.3861 | square miles | $mi^2$ |
| | **VOLUME** | | | |
| mL | milliliters | 0.0338 | fluid ounces | fl oz |
| L | liters | 0.2642 | gallon | gal |
| $m^3$ | cubic meters | 35.315 | cubic feet | $ft^3$ |
| $m^3$ | cubic meters | 1.308 | cubic yards | $yd^3$ |
| | **MASS** | | | |
| g | grams | 0.0353 | ounces | oz |
| kg | kilograms | 2.205 | pounds | lb |
| Mg | megagrams | 1.1023 | short tons (2000 lb) | T |
| | **TEMPERATURE (exact)** | | | |
| °C | degrees Fahrenheit | 9/5(°C)+32 | degrees Celsius | °F |
| | **FORCE and PRESSURE or STRESS** | | | |
| N | Newtons | 0.2248 | poundforce | lbf |
| kPa | kilopascals | 0.1450 | poundforce per square inch | $lbf/in^2$ |

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# EXECUTIVE SUMMARY

In the past, implementation of research project findings has been an informal process at the Oklahoma Department of Transportation. New federal requirements and Department needs have prompted the Office of Research to establish a formal set of standard procedures for implementation. The resulting Research Implementation Management System (RIMS) is a systematic process designed to improve the implementation of research project findings. This report presents a review of the literature, survey of states, and needs analysis performed to define the requirements of the system, then describes the procedures which comprise the RIMS.

The RIMS procedures are categorized according to planning, execution, and evaluation phases. In the planning stage, proposals are evaluated for potential to produce practical, useful results, and acceptable projects have an estimated benefit cost ratio calculated. After project completion, an implementation planning meeting is held where the strategies/tasks needed to achieve implementation are determined. A formal implementation plan is developed which includes the strategies, assigns responsibilities for tasks, and projects the time/resources needed to achieve the objectives. As the implementation plan is carried out (execution phase), activity is documented by responsible parties and progress is monitored/reported by the Project Manager and Implementation Manager.

After three years, the implementation effort is evaluated by the Implementation Manager. A Research Project Cost and Savings Report is prepared to summarize how the research findings were implemented, the total costs of the project and the implementation effort, and the estimated tangible benefits. The final benefit/cost ratio is compared to the preliminary estimate. The effectiveness of the implementation efforts are evaluated annually on a project-by-project basis by the Implementation Manager and recommendations for improvement made.

# INTRODUCTION

Increased investment in the nation's aging infrastructure has prompted new interest in innovative and cost-effective products and procedures. As a service unit within the Oklahoma Department of Transportation (ODOT), the Office of Research is dedicated to bringing practical applications of new technology to the Department. Significant savings and improvements in practice result from the utilization of knowledge gained through research. Application of that knowledge is provided through implementation of research findings, that is, *activity undertaken to the convert research results into the media of practice*. This could include development/revision of policies, specifications, standards, or procedures, as well as technology transfer activities (presentations, workshops, reports, videos, etc.) designed to disseminate the findings.

In the past, it was often assumed that if a problem merited research then the results would be easily incorporated into standard practice by the user. Traditionally, implementation was unstructured and depended on the practitioner to "take the ball and run." Practitioners often did not have the time, information, and resources to properly implement new technology. The result was inconsistent implementation of research findings.

## NEEDS ANALYSIS

To begin the development of the Research Implementation Management System (RIMS), a needs analysis was performed to identify the difference between what existed in current practice at ODOT and what was desired. Needs arose from both internal and external sources. The federal government, through the Intermodal Surface Transportation Efficiency Act (ISTEA) of 1991, recognized the need for procedures to better manage the conduct of transportation research, prevent duplication of efforts, and translate the results into effective action. It required that the states: 1) actively implement research findings; 2) document the benefits; and 3) determine the utilization of the state's research outputs. (See Appendix A for ISTEA regulations.)

Further needs for the proposed system emanated from within the Office of Research at ODOT. The standard method of implementation had been to disseminate the Project Manager's recommendations

for implementation in the research final report. It was recognized that these recommendations were inconsistently acted upon. More direct implementation efforts sometimes encountered resistance from within the Department. Furthermore, project implementation was not monitored to determine the degree to which implementation had occurred or the benefits derived from implementation.

Following is a breakdown of the ISTEA requirements and the needs associated with each:

- ***Actively implement research results.*** ODOT's past approach to research implementation tended to be characterized by more passive methods such as report dissemination. Implementation procedures were needed which would facilitate and more actively promote utilization of research findings.

- ***Document the benefits of implementation.*** In the past, the benefits of research had been assumed and not quantified or documented. Benefit analysis methods were needed to categorize, quantify, and document the benefits incurred through implementation. Supporting data was needed in order to evaluate the tangible and intangible benefits of research.

- ***Develop procedures to determine the utilization of the state's research output.*** Previous implementation efforts, for the most part, were not monitored. Monitoring procedures were needed to enable the Office of Research to determine the degree of utilization of research findings by the various ODOT divisions.

The following additional needs were also identified:

- ***Research findings were inconsistently utilized.*** Methods were needed to achieve consistent utilization of research findings. Procedures were needed to accomplish implementation objectives quickly and efficiently.

- ***Project implementation was not formally monitored.*** Follow-up procedures were needed to monitor and ensure the progress of implementation.

- ***The benefits derived from implementation were not documented.*** In the current climate of down-sizing and controlling costs of government, the Office of Research needed to be able to support its use of valuable resources to ODOT management and the public.

- ***The effectiveness of the implementation efforts were not known.*** Implementation practices had not been specifically examined to determine the relative effectiveness of the efforts on different projects. A periodic review and evaluation of the management of implementation was needed to determine the effectiveness of the implementation procedures. Acceptable criteria for measuring the effectiveness of the implementation procedures needed to be developed.

**OBJECTIVES**

The above needs analysis aided in the development of requirements for a system to better manage the implementation of ODOT's research project results. The following objectives were identified as a means to meet ODOT's research implementation needs:

1. Establish standard implementation procedures for use with research projects to actively implement research findings;
2. Establish follow-up procedures to determine the utilization of research output;
3. Establish procedures to analyze and document the benefits of implementation;
4. Establish procedures to determine the effectiveness of the implementation management system.

# LITERATURE REVIEW & SURVEY OF STATES

Current literature was reviewed to provide state-of-the-art knowledge about implementing research findings. A survey of selected states was also conducted to compile information from state transportation agencies concerning their implementation practices. The following is a summary of the literature review and survey responses.

## LITERATURE REVIEW

Implementation of research results involves "putting research results to work" [1] and "getting research findings into practice" [2]. A more specific definition of implementation is "that part of a development or technology transfer activity relating directly to the conversion of research results into the media of practice (the development of specifications, standards, policies, etc.)" [3].

Implementation, as a distinct phase of research, received more attention beginning in the early 1970s, a time of growth for federal programs. Faced with public demands for increased accountability, researchers saw the importance of implementation in justifying research expenditures [4]. At the same time, technology was becoming more complex and difficult for practicing engineers to understand and apply, creating a gap between research and the field of practice [1].

Early experience with implementation had shown that it was not enough for researchers to report on the results of studies and leave implementation to the users. It was unlikely that anyone could keep up with the myriad of new technologies. Overcoming resistance to change was a major obstacle in many organizations [2]. Bridging the gap between innovation and application required involving the users and making implementation an integral part of the research project [1]. Within this context, state and federal transportation researchers began to examine and evaluate different strategies for achieving effective implementation of research results [4,5].

The Federal Highway Administration (FHWA) developed an implementation program in the 1970s to provide a means of transferring research results to the field of practice. It emphasized systematic management of research and establishment of an environment conducive to coordinated

implementation efforts by the FHWA. The six-stage process for implementation included the following steps [4]:

- *Identification* - Evaluate the potential of research results for implementation.
- *Planning* - Outline the actions required to achieve effective implementation.
- *Packaging* - Develop a package of user-oriented materials. This could include specifications, standards, training manuals, or other similar documents.
- *Promotion* - Promote implementation through organizations, workshops, films, and publications.
- *Evaluation* - Identify and document measurable benefits after implementation has been tried in one or several places.
- *Adoption* - The innovation is accepted and becomes an integral part of standard procedures.

Many of the factors identified in the 1970s as important to the success of implementation are still the major topics in current articles about implementation. Involving the practicing engineer (or user) from the inception of the research study through to demonstration projects, gaining the support of top management, and having an organizational context that promotes and accommodates change are all recognized as ways of enhancing implementation. Recommended techniques include planning for implementation (including developing draft specifications and instructions for users), collaborating with key stakeholders in implementation activities, and providing workshops and demonstrations to promote implementation [1,2,4,6].

Involvement of potential users from the beginning of a project has long been recognized as one of the most effective strategies for improving implementation. Strategies that bring researchers and practitioners closer together enhance the transfer of new technologies [6]. Practicing engineers, included in the planning and execution of the study, help to focus the research on practical solutions to real-world problems and then have a stake in the utilization of the results. In this way, the needs of the user are more likely to push the research project toward practical results [1,2,4,5,7].

Planning for implementation is as important at the beginning of a project as in the final stages [3,6,7]. Many agencies require that preliminary implementation statements be included in proposals and then

modified as the project progresses [8]. By the 1980s some highway agencies had established formal procedures for implementation planning. Several research organizations have designated units staffed by full-time implementation specialists to guide and track the implementation process [3].

Implementation itself has become the subject of research and the most recent studies identify elements that either encourage or hinder utilization of research results. The factors most important to an environment that supports adoption of new technologies "are likely to be:

- *developing a pro-innovation culture* in user agencies, e.g., by senior management commitment to change, by making implementation activity a real part of professional work and rewarding it, by publicizing user organizations' implementation successes;
- *taking a proactive approach* to technology transfer and use, e.g., by planning for implementation as a recurring rather than a one-time or special agency activity, by regularly scanning for new processes or products in key areas of concern, by maintaining high technical skill levels in domains where implementation activity is expected; and
- *establishing inter-organizational linkages*, e.g., user consortia for sharing implementation know-how, efforts, cost and risks; regular two-way communication channels maintained between research provider and user organizations independently of any particular new technology" [6].

Another influence that has changed the way state highway agencies approached implementation was the Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA). ISTEA gave the states more flexibility but greater responsibility in managing federally funded research, development and technology transfer (RD&T) programs. It required that the states develop procedures to actively implement research findings and determine the utilization of the state's research outputs. The states have also been encouraged to document the benefits of implementation and evaluate the effectiveness of the implementation efforts. Management processes which satisfy these requirements and others must be documented and approved by the FHWA. This requirement has placed added emphasis on implementation in the conduct of transportation research [9].

## SURVEY OF STATES

Selected states transportation agencies were surveyed to gather information concerning their implementation practices. The state departments of transportation (DOTs) were asked the following questions:

1. How is implementation initiated and who is involved?
2. How are the implementation efforts tracked and for how long?
3. How is technology transfer used to effect implementation?
4. How are the benefits of implementation measured and documented?
5. What follow-up is done to determine whether the research results have been incorporated into state standards, specifications, practices, or procedures?
6. What procedures are used to determine the effectiveness of the implementation efforts?

The responses received reflected a wide variety of implementation methods currently being used by state DOTs. A summary of the procedures used by each state follows.

### California

The California Department of Transportation includes an implementation section in the research final report. The principal investigator (in consultation with the Implementation Coordinator and Program Manager) makes recommendations on the most suitable methods for implementation. This may include actual development of training programs, presentations, manuals, new specifications or standards, or new procedures by the principal investigator. These activities may be included in the research proposal as tasks of the research project. Functional area managers are responsible for implementing findings within their areas.

When projects are considered to have potential for statewide or nationwide implementation, an Implementation Plan is developed by the functional area and the Office of Research. The plan includes a synopsis of the research problem and objectives, the nature and significance of the accomplishments, what changes are recommended, and why they represent an improvement.

Evidence of effectiveness of the product, estimated benefits, and guidance in revision of existing procedures must be given.

The principal investigator is also responsible for completing the "Estimate of Research Project Cost and Savings Report" annually for at least four consecutive years after completion of the research project. The report gives the total cost of the research project, describes how the findings were used, and shows the benefits and savings brought about as a direct result of the research.

**Georgia**

Research proposals prepared in-house or by a contractor for the Georgia Department of Transportation include discussion of expected results and possible implementation. Specific implementation activities are incorporated in the work plan if needed. Statements concerning implementation strategies are included in semiannual progress reports for the duration of the project. The project director/principal investigator presents recommendations for implementation in the final report and formal implementation plans may be developed but are not required. Implementation and technology transfer activities are the responsibility of the Research and Development Branch.

**Louisiana**

The Louisiana Technical Research Center (LTRC) assesses the implementation potential of research findings at various stages of the project. Assessments are done following interim, annual, or final reports, or when a significant development occurs during the study. The LTRC Group Administrator has primary responsibility for implementation. The Project Review Committee, principal investigator, and Group Administrator recommend strategies for implementation to the Director in the form of a Research Assessment and Implementation Report. This report gives the study objectives, findings, assessment of implementation potential, recommended implementation strategies, and estimated benefits.

**Minnesota**

At the Minnesota Department of Transportation (Mn/DOT) a general plan for implementation is required in the problem statement and work plan. An implementation plan is developed for each project by the office or functional group that developed the initial problem statement. The Office of

Research Administration (ORA) provides guidelines to assist in development of the final implementation plan. Using the guidelines, the functional group determines if the research should be put into practice, identifies the challenges to implementation, and defines the parameters for evaluation of the implementation efforts. Some funding is provided by the ORA for the execution of implementation plans. Evaluation of implementation efforts is performed using specified parameters from MnDOT's "Family of Measures." The effectiveness of the evaluation depends on the selection of relevant and measurable objectives, defining effective data collection, and performing/reporting on an understandable analysis of implementation results. Implementation achievements are documented as part of an annual report.

**Montana**

The Montana Department of Transportation (MDT) assigns a Technical Panel to follow each project throughout its duration. The panel is composed of MDT (and sometimes outside) personnel with expertise in the subject area. The Technical Panel evaluates the Implementation Plan written by the Principal Investigator and presents it to the Research Review Committee. The Implementation Plan is a part of the final report and defines organizational responsibilities, and the procedures necessary for implementation and documentation of benefits.

**North Carolina**

The Research and Development Unit staff prepare an Implementation Status Report for each project to serve as a transition between the completion of the formal research project and initiation of implementation activities. The report describes the research objectives/findings, current procedures addressed by the research, estimated benefits, technology transfer needs, and training requirements and costs.

**Pennsylvania**

The Pennsylvania Department of Transportation (PennDOT) includes implementation tasks in proposals and reserves project funds exclusively for implementation. Much of PennDOT's research is done by contract, so the contractor is involved in implementation efforts. At an appropriate time near the middle of the project, the contractor makes a presentation to PennDOT projecting the intended methods of implementation and estimated benefits. Upon completion of the project, the

University researchers submit semiannual reports as the studies progress and discuss the possible implementation of results (in the context of the project director's implementation plan) and implementation aids which need development. Final reports contain an implementation statement prepared cooperatively by the researcher and the project director. It points out practical applications of the research findings, proposes procedures for implementation, and describes the benefits to be derived.

An Implementation Report (formerly titled Research Summary) is required for each project unless waived by TxDOT. Prepared by the researcher after completion of the project, these two-page reports (front and back of one sheet) are primarily used for technology transfer rather than research documentation. They are designed to briefly convey the pertinent project information and the practical application of results to those interested in implementing the results quickly.

**Washington State**

The Washington State Department of Transportation (WSDOT) has an Implementation Management program to facilitate implementation of applicable research results. Responsibility for facilitating, evaluating, and documenting implementation activities belongs to the Implementation Manager.

At a presentation meeting, the final report is presented by the Project Manager to the Technical Monitor, functional area manager, and other interested WSDOT or outside agency personnel. At this time, the Technical Monitor (a representative of a functional area that is assigned to the research project from its inception) presents a proposed implementation plan, developed with guidance from the Research Office. The plan identifies key users and their roles in implementation, describes the steps required for full implementation, and addresses equipment, staff, and budgeting issues. The functional area may also draft a proposed implementation plan if they so desire. Final reports are reviewed by the Implementation Manager for the appropriate implementation action.

Six months after presentation of the final report, implementation progress is evaluated by the Research Project Manager, the Implementation Manager, the Technical Monitor, and the functional area manager. This evaluation documents the degree to which the implementation plan has been followed and explains any significant deviations.

# RESEARCH IMPLEMENTATION MANAGEMENT SYSTEM COMPONENTS

The Office of Research has developed the Research Implementation Management System (RIMS) as a "systematic process, designed to assist decisionmakers in selecting cost effective strategies/actions" to improve the utilization of the research investment [9]. The system includes procedures to facilitate active implementation of research findings, track implementation progress, analyze the benefits, and evaluate the effectiveness of the implementation efforts. The RIMS can be most easily described in terms of its procedural components. These procedures fall into three main phases: 1) planning; 2) execution; and 3) evaluation. A flowchart depicting the sequence of RIMS steps is shown in Appendix B.

## PLANNING PHASE

### Proposals

Planning for implementation begins with project proposals. Successful implementation depends upon relevant findings, thus each proposal is evaluated for (among other things) its potential to produce practical results. Once a proposal is accepted (including the budget), a projected cost and savings estimate is performed. The projected benefit/cost ratio for the research project is documented on a preliminary Research Project Cost and Savings Report form. (This form is explained in further detail in the "Evaluation Phase" section of this report.) Once the research has begun, its progress is monitored by the Office of Research and the Project Panel. The members of the Project Panel are selected from both within and outside ODOT from areas that have an investment in the project's outcome and utilization of the findings. The panel helps guide the research as it progresses and keeps it focused on finding practical results.

### Implementation Plans

After completion of the research project and publication of the final report, an Implementation Planning Meeting is scheduled by the Project Manager. The Project Panel is sent copies of the final report (which includes the Project Manager's recommendations for implementation) and Guidelines for Implementation Planning to help prepare for the meeting. The Implementation Manager facilitates the meeting and uses the Guidelines for Implementation Planning as an outline to direct

discussion. The purpose of the guidelines is to assist the Project Panel in developing a comprehensive, cost-effective implementation plan with measurable objectives. The guideline questions address the topics of project implementation potential/strategies, potential constraints, and task scheduling.

Once a consensus has been reached, the Implementation Manager records the responses. An example of the Guidelines for Implementation Planning with recorded responses is given in Appendix C. The completed document, approved by the Project Sponsor, is given to the Project Manager to develop an implementation plan.

The Standard Format for Research Implementation Plans and a sample implementation plan are included in Appendix D. The Standard Format outlines the minimum information that an implementation plan should include. Each plan begins with a Background section that gives brief summary of the research project and the findings. Enough detail should be given to provide a basic understanding of the project without necessitating reading the final report. Next, the Project Panel members are listed and their title and division (or functional area) given. The Implementation Potential section explains how the results of the research study solved the problem, specifies the types of changes being recommended, and describes the expected benefits of implementation. The goals and scope of implementation, any potential problems or constraints, and the tools needed to achieve implementation are described under Implementation Strategies. Task Scheduling assigns responsibilities for tasks to functional areas, and includes a time schedule for completion of activities. A Budget Estimate details the anticipated costs of implementation. The Tracking section describes how progress will be monitored and specifies reporting periods.

The Implementation Manager is responsible for reviewing the plan to ensure that it accurately reflects the decisions made by the Project Panel and is feasible, realistic and functional. The Implementation Plan is approved by the Implementation Manager, Branch Manager, Project Sponsor, and Office Head before copies are sent to the Project Panel members.

## EXECUTION PHASE

After approval of the implementation plan, each task is executed by designated personnel within the responsible area. The progress of each task is recorded by the responsible party and overall progress of project implementation is documented by the Project Manager.

### Records of Implementation Activity

The Project Manager prepares Record of Implementation Activity forms for each task and distributes them to the responsible areas. Individuals are asked to record on the forms the time spent on each implementation task and to provide this information to the Project Manager twice during each fiscal year (by March 15th and September 15th of each year). The Project Manager submits the Records of Implementation Activity to the Implementation Manager to be used later for the benefit cost analysis. See Appendix E for a Record of Implementation Activity form prepared for distribution.

### Semi-Annual Progress Reports

The Project Manager contacts each responsible area to assess the overall progress of implementation and planned activity for the next period. Progress and/or completion of each implementation task is documented by the Project Manager in Semi-Annual Progress Reports (see Appendix F). These reports are completed every six months for the three years following acceptance of the Implementation Plan.

## EVALUATION PHASE

Three years after approval of the Implementation Plan the implementation effort is considered to be completed. The final phase consists of estimating the research cost and savings, evaluating the implementation effort, and reporting.

### Research Project Cost and Savings Reports

As mentioned before, once a proposal has been accepted, a preliminary Research Cost Project Cost and Savings Report is prepared and a projected benefit/cost ratio calculated by the Implementation Manager. These figures are, of necessity, estimates since the outcome of the study and the course of implementation are yet to be determined. However, the Project Manager should be able to assist

in estimating the possible benefits that would be realized over a three-year period from the successful implementation of positive findings.

After the project is completed and the implementation plan has been in effect for three years, a final Research Project Cost and Savings Report is prepared by the Implementation Manager. The report gives a brief summary of the project objectives and findings and how the findings were used. Project budget and expenditure information, including over/underruns, and a final benefit cost analysis are included.

The benefit cost analysis estimates the tangible savings brought about as a direct result of the project over the three years of implementation effort. The Office of Research considers the benefits derived after three years to be incorporated into the standard operating cost of the Department and, therefore, are no longer considered a measurable benefit. Project and implementation costs are determined from Office of Research records of project expenditures and the Records of Implementation Activity. Benefits are estimated based on project results and implementation efforts. A guide to performing benefit cost analyses (based primarily on an approach developed by ERES Consultants for the FHWA [10]) and examples of a preliminary and final Research Project Cost and Savings Report are included in Appendix G.

**Evaluation of the Implementation Effort**

The effectiveness of the Research Implementation Management System is evaluated on a project-by-project basis by the Implementation Manager. The completion of steps in the RIMS is documented for each project in order to compare actual operations to the system design (as reflected in the procedural flowchart shown in Appendix B). Deviations from system procedures are documented on the RIMS Process Evaluation form and the effect on implementation examined. The factors contributing to success or failure of implementation are identified and recommended strategies to improve implementation of a project are given on the Annual Summary form. The Process Evaluations and Annual Summaries become part of project documentation and are used in an annual review of implementation activity by the Office of Research. An example of the Process Evaluation and Annual Summary forms are shown in Appendix H.

# CONCLUSIONS AND RECOMMENDATIONS

The Research Implementation Management System is a comprehensive set of procedures designed to promote active implementation of research findings within ODOT. This system incorporates current state-of-the-art strategies to most effectively implement research results. It involves the user/customer from the beginning of the project, solicits the support of management and customers (serving on project panels), formalizes the implementation process, and facilitates tracking of implementation. In addition, it allows the benefits of research to be identified and documented. (A blank copy of each RIMS form described in this document is included in Appendix I.)

At present, the system has been applied to three research projects that have reached the implementation stage. The Office of Research should continue to employ the Research Implementation Management System with future research projects. The RIMS evaluation procedures should be used to provide feedback about factors that influence the effectiveness of the implementation efforts. New strategies should be developed as information becomes available about what works in the user settings.

The last objective of the RIMS project was to establish procedures to determine the effectiveness of the implementation management system. Although the RIMS does include an evaluation of the implementation effectiveness on a project-by-project basis, the next step would be to develop procedures to evaluate the overall program effectiveness. Once these procedures are established, the RIMS can be modified and continually improved to best serve the needs of ODOT.

# REFERENCES


1. Keese, Charles J., "Implementation - A Part of the Research Project," *Highway Research Record No. 478*, Highway Research Board, Washington, D.C., 1973.

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7. Ardis, Colby V., "Evaluation of ODOT Research and Development Implementation Effectiveness," Ohio Department of Transportation, 1989.

8. Transportation Research Board, "NCHRP: Summary of Progress through 1988," Washington, D.C., 1988.

9. Federal Register, 23 CFR Part 420, Vol. 59, No. 140, 1994.

10. Transportation Research Board, "Life-Cycle Cost Analysis of Pavements," *NCHRP Synthesis 122*, Washington, D.C., 1985.

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1. Keese, Charles J., "Implementation - A Part of the Research Project," *Highway Research Record No. 478*, Highway Research Board, Washington, D.C., 1973.

2. Copas, Thomas L., "The Synthesis of Information as an Implementation Tool," *Highway Research Record No. 478*, Highway Research Board, Washington, D.C., 1973.

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4. Highway Research Board, "Getting Research Findings Into Practice," *NCHRP Synthesis 23*, Washington, D.C., 1974.

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7. Ardis, Colby V., "Evaluation of ODOT Research and Development Implementation Effectiveness," Ohio Department of Transportation, 1989.

8. Transportation Research Board, "NCHRP: Summary of Progress through 1988," Washington, D.C., 1988.

9. Federal Register, 23 CFR Part 420, Vol. 59, No. 140, 1994.

10. Transportation Research Board, "Life-Cycle Cost Analysis of Pavements," *NCHRP Synthesis 122*, Washington, D.C., 1985.

# APPENDIX A

CODE OF FEDERAL REGULATIONS 23, PART 420, SUBPART B

(o) States and their subrecipients shall administer subgrants to universities, hospitals, and other non-profit organizations in accordance with the administrative requirements of OMB Circular A-110 as implemented by the U.S. DOT in 49 CFR Part 19, Uniform Administrative Requirements for Grants and Agreements with Institutions of Higher Education, Hospitals, and Other Non-Profit Organizations.

(p) Reports and other documents prepared under FHWA planning and research funded grants or subgrants awarded after August 22, 1994, must be in metric units.

## Subpart B—Research, Development and Technology Transfer Program Management

### § 420.201 Purpose and applicability.

The purpose of this subpart is to implement the provisions of 23 U.S.C. 307 and to prescribe Federal assistance requirements for research, development, and technology transfer (RD&T) activities, programs, and studies undertaken by States with FHWA planning and research funds. The requirements of this subpart and subpart A of this part are applicable to work performed by the States and their subrecipients with FHWA planning and research funds.

### § 420.203 Definitions.

Unless otherwise specified in this part, the definitions in 23 U.S.C. 101(a) and Part 420, subpart A, are applicable to this subpart. As used in this subpart:

*Applied research* means the study of phenomena relating to a specific known need in connection with the functional characteristics of a system; the primary purpose of this kind of research is to answer a question or solve a problem.

*Basic research* means the study of phenomena whose specific application has not been identified; the primary purpose of this kind of research is to increase knowledge.

*Cooperatively funded study* means an RD&T study or activity, administered by the FHWA, a lead State, or other agency, that is funded by some combination of a State's contribution of FHWA planning and research funds, FHWA administrative contract funds, 100 percent State funds, or funds from other Federal agencies.

*Development* means the translation of basic or applied research results into prototype materials, devices, techniques, or procedures for the practical solution of a specific problem in transportation.

*Final report* means a report documenting a completed RD&T study or activity.

*Intermodal RD&T* means research, development, and technology transfer activities involving more than one mode of transportation including transfer facilities between modes.

*National Cooperative Highway Research Program (NCHRP)* means the cooperative RD&T program directed toward solving problems of national or regional significance identified by States and the FHWA, and administered by the Transportation Research Board, National Academy of Sciences.

*Peer review* means a review conducted by persons who are knowledgeable of the management and operation of RD&T programs. This may include but is not limited to representatives of another State, the FHWA, American Association of State Highway and Transportation Officials, Transportation Research Board (TRB), universities or the private sector.

*RD&T activity* means a basic or applied research, development, or technology transfer project or study.

*Research* means a systematic controlled inquiry involving analytical and experimental activities which primarily seek to increase the understanding of underlying phenomena. Research can be basic or applied.

*Technology transfer* means those activities that lead to the adoption of a new technique or product by users and involves dissemination, demonstration, training, and other activities that lead to eventual innovation.

*Transportation Research Information Services (TRIS)* means the TRB-maintained computerized storage and retrieval system for abstracts of ongoing and completed RD&T activities, including abstracts of RD&T reports and articles.

**§420.205 Policy.**

(a) It is the FHWA's policy to administer the RD&T program activities utilizing FHWA planning and research funds consistent with the policy specified in §420.105 and the following general principles in paragraphs (b) through (g) of this section.

(b) State transportation agencies shall provide information necessary for peer reviews.

(c) States are encouraged to develop, establish, and implement an RD&T program, funded with Federal and State resources, that anticipates and addresses transportation concerns before they become critical problems. To promote effective utilization of available resources, States are encouraged to cooperate with other States, the FHWA, and other appropriate agencies to achieve RD&T objectives established at the national level and to develop a technology transfer program to promote and use those results.

(d) States will be allowed the authority and flexibility to manage and direct their RD&T activities as presented in their work programs, and to initiate RD&T activities supported by FHWA planning and research funds, subject to the limitation of Federal funds and to compliance with program conditions set forth in subpart A of this part and §420.207.

(e) States will have primary responsibility for managing RD&T activities supported with FHWA planning and research funds carried out by other State agencies and organizations and for ensuring that such funds a e expended for purposes consistent with this subpart.

(f) Each State shall develop, establish, and implement a management process that ensures effective use of available FHWA planning and research funds for RD&T activities on a statewide basis. Each State is permitted to tailor its management process to meet State or local needs; however, the process must comply with the minimum requirements and conditions of this subpart.

(g) States are encouraged to make effective use of the FHWA Division, Regional, and Headquarters office expertise in developing and carrying out their RD&T activities. Participation of the FHWA on advisory panels and in program review meetings is encouraged.

**§420.207 Conditions for grant approval.**

(a) As a condition for approval of FHWA planning and research funds for RD&T activities, a State shall implement a program of RD&T activities for planning, design, construction, and maintenance of highways, public transportation, and intermodal transportation systems. Not less than 25 percent of the State's apportioned SPR funds shall be spent on such activities, unless waived by the FHWA, in accordance with the provisions of §420.107. In addition the State shall develop, establish, and implement a management process that identifies and implements RD&T activities expected to address highest priority transportation issues, and includes:

(1) An interactive process for identification and prioritization of RD&T activities for inclusion in an RD&T work program;

(2) Utilization, to the maximum extent possible, of all FHWA planning and research funds set aside for RD&T activities either internally or for participation in national, regional pooled, or cooperatively funded studies;

(3) Procedures for tracking program activities, schedules, accomplishments, and fiscal commitments;

(4) Support and use of the TRIS database for program development, reporting of active RD&T activities, and input of the final report information;

(5) Procedures to determine the effectiveness of the State's management process in implementing the RD&T program, to determine the utilization of the State's RD&T outputs, and to facilitate peer reviews of its RD&T Program on a periodic basis and;

(6) Procedures for documenting RD&T activities through the preparation of final reports. As a minimum, the documentation shall include the data collected, analyses performed, conclusions, and recommendations. The State shall actively implement appropriate research findings and should document benefits.

(b) Each State shall conduct peer reviews of its RD&T program and should participate in the review of other

States' programs on a periodic basis. To assist peer reviewers in completing a quality and performance effectiveness review, the State shall disclose to them information and documentation required to be collected and maintained under this subpart. Travel and other costs associated with peer reviews of the State's program may be identified as a line item in the State work program and will be eligible for 100 percent Federal funding. At least two members of the peer review team shall be selected from the FHWA list of qualified peer reviewers. The peer review team shall provide a written report of its findings to the State. The State shall forward a copy of the report to the FHWA Division Administrator with a written response to the peer review findings.

(c) Documentation that describes the management process and the procedures for selecting and implementing RD&T activities shall be developed and maintained by the State. The documentation shall be submitted by the State to the FHWA Division office for FHWA approval. Significant changes in the management process also shall be submitted by the State for FHWA approval. The State shall make the documentation available, as necessary, to facilitate peer reviews.

**§ 420.209 RD&T work program.**

(a) The State's RD&T work program shall, as a minimum, consist of an annual or biennial description of activities and individual RD&T activities to be accomplished during the program period, estimated costs for each eligible activity, and a description of any cooperatively funded activities that are part of a national or regional pooled study including the NCHRP contribution. The State's work program should include a list of the major items with a cost estimate for each item.

(b) The State's RD&T work program shall include financial summaries showing the funding levels and share (Federal, State, and other sources) for RD&T activities for the program year. States are encouraged to include any activity funded 100 percent with State or other funds.

(c) Approval and authorization procedures in § 420.115 are applicable to the State's RD&T work program.

**§ 420.211 Eligibility of costs.**

(a) Unless otherwise specified in this section, the eligible costs for Federal participation in § 420.113 are applicable to this part.

(b) Costs for implementation of RD&T activities in conformity with the requirements and conditions set forth in this subpart are eligible for Federal participation.

(c) Indirect costs of a State transportation agency RD&T unit are allowable to the extent specified in § 420.113(b).

(d) Indirect costs of other State agencies and organizations are allowable if supported by a cost allocation plan and indirect cost proposal in accordance with OMB requirements.

**§ 420.213 Certification requirements.**

(a) Each State shall certify to the FHWA Division Administrator before June 30, 1995, that it is complying with the requirements of this subpart. For those States unable to meet full compliance by June 30, 1995, the FHWA Division Administrator may grant conditional approval of the State's RD&T management process. A conditional approval shall cite those areas of the State's management process that are deficient. All deficiencies must be corrected by January 1, 1996. A copy of the certification shall be submitted with each work program. A new certification will be required if the State significantly revises its management process for the RD&T program.

(b) The certification shall consist of a statement signed by the Administrator, or an official designated by the Administrator, of the State transportation agency certifying as follows: I (name of certifying official), (position title), of the State (Commonwealth) of _____, do hereby certify that the State (Commonwealth) is in compliance with all requirements of 23 U.S.C. 307 and its implementing regulations with respect to the research, development and technology transfer program, and contemplate no changes in statutes, regulations, or administrative procedures which would affect such compliance.

(c) The FHWA Division Administrator shall determine if the State is in compliance with the requirements of this subpart.

### §420.215 Procedure for withdrawal of approval.

(a) If a State is not complying with the requirements of this subpart, or is not performing in accordance with its RD&T management process, the FHWA Division Administrator shall issue a written notice of proposed determination of noncompliance to the State. The notice shall set forth the reasons for the proposed determination and inform the State that it may reply in writing within 30 calendar days from the date of the notice. The State's reply should address the deficiencies cited in the notice and provide documentation as necessary.

(b) If the State and Division Administrator cannot resolve the differences set forth in the determination of nonconformity, the State may appeal to the Federal Highway Administrator.

(c) The Federal Highway Administrator's action shall constitute the final decision of the FHWA.

(d) An adverse decision shall result in immediate withdrawal of approval of FHWA planning and research funds for the State's RD&T activities until the State is in full compliance.

# PART 450—PLANNING ASSISTANCE AND STANDARDS

## Subpart A—Planning Definitions

Sec.



## Subpart B—Statewide Transportation Planning



## Subpart C—Metropolitan Transportation Planning and Programming



AUTHORITY: 23 U.S.C. 104(f), 134, 135, 217, and 315; 42 U.S.C. 7410 et seq; 49 U.S.C. app. 1602, 1604, 1607, and 1607a; 49 CFR 1.48(b) and 1.51.

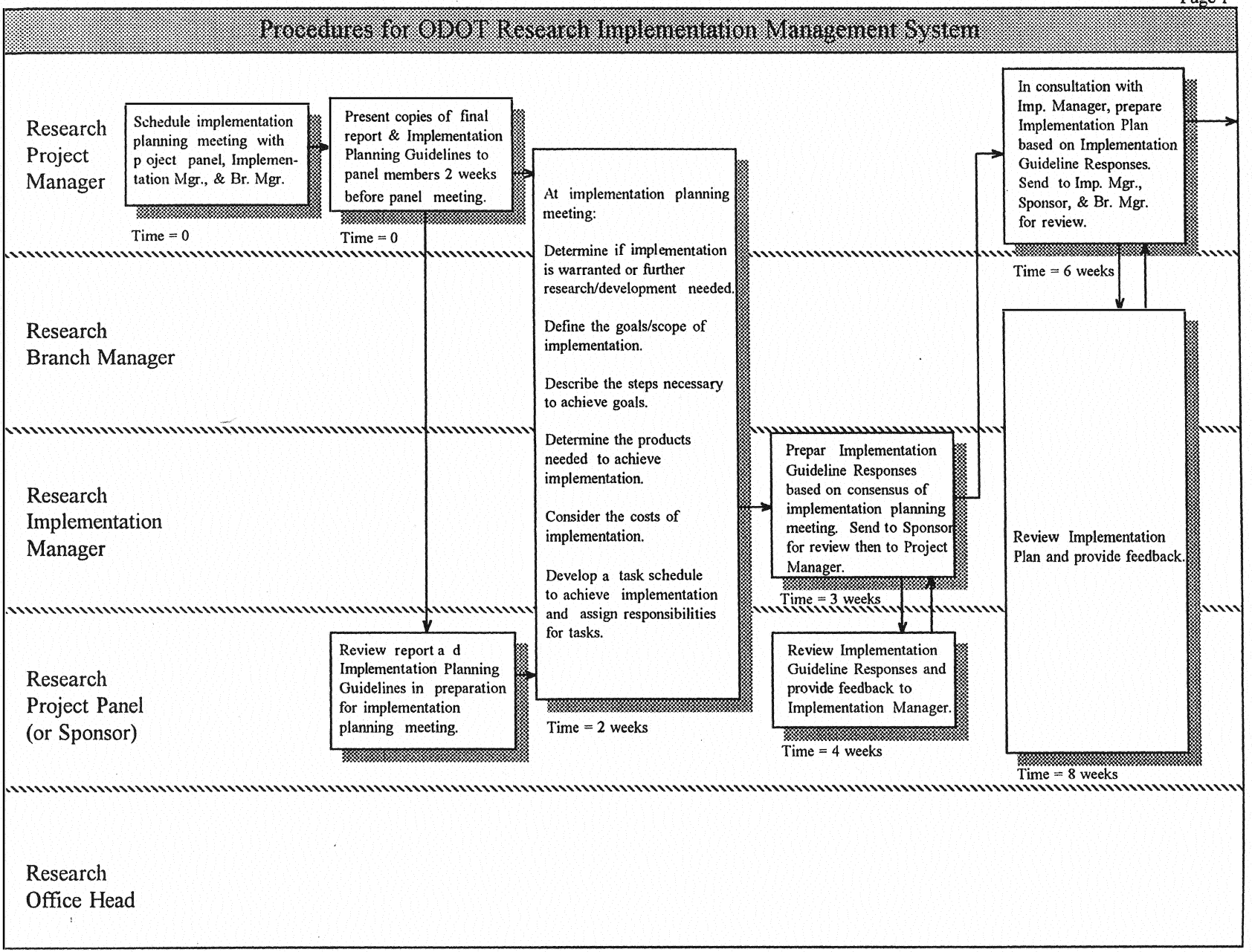
SOURCE: 58 FR 58064, Oct. 28, 1993, unless otherwise noted.

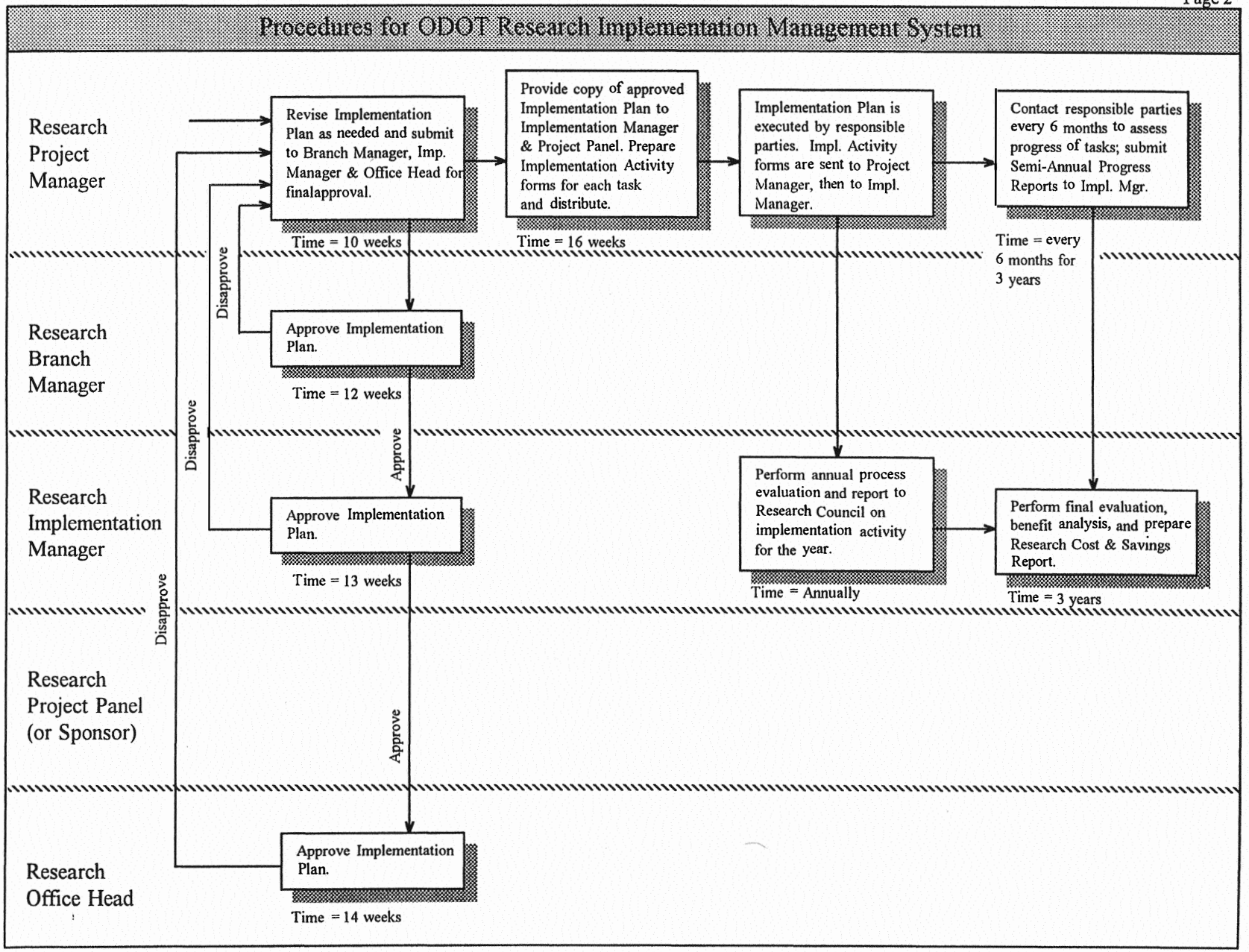
## Subpart A—Planning Definitions

### §450.100 Purpose.

The purpose of this subpart is to provide definitions for terms used in this part which go beyond those terms defined in 23 U.S.C. 101(a).

# Procedures for ODOT Research Implementation Management System




Procedures for ODOT Research Implementation Management System
Research Project Manager
Research Branch Manager
Research Implementation Manager
Research Project Panel (or Sponsor)
Research Office Head
Revise Implementation Plan as needed and submit to Branch Manager, Imp. Manager & Office Head for finalapproval.
Time = 10 weeks
Provide copy of approved Implementation Plan to Implementation Manager & Project Panel. Prepare Implementation Activity forms for each task and distribute.
Time = 16 weeks
Implementation Plan is executed by responsible parties. Impl. Activity forms are sent to Project Manager, then to Impl. Manager.
Contact responsible parties every 6 months to assess progress of tasks; submit Semi-Annual Progress Reports to Impl. Mgr.
Time = every 6 months for 3 years
Disapprove
Approve Implementation Plan.
Time = 12 weeks
Approve
Disapprove
Approve Implementation Plan.
Time = 13 weeks
Perform annual process evaluation and report to Research Council on implementation activity for the year.
Time = Annually
Perform final evaluation, benefit analysis, and prepare Research Cost & Savings Report.
Time = 3 years
Disapprove
Approve
Approve Implementation Plan.
Time = 14 weeks
Disapprove

# APPENDIX C

AN EXAMPLE OF GUIDELINES FOR IMPLEMENTATION PLANNING
WITH RESPONSES INCLUDED

**IMPLEMENTATION STRATEGIES**

1. Describe the specific steps necessary to achieve implementation?

   *Deferred to last page.*

2. What are the goals/objectives of implementation? What is the scope of the planned effort?

   *Restore all underdrains to proper function and maintain function with regular inspection and cleaning as necessary. Scope should be statewide.*

3. What are the potential problems or constraints associated with implementation? This could include lack of equipment/resources, need for FHWA approval, etc.

   *Jetter and camera are too expensive for field divisions to purchase. May need FHWA approval for change in specifications/revised standard. Limited personnel to do initial cleaning and repair of underdrains.*

4. What will be the costs associated with implementation?

   *Cost of personnel to inventory underdrains in each division. Cost of personnel to do initial cleaning and repair of underdrains. Cost of jetter and camera. Increased cost for requirements of headwalls and stiffer outlet pipe for new construction. Cost of training personnel, including presentations, workshops, demonstrations, and production of training vides. Cost of personnel to do ongoing maintenance.*

5. What tools are needed to achieve implementation? (Check all that could apply.)

_x_ Report or Summary
___ Brochure
___ Poster
_x_ Slide Presentation
_x_ Videotape
_x_ Demonstration
_x_ Manual or Guideline
_x_ Training Program
_x_ Workshop/Seminar
_x_ Technical Assistance
_x_ Special or Additional Equipment/Materials
_x_ Draft Specification, Special Provision, Standard, Revision, etc.
_x_ Other (Please describe) *Inventory of underdrain locations.*

**TASK SCHEDULING**

Describe the sequence of steps necessary to achieve implementation, including who is responsible for each task and an approximate schedule of when it could be completed.

*Roadway Design will work on a detail sheet that Project Engineers can begin including in plans immediately. They will also work on revisions to the underdrain standard and will bring what they have developed to the next meeting.*

*Research will made a slide and video presentation at the Division Engineers' meeting on January 4, 1996, and at the next Maintenance Engineers' meeting, emphasizing the importance of proper underdrain function. They will also make the presentation to the Resident Engineers at the upcoming Residency Academy. Research will work with Video Production to produce a training video for construction inspectors, emphasizing quality control during installation, and later a training video for maintenance workers, showing proper use of jetter and camera.*

*Project Sponsor will present the panel's request at the next Division Engineers' meeting for an inventory of all underdrain locations and conditions.*

*The panel will consider what changes need to be made to the underdrain specifications and be ready to discuss at the next meeting.*

# IMPLEMENTATION PLAN FOR ESTABLISHMENT OF UNDERDRAIN MAINTENANCE PROCEDURES

## ITEM 2183

**February 1996**

**Steve Sawyer**
**Research Project Manager**

**Research, Development & Technology Transfer**
**Oklahoma Department of Transportation**
**200 N.E. 21st Street, Room 2A2**
**Oklahoma City, Oklahoma 73105**
**(405)521-2671**

# IMPLEMENTATION PLAN FOR ESTABLISHMENT OF UNDERDRAIN MAINTENANCE PROCEDURES

## BACKGROUND

The research project entitled "Establishment of Underdrain Maintenance Procedures-Item 2183" was conducted by the Oklahoma Department of Transportation (ODOT) Office of Research to investigate the causes of diminished performance of perforated pipe underdrains. The purpose of the project was to establish the procedures necessary to restore and maintain the proper function of pipe underdrains.

Perforated pipe underdrains are placed in trenches parallel and adjacent to the edges of the roadway in order to lower ground water that may encroach into the subgrade and perhaps even the base material and pavement. Saturation of the subgrade weakens the structural capacity of the subgrade and base layers and can result in such surface pavement distresses as potholes, rutting, and alligator or longitudinal cracking.

This project examined 100 underdrain sites across the state. The largest number of sites were concentrated in the eastern part of the state which receives more annual rainfall. The underdrains were classified by outlet condition and it was found that 71% were either partially or fully clogged or buried. Wherever possible the condition of the interior of the outlets were inspected with a pipe inspection system that included a small video camera. When an obstruction was encountered that prevented further inspection of the outlet, the nature of the obstructions was recorded.

Fourteen sites were selected for development of maintenance procedures. Techniques were developed using a high pressure jetter to clear underdrains and outlets of obstructions such as sediment and roots. Ditch regrading and outlet replacement were required in more extreme cases of blockage or damage.

expense of the pipe inspection camera and jetter for inspection and cleaning. Approval will be needed for changes in specifications, a new underdrain outlet installation standard, and revisions to the ODOT PUD-1 underdrain installation standard. Field divisions have limited personnel to do the tasks of initial cleaning and restoration of underdrains.

Achieving the goals of implementation will require revision of the PUD-1 underdrain installation standard to disallow use of galvanized steel or other metal pipe and delete requirement for marker posts at outlets. A new standard for underdrain outlet installation is needed and should include mandatory headwalls, minimum diameter pipe, and a minimum bend radius from underdrain to outlet. New specifications are needed to require a stronger pipe be used for new construction and to require stricter quality control/acceptance standards for installation. An inventory of underdrain locations is needed. Two videotapes are needed, one to specifically target quality control during installation and and the other showing proper use of the camera and jetter for maintenance. Presentations will need to be made to Division, Maintenance, and Resident Engineers, and Construction Inspectors. Maintenance workers will need special training and demonstrations of proper use of the equipment.

## TASK SCHEDULING

The following steps are recommended by the Project Panel to achieve the implementation goals of this project. They have been grouped into three major categories of design, installation, and maintenance.

### *Design*

- Roadway Design will create a new detail sheet that Project Engineers can begin including in plans immediately.
- Roadway Design will revise the underdrain installation standard PUD-1 to delete any reference to galvanized steel or other metal pipe and the outlet marker posts.
- Roadway Design will also create a new underdrain outlet installation standard, including a design for a mandatory headwall, and specifying a minimum bend radius for the connection of the outlet lateral pipe to the underdrain and a minimum 6" pipe to be used for outlet laterals.
- Roadway Design will present these to Standards Committee for approval.

*Installation*

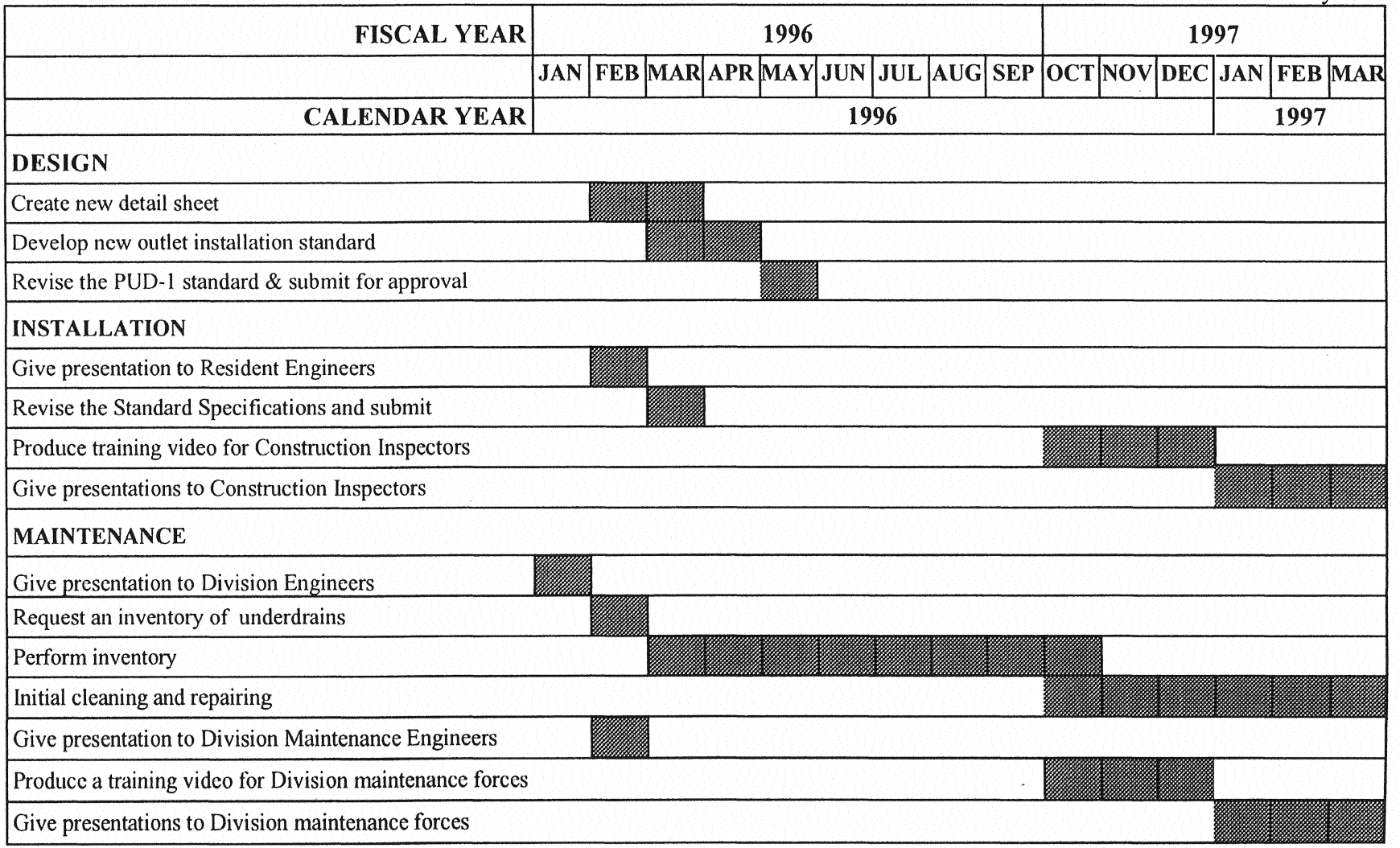
- Research will give a video and slide presentation to Resident Engineers to inform them of current problems and importance of proper installation and maintenance.
- Research will compose revisions to the Standard Specifications for Highway Construction to disallow the use of metal pipes, and require a stiffer pipe for lateral outlets, a headwall on all outlets, and standards for acceptance of installation. He will forward the revisions to Project Sponsor who will approve and then submit them to the Office Engineer.
- Research will work with Video Production to produce a training video for Construction Inspectors emphasizing quality control during installation.
- Research will give presentations to Construction Inspectors emphasizing quality control during installation.

*Maintenance*

- Research will give the video and slide presentation to Division Engineers to inform them of the magnitude of problems associated with clogged pipe underdrains.
- Project Sponsor will present the panel's recommendation for an inventory to be taken of all locatable underdrains to the Division Engineers.
- Project Sponsor will submit the panel's recommendation that Division contracts be let to do the initial cleaning and repairing necessary to clean and restore all inventoried underdrains to proper function and provide headwalls for existing underdrains.
- Research will give a video and slide presentation to Maintenance Engineers to inform them of current problems and the importance of proper maintenance.
- Research will work with Video Production to produce a training video for Division maintenance forces showing proper use of the pipe inspection camera and jetter.
- Research will give presentations to Division maintenance forces showing proper use of the pipe inspection camera and jetter.

# ESTIMATED TIME SCHEDULE FOR IMPLEMENTATION OF UNDERDRAIN MAINTENANCE PROCEDURES

February 1996



# BUDGET ESTIMATE FOR IMPLEMENTATION OF UNDERDRAIN MAINTENANCE PROCEDURES

February 1996

| FISCAL YEAR | | FY 1996 (JAN 96-SEP 96) | | FY 1997 (OCT 96-SEP 97) | | TOTAL COSTS | |
|---|---|---|---|---|---|---|---|
| | UNIT COST | UNITS | COST | UNITS | COST | UNITS | COST |
| **NON-RD&T PERSONNEL COSTS** | | | | | | | |
| Roadway Design | $19.36/hr | 45 hours | $ 871 | 0 hours | $ 0 | 45 hours | $ 871 |
| Video Production | $11.36/hr | 70 hours | 795 | 0 hours | 0 | 70 hours | 795 |
| Division Maintenance | $10.00/hr | 135 hours | 1,350 | 15 hours | 150 | 150 hours | 1,500 |
| | SUBTOTAL | | $ 3,016 | | $ 150 | | $ 3,166 |
| Labor Additive | 67.1% Subtotal | | $ 2,024 | | $ 101 | | $ 2,125 |
| | **TOTAL** | | **$ 5,040** | | **$ 251** | | **$ 5,291** |
| **RD&T PERSONNEL COSTS** | | | | | | | |
| Project Manager | $11.69/hr | 54 hours | $ 631 | 180 hours | $ 2,104 | 234 hours | $ 2,735 |
| | SUBTOTAL | | $ 631 | | $ 2,104 | | $ 2,735 |
| Labor Additive | 67.1% Subtotal | | $ 423 | | $ 1,412 | | $ 1,835 |
| | **TOTAL** | | **$ 1,054** | | **$ 3,516** | | **$ 4,570** |
| **CONTRACT COSTS** | | | | | | | |
| Initial repair & cleaning | n/a | lump sum | **$ 150,000** | lump sum | **$ 150,000** | lump sum | **$ 300,000** |
| **TRAVEL** | | | | | | | |
| Lodging | $40/night | 1 night | $ 40 | 11 nights | $ 440 | 12 nights | $ 480 |
| Per Diem | $25/day | 1 day | $ 25 | 11 days | $ 275 | 12 days | $ 300 |
| | **TOTAL COSTS** | | **$ 156,160** | | **$ 154,481** | | **$ 310,641** |

## TRACKING

Implementation progress will be monitored every six months by the Research Implementation Manager and the Project Manager. Implementation activity will be documented by the responsible area. Semi-Annual Implementation Progress Reports will be completed by the Project Manager every six months for the three years following acceptance of this plan. A final report detailing the achievements, costs, and benefits of implementation will be written by the Implementation Manager at the end of the three year period. It will include a benefit/cost analysis of the research project and its implementation.

# APPENDIX E

RECORD OF IMPLEMENTATION ACTIVITY FORM

# RECORD OF IMPLEMENTATION ACTIVITY

**Office of Research**
**Oklahoma Department of Transportation**
**(405) 521-2671**
**FAX (405) 521-6528**

| PROJECT: | PROJECT MANAGER: | ITEM NO.: |
|---|---|---|
| Establishment of Underdrain Procedures | Steve Sawyer | 2110-2183 |

**TASK (FROM IMPLEMENTATION PLAN):**
Revise underdrain installation standard PUD-1 to delete any reference to galvanized steel or other metal pipe and to the outlet marker posts.

| START DATE: January 5, 1996 | EXPECTED COMPLETION DATE: March 1, 1996 |
|---|---|
| NAME AND JOB TITLE: Brian Schmitt, Engineering Manager | DIVISION: IX |

| DATE | ACTIVITY (Brief descriptive phrase) | HOURS SPENT (to nearest hour) |
|---|---|---|

Copies of this form to be faxed or mailed to the Office of Research every six months (by March 15 and September 15). Please return the original completed form to the Office of Research when the task is finished.

# APPENDIX F

RESEARCH SEMI-ANNUAL PROGRESS REPORT

STATE OF OKLAHOMA • DEPARTMENT OF TRANSPORTATION

# RESEARCH SEMI-ANNUAL PROGRESS REPORT

| 1. TITLE | 2. ITEM NUMBER |
|---|---|
| Implementation - Establishment of Underdrain Maintenance Procedures | 2110 - 2183 |

| 3. PURPOSE | 4. CONTRACT MANAGER |
|---|---|
| To provide the mechanism for divisions to be able to restore all identifiable underdrains to proper function and maintain them with regular inspection and cleaning. | Curtis J. Hayes |
| | 4A. PROJECT MANAGER: Steven Sawyer |

| 5. WORK PLAN APPROVED | 6. ORIGINAL START | 7. ESTIMATED COMPLETION | 8. REVISED COMPLETION | 9. % COMPLETED TO DATE (TASKS) |
|---|---|---|---|---|
| September 1996 | January 1996 | March 1997 | September 1997 | 43% |

10. List specific major tasks or phases to accomplish the purpose.
Use the fo lowing symbols to indicate planned progress.
Strike-Out the symbol when actually accomplished.
S = ESTIMATED STARTING PERIOD, C = ESTIMATED COMPLETION PERIOD
~~S~~ = ACTUAL STARTING PERIOD, ~~C~~ = ACTUAL COMPLETION PERIOD

**LIST OF TASKS**

**FISCAL YEAR**

| LIST OF TASKS | Prior | 1996 Oct - Dec | 1996 Jan - Mar | 1996 Apr - Jun | 1996 Jul - Sep | 1997 Oct - Dec | 1997 Jan - Mar | 1997 Apr - Jun | 1997 Jul - Sep | Beyond |
|---|---|---|---|---|---|---|---|---|---|---|
| 1) Give presentations to Div. Engrs., Res. Engrs., & Div. Maint. Engrs. | | | ~~S~~~~C~~ | | | | | | | |
| 2) Develop new detail sheet, installation standard, and revise PUD-1 | | | ~~S~~ | ~~C~~ | | | | | | |
| 3) Revise and submit Standard Specifications | | | ~~S~~ | ~~C~~ | | | | | | |
| 4) Produce training videos for Constr. Insp. and Maintenance workers | | | | | | S | C | | | |
| 5) Perform inventory of underdrains | | | ~~S~~ | - | - | - | - | C | | |
| 6) Do initial cleaning and repair on underdrains | | | | | | S | - | - | C | |
| 7) Give presentations to Constr. Insp. and Maintenance workers | | | | | | | S | C | | |

11. EXPLAIN WHAT WAS DONE THIS PERIOD AND HOW IT COMPARES WITH WHAT WAS PROPOSED IN BLOCK 12 OF THE LAST SEMI-ANNUAL REPORT. DESCRIBE ANY UNANTICIPATED PROBLEMS THAT AROSE THIS SEMI-ANNUAL PERIOD OR ANY RECENT IMPLEMENTATION.

Implementation phase began. New detail sheet and outlet installation standard were created. PUD-1 standard was revised. Revised Specifications were submitted. One specification was inadvertently omitted and must be submitted next period. Underdrain inventories were completed in four divisions. Two more are in the process of performing inventories. The remaining two have been delayed. Contract was prepared for cleaning and repair but has not been executed do to inventories not complete. This has caused the fiscal year expenditures to be below estimates.

12. BRIEFLY DESCRIBE THE WORK PLANNED FOR THE NEXT PERIOD ALONG WITH ANY PROJECTED DEVIATIONS FROM THE WORK PLAN OR ANTICIPATED MODIFICATIONS TO THE COST ESTIMATE OR THE WORK SCHEDULE.

Work will begin on training videos. Inventories will be completed in two divisions. Contracts will be let and cleaning/repair begun in six divisions. Presentations to Construction Inspectors and Maintenance workers will be delayed until completion of the training videos.

| | Fiscal Year Budget | Fiscal Year Expenditures | Total Project Budget | Total Expenditures to Date |
|---|---|---|---|---|
| 13A. APPROVED RD&T FUNDING | $ 1,056 | $ 547 | $ 4,572 | $ 547 |
| 13B. APPROVED TOTAL BUDGET | Fisca Year Budget $ 156,096 | Fiscal Year Expenditures $ 3,147 | Total Project Budget $ 309,863 | Total Expenditures to Date $ 3,147 |

| 14. RESEARCH AGENCY | 15. RESPONSIBLE UNIT |
|---|---|
| Oklahoma Department of Transportation | Research, Development and Technology Transfer |

| 16. PROGRESS REPORT DATE | 17. PROJECT MANAGER (NAME AND SIGNATURE) | 18. CONTRACT MANAGER INITIAL |
|---|---|---|
| September 1996 | Steven Sawyer | |

| **Cash Flow Plan** | **Anticipated Expenditures** | | |
|---|---|---|---|
| Item: **2110-2183** | Future Three Six-Month Periods | | |
| Date: September 30,1996 | 1 | 2 | 3 |
| Anticipated Expenditures ($) TOTAL* | $154,002 | $152,167 | |
| Anticipated ODOT Staff Cost ($) | $4,002 | $2,167 | |
| Anticipated Contractor Invoices ($) | $150,000 | $150,000 | |

Note: The Cash Flow Plan must be attached to the Research Semi-Annual Progress Report. The Cash Flow Plan lists the expenditures anticipated in the three periods that immediately follow the period reported in the Research Semi-Annual Progress Report.

** May also include equipment and other expenses*

# APPENDIX G

BENEFIT COST ANALYSIS GUIDE AND EXAMPLES OF PRELIMINARY AND FINAL RESEARCH PROJECT COST AND SAVINGS REPORTS

To compare alternatives with different service lives, the benefits and costs associated with each must be converted to present worth and then annualized. The method for converting net present worth to an **equivalent uniform annual cost (EUAC)** is to multiply the NPW by a **capital recovery factor (CRF)**. The same discount rate used to convert future costs to present worth is also used to convert NPW to EUAC (4% for ODOT research project analyses). Different CRFs (see the attached tables) will be used, depending on the service life of each alternative. The difference between EUACs is the annual savings. The Office of Research considers three years of annual savings to be the measurable benefit of the project. The annual savings are converted to a three-year benefit by multiplying the EUAC by the **present worth uniform series (PWUS) factor**.

Whether comparing NPW or EUAC, assumptions must be made about the costs of construction and maintenance activities. One source of data for these costs at ODOT is the PlanJob program on the mainframe computer. Information displayed for each project include length of project, type of work done, year of construction, and total cost.

One of the problems inherent in BCA is the difficulty in quantifying certain benefits and costs, such as the value of a human life, traffic delay costs, or other user costs. Due to the problem of transforming these types of costs into monetary terms in a consistent and credible manner, it is recommended that user costs be neglected in the BCA and described in qualitative terms. The Research Project Cost and Savings Report form provides for such descriptions in Box 13.

**Example of a Three-Year Estimate of Savings for EUAC:**

The hypothetical analysis below was performed on the research project, "Establishment of Underdrain Maintenance Procedures." This is an example of the procedures and concepts only, and the figures used here should not be taken as representative of the actual costs of construction and maintenance activities. All calculations were performed using a 4% discount rate.

Step 1. Estimate decrease in service life of pavement:

It is estimated that inadequate subsurface drainage results in a 15% decrease in service life of a flexible pavement. For this analysis, a flexible pavement is assumed to have a 20-year design life. The actual service life of an inadequately drained asphalt pavement (due to clogged underdrains) would be 17 years. Maintenance activities are also assumed to occur at correspondingly more frequent intervals.

Step 2. Select a representative roadway section:

The Project Manager describes the typical roadway as a 4-lane asphalt pavement section. He also estimated the average length of roadway affected by each underdrain to be 500 feet.

Step 3. Estimate construction and maintenance costs for drained and undrained sections and compute present worth:

Construction of each section is set at year 0, therefore the present worth is equal to the cost. The cost of construction is assumed to be equal for both sections since both have underdrains; one section has properly functioning underdrains and the other, clogged.

Present Worth per mile of 4-lane undrained section

| Year | Activity | Cost | PWSP factor | Present Worth |
|---|---|---|---|---|
| 0 | Construction | $1,500,000 | n/a | $1,500,000 |
| 9 | Overlay | $ 115,000 | 0.70259* | $ 80,798 |
| 17 | Overlay | $ 115,000 | 0.51337 | $ 59,038 |
| | | | Total Present Worth | $1,639,836/mile |

* - See G-5 for all factors.

Step 3. (Continued)

Present Worth per mile of 4-lane drained section

| Year | Activity | Cost | PWSP factor | Present Worth |
|---|---|---|---|---|
| 0 | Construction | $1,500,000 | n/a | $1,500,000 |
| 10 | Overlay | $ 115,000 | 0.67556 | $ 77,689 |
| 20 | Overlay | $ 115,000 | 0.45639 | $ 52,485 |
| | | | Total Present Worth | $1,630,174/mile |

Step 4. Convert to equivalent uniform annual cost (EUAC) and find annual savings:

| Type | Present Worth | Analysis Period | CRF | EUAC | Savings |
|---|---|---|---|---|---|
| Undrained | $1,639,836 | 17 years | 0.08220 | $134,795 | |
| Drained | $1,630,174 | 20 years | 0.07358 | $119,948 | $14,847 |

Step 5. Find savings for three-year period for entire length of affected roadway:

A total of 580 underdrain outlets were found and restored for a total of 55 miles of affected roadway. Annual savings/mile x 55 miles x PWUS= $14,847 x 55 x 2.7751= $2,266,105.

STATE OF OKLAHOMA • DEPARTMENT OF TRANSPORTATION

# RESEARCH PROJECT COST AND SAVINGS REPORT - PRELIMINARY

| 1. NAME OF PROJECT | 2. ITEM NO. |
|---|---|
| Establishment of Underdrain Maintenance Procedures | 2110-2183 |

3. OBJECTIVES

To conduct a statewide survey of underdrain and outlet conditions, classify the problems, and develop methods to clean or repair underdrains.

| 4. PROJECT BUDGET | 5. IMPLEMENT. BUDGET | 6. TOTAL BUDGET | 7. OVER/UNDERRUN | 8. PROJECTED BENEFITS | 9. PROJECTED B/C RATIO |
|---|---|---|---|---|---|
| $125,000 | | | | $546,337 | 4.37 |
| **4A. PROJECT EXP.** | **5A. IMPLEMENTATION EXP.** | **6A. TOTAL EXPENDITURES** | **7A. % OVER/UNDERRUN** | **8A. ACTUAL BENEFITS** | **9A. ACTUAL B/C R TIO** |
| | | | | | |

10. RESEARCH FINDINGS

11. HOW HAVE RESEARCH FINDINGS BEEN USED? (Describe methods of implementation, i.e., Special Provisions, Standard Specifications, Standard Plans, Change in Procedure, Manual Change, New Test Method, Change Order, etc.)

12. THREE-YEAR ESTIMATE OF SAVINGS (Describe and estimate savings brought about as a direct result of this project. Do not consider the cost of the project.)

It is estimated that approximately 350 feet of roadway length are affected per underdrain outlet location. Also, 200 outlets will be cleaned as a result of demonstrations and subsequent maintenance efforts for a total of 13.26 miles. It is estimated that inadequate subsurface drainage results in 15% decrease in service life (from 20 years to 17 years) of an asphalt pavement.

1. Present Worth per mile of 4-lane undrained section (all calculations using 4% discount rate):

| Year | Activity | Cost | Present Worth |
|---|---|---|---|
| 0 | Construction | $1,500,000 | $1,500,000 |
| 9 | Overlay | $ 115,000 | $ 80,798 |
| 17 | Overlay | $ 115,000 | $ 59,038 |
| Total Present Worth | | | $1,639,836/mile |

2. Present Worth per mile of 4-lane drained section:

| Year | Activity | Cost | Present Worth |
|---|---|---|---|
| 0 | Construction | $1,500,000 | $1,500,000 |
| 10 | Overlay | $ 115,000 | $ 77,689 |
| 20 | Overlay | $ 115,000 | $ 52,485 |
| Total Present Worth | | | $1,630,174/mile |

3. Equivalent Uniform Annual Costs (EUAC) Per Mile:

| Type | Analysis Period | Present Worth | EUAC | Annual Savings |
|---|---|---|---|---|
| Undrained | 17 years | $1,639,836 | $134,795 | --- |
| Drained | 20 years | $1,630,174 | $119,948 | $14,847/mile |

Over a 3 year period, this will result in a present worth savings of $546,337 for the 13.26 miles of affect ed roadway.

13. OTHER BENEFITS (Describe other benefits such as safety, convenience, technology transfer, or long-term benefits.)

| 14. PROJECT MANAGER | 15. CONTRACT MANAGER | 16. DATE |
|---|---|---|
| Glenda Goodner | Curtis Hayes | May 1991 |

STATE OF OKLAHOMA • DEPARTMENT OF TRANSPORTATION

# RESEARCH PROJECT COST AND SAVINGS REPORT - FINAL

| 1. NAME OF PROJECT | 2. ITEM NO. |
|---|---|
| Establishment of Underdrain Maintenance Procedures | 2110-2183 |

3. OBJECTIVES

To conduct a statewide survey of underdrain and outlet conditions, classify the problems, and develop methods to clean or repair underdrains.

| 4. PROJECT BUDGET | 5. IMPLEMENT. BUDGET | 6. TOTAL BUDGET | 7. OVER/UNDERRUN | 8. PROJECTED BENEFITS | 9. PROJECTED B/C RATIO |
|---|---|---|---|---|---|
| $125,000 | $310,641 | $435,641 | $333,465 | $546,337 | 4.37 |
| **4A. PROJECT EXP.** | **5A. IMPLEMENTATION EXP.** | **6A. TOTAL EXPENDITURES** | **7A. % OVER/UNDERRUN** | **8A. ACTUAL BENEFITS** | **9A. ACTUAL B/C RATIO** |
| $479,543 | $289,563 | $769,106 | +177% | $2,266,105 | 2.94 |

10. RESEARCH FINDINGS

Study found that 71% of outlets examined were either partially or fully clogged or buried. Video inspection of outlet interiors revealed root and sediment obstructions. It was determined that a high-pressure jetter was effective in removing obstructions, but ditch regrading and outlet replacement were necessary in cases of extreme blockage or damage.

11. HOW HAVE RESEARCH FINDINGS BEEN USED? (Describe methods of implementation, i.e., Special Provisions, Standard Specifications, Standard Plans, Change in Procedure, Manual Change, New Test Method, Change Order, etc.)

The research findings were used to revise the underdrain specification to require stiffer outlet pipe; to develop a new standard for outlet installation requiring mandatory headwalls, a minimum diameter pipe, and a minimum bend radius from underdrain to outlet; to revise the PUD-1 standard to prohibit use of metal pipe; to develop new maintenance procedures to inspect and clean underdrains; and to let a special maintenance contract to clean, repair, and pour headwalls for located underdrains.

12. THREE-YEAR ESTIMATE OF SAVINGS (Describe and estimate savings brought about as a direct result of this project. Do not consider the cost of the project.)

Approximately 580 underdrain outlets were identified (average 500 feet roadway per underdrain) for a total of 55 miles of roadway to be restored by maintenance contract. It is estimated that inadequate subsurface drainage results in 15% decrease in service life (from 20 years to 17 years) of an asphalt pavement.

1. Present Worth per mile of 4-lane undrained section (all calculations using 4% discount rate):

| Year | Activity | Cost | Present Worth |
|---|---|---|---|
| 0 | Construction | $1,500,000 | $1,500,000 |
| 9 | Overlay | $ 115,000 | $ 80,798 |
| 17 | Overlay | $ 115,000 | $ 59,038 |
| Total Present Worth | | | $1,639,836/mile |

2. Present Worth per mile of 4-lane drained section:

| Year | Activity | Cost | Present Worth |
|---|---|---|---|
| 0 | Construction | $1,500,000 | $1,500,000 |
| 10 | Overlay | $ 115,000 | $ 77,689 |
| 20 | Overlay | $ 115,000 | $ 52,485 |
| Total Present Worth | | | $1,630,174/mile |

3. Equivalent Uniform Annual Costs (EUAC) Per Mile:

| Type | Analysis Period | Present Worth | EUAC | Annual Savings |
|---|---|---|---|---|
| Undrained | 17 years | $1,639,836 | $134,795 | --- |
| Drained | 20 years | $1,630,174 | $119,948 | $14,847/mile |

Over a 3 year period, this results in a present worth savings of $2,266,105 for the 55 miles of affected roadway

13. OTHER BENEFITS (Describe otherbenefits such as safety, convenience, technology transfer, or long-term benefits.)

Technology transfer was provided to local governments and other state DOTs by report and video distribution. Long-term savings from extended service life of pavements maintained by field divisions using these procedures is expected.

| 14. PROJECT MANAGER | 15. CONTRACT MANAGER | 16. DATE |
|---|---|---|
| Steven Sawyer | Curtis Hayes | June 1999 |

# APPENDIX H

RIMS PROCESS EVALUATION AND ANNUAL SUMMARY

# PROCESS EVALUATION OF RIMS

**Office of Research**
**Oklahoma Department of Transportation**



| PROJECT: | PROJECT MANAGER: | ITEM NO.: |
|---|---|---|
| | | |

STEP: **Schedule implementation planning meeting.**

Expected Completion Date: Actual Completion Date:

Describe deviations (if any) and effect on implementation:

STEP: **Present copies of final report and Implementation Planning Guidelines to panel members.**

Expected Completion Date: Actual Completion Date:

Describe deviations (if any) and effect on implementation:

STEP: **Review report and Implementation Planning Guidelines.**

Expected Completion Date: Actual Completion Date:

Describe deviations (if any) and effect on implementation:

STEP: **Complete Implementation Planning Meeting tasks.**

Expected Completion Date: Actual Completion Date:

Describe deviations (if any) and effect on implementation:

STEP: **Prepare Implementation Guideline Responses and send to Sponsor and Project Manager.**

Expected Completion Date: Actual Completion Date:

Describe deviations (if any) and effect on implementation:

STEP: **Review Implementation Guideline Responses and provide feedback.**

Expected Completion Date: Actual Completion Date:

Describe deviations (if any) and effect on implementation:

# PROCESS EVALUATION OF RIMS

**Office of Research**
**Oklahoma Department of Transportation**



| PROJECT: | PROJECT MANAGER: | ITEM NO.: |
|---|---|---|
| | | |

STEP: **Prepare Implementation Plan, send to Sponsor, Branch Mgr. and Impl. Mgr. for review.**

Expected Completion Date: Actual Completion Date:

Describe deviations (if any) and effect on implementation:

STEP: **Review Implementation Plan and provide feedback.**

Expected Completion Date: Actual Completion Date:

Describe deviations (if any) and effect on implementation:

STEP: **Revise Implementation Plan and submit for final approval.**

Expected Completion Date: Actual Completion Date:

Describe deviations (if any) and effect on implementation:

STEP: **Approve Implementation Plan (Branch Mgr., Implementation Mgr., and Office Head).**

Expected Completion Date: Actual Completion Date:

Describe deviations (if any) and effect on implementation:

STEP: **Provide copy of Implementation Plan to Implementation Manager and Project Panel.**

Expected Completion Date: Actual Completion Date:

Describe deviations (if any) and effect on implementation:

STEP: **Prepare Implementation Activity forms and distribute.**

Expected Completion Date: Actual Completion Date:

Describe deviations (if any) and effect on implementation:

# PROCESS EVALUATION OF RIMS

**Office of Research**
**Oklahoma Department of Transportation**



| PROJECT: | PROJECT MANAGER: | ITEM NO.: |
|---|---|---|
| | | |

STEP: **Execute Implementation Plan.**

Expected Completion Date: Actual Completion Date:

Describe deviations (if any) and effect on implementation:

STEP: **Submit Implementation Activity forms every six months.**

Expected Completion Date: Actual Completion Date:

Describe deviations (if any) and effect on implementation:

STEP: **Perform annual process eval. and report to Research Council on implementation activity.**

Expected Completion Date: Actual Completion Date:

Describe deviations (if any) and effect on implementation:

STEP: **Follow-up every six months; submit Semi-Annual Progress Reports.**

Expected Completion Date: Actual Completion Date:

Describe deviations (if any) and effect on implementation:

STEP: **Perform final evaluation, benefit analysis, and submit Research Cost & Savings Report.**

Expected Completion Date: Actual Completion Date:

Describe deviations (if any) and effect on implementation:

# ANNUAL SUMMARY OF RIMS PROCESS EVALUATION

**Office of Research**
**Oklahoma Department of Transportation**
**Fiscal Year 1996 (Oct 95 - Sep 96)**

| PROJECT: | PROJECT MANAGER: | ITEM NO.: |
|---|---|---|
| | | |

**FACTORS CONTRIBUTING TO SUCCESS OR FAILURE OF IMPLEMENTATION ACTIVITIES:**

**RECOMMENDED STRATEGIES TO IMPROVE IMPLEMENTATION OF THIS PROJECT:**

# APPENDIX I

RIMS BLANK FORMS

# GUIDELINES FOR
# RESEARCH IMPLEMENTATION PLANNING

## EVALUATION OF IMPLEMENTATION POTENTIAL

1. What was the problem identified in the Research Problem Statement and how do the results of the research effort solve that problem? If the results do not solve the problem, explain why not.

2. Are the results practical for application and ready to be implemented in their current form or is further research/development warranted?

3. What specifically should be implemented as a result of this project? Do the findings warrant a change in existing methods, procedures, specifications, standards, or design?

4. What improvement is offered over currently used products, methods, or procedures? What are the expected benefits of implementation (e.g., savings in time, money, lives, increased safety, better service, increased efficiency, etc.) and how can they be measured?

## IMPLEMENTATION STRATEGIES

1. Describe the specific steps necessary to achieve implementation?

2. What are the goals/objectives of implementation? What is the scope of the planned effort?

3. What are the potential problems or constraints associated with implementation? This could include lack of equipment/resources, need for FHWA approval, etc.

4. What will be the costs associated with implementation?

5. What tools are needed to achieve implementation? (Check all that could apply.)

___ Report or Summary
___ Brochure
___ Poster
___ Slide Presentation
___ Videotape
___ Demonstration
___ Manual or Guideline
___ Training Program
___ Workshop/Seminar
___ Technical Assistance
___ Special or Additional Equipment/Materials
___ Draft Specification, Special Provision, Standard, Revision, etc.
___ Other (Please describe)

**TASK SCHEDULING**

Describe the sequence of steps necessary to achieve implementation, including who is responsible for each task and an approximate schedule of when it could be completed.

# RECORD OF IMPLEMENTATION ACTIVITY

**Office of Research**
**Oklahoma Department of Transportation**
**(405) 521-2671**
**FAX (405) 521-6528**

| PROJECT: | PROJECT MANAGER: | ITEM NO.: |
|---|---|---|
| TASK (FROM IMPLEMENTATION PLAN): | | |
| START DATE: | EXPECTED COMPLETION DATE: | |
| NAME AND JOB TITLE: | | DIVISION: |

| DATE | ACTIVITY (Brief descriptive phrase) | HOURS SPENT (to nearest hour) |
|---|---|---|

Copies of this form to be faxed or mailed to the Office of Research every six months (by March 15 and September 15). Please return the original completed form to the Office of Research when the task is finished.

STATE OF OKLAHOMA • DEPARTMENT OF TRANSPORTATION

# RESEARCH SEMI-ANNUAL PROGRESS REPORT

| 1. TITLE | 2. ITEM NUMBER |
|---|---|
| | |

| 3. PURPOSE | 4. CONTRACT MANAGER |
|---|---|
| | 4A. PROJECT MANAGER |

| 5. WORK PLAN APPROVED | 6. ORIGINAL START | 7. ESTIMATED COMPLETION | 8. REVISED COMPLETION | 9. % COMPLETED TO DATE (TASKS) |
|---|---|---|---|---|
| | | | | |

10. List specific major tasks or phases to accomplish the purpose.
Use the following symbols to indicate planned progress.
Strike-Out the symbol when ac ually accomplished.
S = ESTIMATED STARTING PERIOD, C = ESTIMATED COMPLETION PERIOD
~~S~~ = ACTUAL STARTING PERIOD, ~~C~~ = ACTUAL COMPLETION PERIOD

**LIST OF TASKS**

**FISCAL YEAR**

| | 1996 | | | | 1997 | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Prior | Oct - Dec | Jan - Mar | Apr - Jun | Jul - Sep | Oct - Dec | Jan - Mar | Apr - Jun | Jul - Sep | Beyond |
| | | | | | | | | | |

11. EXPLAIN WHAT WAS DONE THIS PERIOD AND HOW IT COMPARES WITH WHAT WAS PROPOSED IN BLOCK 12 OF THE LAST SEMI-ANNUAL REPORT. DESCRIBE ANY UNANTICIPATED PROBLEMS THAT AROSE THIS SEMI-ANNUAL PERIOD OR ANY RECENT IMPLEMENTATION.

12. BRIEFLY DESCRIBE THE WORK PLANNED FOR THE NEXT PERIOD ALONG WITH ANY PROJECTED DEVIATIONS FROM THE WORK PLAN OR ANTICIPATED MODIFICATIONS TO THE COST ESTIMATE OR THE WORK SCHEDULE.

| | Fiscal Year Budget | Fiscal Year Expenditures | Total Project Budget | Total Expenditures to Date |
|---|---|---|---|---|
| 13A. APPROVED RD&T FUNDING | $ | $ | $ | $ |
| 13B. APPROVED TOTAL BUDGET | $ | $ | $ | $ |

| 14. RESEARCH AGENCY | 15. RESPONSIBLE UNIT |
|---|---|
| | |

| 16. PROGRESS REPORT DATE | 17. PROJECT MANAGER (NAME AND SIGNATURE) | 18. CONTRACT MANAGER INITIAL |
|---|---|---|
| | | |

| **Cash Flow Plan** | **Anticipated Expenditures** | | |
|---|---|---|---|
| Item: | Future Three Six-Month Periods | | |
| Date: | 1 | 2 | 3 |
| Anticipated Expenditures ($) TOTAL* | | | |
| Anticipated ODOT Staff Cost ($) | | | |
| Anticipated Contractor Invoices ($) | | | |

Note: The Cash Flow Plan must be attached to the Research Semi-Annual Progress Report. The Cash Flow Plan lists the expenditures anticipated in the three periods that immediately follow the period reported in the Research Semi-Annual Progress Report.

** May also include equipment and other expenses*

STATE OF OKLAHOMA • DEPARTMENT OF TRANSPORTATION

# RESEARCH PROJECT COST AND SAVINGS REPORT - PRELIMINARY

| 1. NAME OF PROJECT | | | | | 2. ITEM NO. |
|---|---|---|---|---|---|
| 3. OBJECTIVES | | | | | |
| 4. PROJECT BUDGET | 5. IMPLEMENT. BUDGET | 6. TOTAL BUDGET | 7. OVER/UNDERRUN | 8. PROJECTED BENEFITS | 9. PROJECTED B/C RATIO |
| 4A. PROJECT EXP. | 5A. IMPLEMENTATION EXP. | 6A. TOTAL EXPENDITURES | 7A. % OVER/UNDERRUN | 8A. ACTUAL BENEFITS | 9A. ACTUAL B/C RATIO |
| 10. RESEARCH FINDINGS | | | | | |
| 11. HOW HAVE RESEARCH FINDINGS BEEN USED? (De cribe methods of implementation, i.e., Special Provisions, Standard Specifications, Standard Plans, Change in Procedure, Manual Change, New Test Method, Change Order, etc.) | | | | | |
| 12. THREE-YEAR ESTIMATE OF SAVINGS (Describe and estimate savings brought about as a direct result of this project. Do not consider the cost of the project.) | | | | | |
| 13. OTHER BENEFITS (Describe otherbenefits suchas safety, convenience, technology transfer, orlong-term benefits.) | | | | | |
| 14. PROJECT MANAGER | | 15. CONTRACT MANAGER | | 16. DATE | |

STATE OF OKLAHOMA • DEPARTMENT OF TRANSPORTATION

# RESEARCH PROJECT COST AND SAVINGS REPORT - FINAL

| 1. NAME OF PROJECT | | | | | 2. ITEM NO. |
|---|---|---|---|---|---|
| 3. OBJECTIVES | | | | | |
| 4. PROJECT BUDGET | 5. IMPLEMENT. BUDGET | 6. TOTAL BUDGET | 7. OVER/UNDERRUN | 8. PROJECTED BENEFITS | 9. PROJECTED B/C RATIO |
| 4A. PROJECT EXP. | 5A. IMPLEMENTATION EXP. | 6A. TOTAL EXPENDITURES | 7A. % OVER/UNDERRUN | 8A. ACTUAL BENEFITS | 9A. ACTUAL B/C RATIO |
| 10. RESEARCH FINDINGS | | | | | |
| 11. HOW HAVE RESEARCH FINDINGS BEEN USED? (Descri e methods of implementation, i.e., Special Provisions, Standard Specifications, Standard Plans, Change in Procedure, Manual Change, New Test Method, Change Order, etc.) | | | | | |
| 12. THREE-YEAR ESTIMATE OF SAVINGS (Describe and estimate savings brought about as a direct result of this project. Do not consider the cost of the project.) | | | | | |
| 13. OTHER BENEFITS (Describe other benefits such as safety, convenience, technology transfer, or long-term benefits.) | | | | | |
| 14. PROJECT MANAGER | | 15. CONTRACT MANAGER | | 16. DATE | |

# PROCESS EVALUATION OF RIMS

**Office of Research**

**Oklahoma Department of Transportation**



| PROJECT: | PROJECT MANAGER: | ITEM NO.: |
|---|---|---|
| | | |

STEP: **Schedule implementation planning meeting.**

Expected Completion Date: Actual Completion Date:

Describe deviations (if any) and effect on implementation:

STEP: **Present copies of final report and Implementation Planning Guidelines to panel members.**

Expected Completion Date: Actual Completion Date:

Describe deviations (if any) and effect on implementation:

STEP: **Review report and Implementation Planning Guidelines.**

Expected Completion Date: Actual Completion Date:

Describe deviations (if any) and effect on implementation:

STEP: **Complete Implementation Planning Meeting tasks.**

Expected Completion Date: Actual Completion Date:

Describe deviations (if any) and effect on implementation:

STEP: **Prepare Implementation Guideline Responses and send to Sponsor and Project Manager.**

Expected Completion Date: Actual Completion Date:

Describe deviations (if any) and effect on implementation:

STEP: **Review Implementation Guideline Responses and provide feedback.**

Expected Completion Date: Actual Completion Date:

Describe deviations (if any) and effect on implementation:

# PROCESS EVALUATION OF RIMS

**Office of Research**
**Oklahoma Department of Transportation**



| PROJECT: | PROJECT MANAGER: | ITEM NO.: |
|---|---|---|
| | | |

STEP: **Prepare Implementation Plan, send to Sponsor, Branch Mgr. and Impl. Mgr. for review.**

Expected Completion Date: Actual Completion Date:

Describe deviations (if any) and effect on implementation:

STEP: **Review Implementation Plan and provide feedback.**

Expected Completion Date: Actual Completion Date:

Describe deviations (if any) and effect on implementation:

STEP: **Revise Implementation Plan and submit for final approval.**

Expected Completion Date: Actual Completion Date:

Describe deviations (if any) and effect on implementation:

STEP: **Approve Implementation Plan (Branch Mgr., Implementation Mgr., and Office Head).**

Expected Completion Date: Actual Completion Date:

Describe deviations (if any) and effect on implementation:

STEP: **Provide copy of Implementation Plan to Implementation Manager and Project Panel.**

Expected Completion Date: Actual Completion Date:

Describe deviations (if any) and effect on implementation:

STEP: **Prepare Implementation Activity forms and distribute.**

Expected Completion Date: Actual Completion Date:

Describe deviations (if any) and effect on implementation:

# PROCESS EVALUATION OF RIMS

**Office of Research**

**Oklahoma Department of Transportation**



| PROJECT: | PROJECT MANAGER: | ITEM NO.: |
|---|---|---|
| | | |

STEP: **Execute Implementation Plan.**

Expected Completion Date: Actual Completion Date:

Describe deviations (if any) and effect on implementation:

STEP: **Submit Implementation Activity forms every six months.**

Expected Completion Date: Actual Completion Date:

Describe deviations (if any) and effect on implementation:

STEP: **Perform annual process eval. and report to Research Council on implementation activity.**

Expected Completion Date: Actual Completion Date:

Describe deviations (if any) and effect on implementation:

STEP: **Follow-up every six months; submit Semi-Annual Progress Reports.**

Expected Completion Date: Actual Completion Date:

Describe deviations (if any) and effect on implementation:

STEP: **Perform final evaluation, benefit analysis, and submit Research Cost & Savings Report.**

Expected Completion Date: Actual Completion Date:

Describe deviations (if any) and effect on implementation:

# ANNUAL SUMMARY OF RIMS PROCESS EVALUATION

**Office of Research**
**Oklahoma Department of Transportation**
**Fiscal Year 1996 (Oct 95 - Sep 96)**

| PROJECT: | PROJECT MANAGER: | ITEM NO.: |
|---|---|---|
| | | |

**FACTORS CONTRIBUTING TO SUCCESS OR FAILURE OF IMPLEMENTATION ACTIVITIES:**

**RECOMMENDED STRATEGIES TO IMPROVE IMPLEMENTATION OF THIS PROJECT:**

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