NATIONAL COOPERATIVE HIGHWAY RESEARCH PROGRAM

Report 382

Facilitating the Implementation of Research Findings: A Summary Report

T.K. BIKSON,
S.A. LAW, and
M. MARKOVICH
RAND
Santa Monica, CA
and
B.T. HARDER
B.T. Harder, Inc.
Philadelphia, PA

Subject Areas

Bridges, Other Structures, and Hydraulics and Hydrology
Materials and Construction

Research Sponsored by the American Association of State Highway and Transportation Officials in Cooperation with the Federal Highway Administration

TRANSPORTATION RESEARCH BOARD
NATIONAL RESEARCH COUNCIL

NATIONAL ACADEMY PRESS
Washington, D.C. 1996

NATIONAL COOPERATIVE HIGHWAY RESEARCH PROGRAM

Systematic, well-designed research provides the most effective approach to the solution of many problems facing highway administrators and engineers. Often, highway problems are of local interest and can best be studied by highway departments individually or in cooperation with their state universities and others. However, the accelerating growth of highway transportation develops increasingly complex problems of wide interest to highway authorities. These problems are best studied through a coordinated program of cooperative research.

In recognition of these needs, the highway administrators of the American Association of State Highway and Transportation Officials initiated in 1962 an objective national highway research program employing modern scientific techniques. This program is supported on a continuing basis by funds from participating member states of the Association and it receives the full cooperation and support of the Federal Highway Administration, United States Department of Transportation.

The Transportation Research Board of the National Research Council was requested by the Association to administer the research program because of the Board's recognized objectivity and understanding of modern research practices. The Board is uniquely suited for this purpose as it maintains an extensive committee structure from which authorities on any highway transportation subject may be drawn; it possesses avenues of communications and cooperation with federal, state and local governmental agencies, universities, and industry; its relationship to the National Research Council is an insurance of objectivity; it maintains a full-time research correlation staff of specialists in highway transportation matters to bring the findings of research directly to those who are in a position to use them.

The program is developed on the basis of research needs identified by chief administrators of the highway and transportation departments and by committees of AASHTO. Each year, specific areas of research needs to be included in the program are proposed to the National Research Council and the Board by the American Association of State Highway and Transportation Officials. Research projects to fulfill these needs are defined by the Board, and qualified research agencies are selected from those that have submitted proposals. Administration and surveillance of research contracts are the responsibilities of the National Research Council and the Transportation Research Board.

The needs for highway research are many, and the National Cooperative Highway Research Program can make significant contributions to the solution of highway transportation problems of mutual concern to many responsible groups. The program, however, is intended to complement rather than to substitute for or duplicate other highway research programs.

NCHRP REPORT 382

Project 20-33 FY '94

ISSN 0077-5614

ISBN 0-309-05721-3

L. C. Catalog Card No. 96-60989

Price $18.00

NOTICE

The project that is the subject of this report was a part of the National Cooperative Highway Research Program conducted by the Transportation Research Board with the approval of the Governing Board of the National Research Council. Such approval reflects the Governing Board's judgment that the program concerned is of national importance and appropriate with respect to both the purposes and resources of the National Research Council.

The members of the technical committee selected to monitor this project and to review this report were chosen for recognized scholarly competence and with due consideration for the balance of disciplines appropriate to the project. The opinions and conclusions expressed or implied are those of the research agency that performed the research, and, while they have been accepted as appropriate by the technical committee, they are not necessarily those of the Transportation Research Board, the National Research Council, the American Association of State Highway and Transportation officials, or the Federal Highway Administration, U.S. Department of Transportation.

Each report is reviewed and accepted for publication by the technical committee according to procedures established and monitored by the Transportation Research Board Executive Committee and the Governing Board of the National Research Council.

Published reports of the

NATIONAL COOPERATIVE HIGHWAY RESEARCH PROGRAM

are available from:

Transportation Research Board
National Research Council
2101 Constitution Avenue, N.W.
Washington, D.C. 20418

Printed in the United States of America

FOREWORD

By Staff
Transportation Research Board

This report contains the findings of a study that was performed to identify the factors affecting implementation of research results, to delineate strategies that are expected to promote this implementation, and to recommend research to test the more viable strategies for putting transportation research results into practice. The report describes the research and provides recommendations to help state highway and transportation agencies and other highway organizations pursue more effective implementation of research results. This report should be of interest to decision makers and agency personnel responsible for research planning and administration.

Great promise and risk are inherent in the conduct of research. The underlying expectation is that research will yield innovative products and practices that will benefit users. The risk is that the research results will not be implemented to yield such benefits. *America's Highways: Accelerating the Search for Innovation* (*TRB Special Report 202,* 1984), which laid the groundwork for the Strategic Highway Research Program (SHRP), stated that "Research often fails to change practice because of limited understanding, organizational inertia, inflexible standards, preoccupation with first costs, mistrust of change, or a desire to perpetuate jobs." Over the years, the FHWA's contract research programs, the SHRP, the NCHRP, and other research programs have produced a large volume of research results. These results make it possible to evaluate the benefits of research in the highway field. Considering the barriers discussed in *Report 202* and the extremely decentralized nature of transportation decision making in the United States, the difficulty in implementing research results is clear. In the public sector, the barriers to implementation of research findings have been both institutional (many agencies and levels of government) and organizational (a risk-averse public management culture). Research was conducted by RAND under NCHRP Project 20-33, "Facilitating the Implementation of Research Findings," to identify and evaluate the factors that influence the implementation of research findings and to recommend strategies to facilitate the timely application of research results. To accomplish these objectives, the researchers reviewed relevant literature, visited state departments of transportation, convened a workshop of representatives of state and local agencies and the private sector, and conducted a national survey of officials in state, county, and city transportation agencies. The report documents the work performed under Project 20-33, discusses the factors that influence—positively and negatively—the application and use of research results in surface transportation, and presents recommendations to help senior managers and decision makers in the transportation community pursue more effective implementation of research results.

CONTENTS

ACKNOWLEDGMENTS

The research reported herein was performed under NCHRP Project 20-33 by RAND and, under a subcontract, by B. T. Harder, Inc. Tora K. Bikson, Senior Scientist, RAND, was the principal investigator. Sally Ann Law, Associate Behavioral Scientist, was co-investigator. The other authors of this report are: Martin Markovich, Assistant Policy Analyst, RAND; and Barbara T. Harder, B. T. Harder, Inc. The project also benefited from the research assistance of Rebecca Mazel and Susan Hillebrand, RAND consultants. Susan Weinblatt coordinated all activities performed by RAND's Survey Research Group.

CHAPTER 1

INTRODUCTION

Millions of dollars are spent annually on research to address surface transportation problems in the United States. The expectation underlying this investment is that this research will result in new products and processes to improve the nation's transportation system. This is not always the case—organizational, institutional, and other barriers often hinder effective implementation of research results. The purpose of this project was to learn what influences—positively and negatively—the transfer, application, and use of research results and to ascertain what practices seem most closely associated with successful implementation.

BACKGROUND

In recent years, there has been unprecedented commitment to the conduct of research as evidenced by the funding of the recently completed Strategic Highway Research Program (SHRP) and the large increases in research spending called for in the Intermodal Surface Transportation Efficiency Act (ISTEA) of 1991. Underlying this increased commitment to research is the belief that "research pays off" by yielding innovative products and processes that will benefit future transportation system users and providers. However, as pointed out in *TRB Special Report 202*, "America's Highways: Accelerating the Search for Innovation," "Research often fails to change practice because of limited understanding, organizational inertia, inflexible standards, preoccupation with first costs, mistrust of change, or a desire to perpetuate jobs." Add to the list the very decentralized multijurisdictional nature of transportation decision making, and the challenge of turning transportation research results into improved products or processes in user settings becomes clear. Especially in the nonprofit sector, daunting institutional and organizational barriers to change—such as the lack of economic incentives or other rewards and a risk-averse public management culture—impede the implementation of research findings.

There is, therefore, an urgent need for a research effort that can help improve technology transfer and facilitate the rapid use of research findings in surface transportation. NCHRP Project 20-33 was initiated, with partial funding provided by the FHWA, to address this need.

OBJECTIVES

Project objectives were as follows:

- Identify and evaluate the significant factors that influence the implementation of research findings,
- Determine ways to improve technology transfer and facilitate interagency and public-private cooperation in applying research results in surface transportation, and
- Recommend strategies to create an environment conducive to innovation and timely application of research findings in surface transportation.

SCOPE

The overall approach was guided by a conceptual framework developed from several studies that examined influences on and outcomes of the implementation of research results in a wide variety of contexts.

The work was performed in two phases. The results of Phase I work were intended to guide the second phase of this project and other future research and decision making related to the implementation of surface transportation innovations. (Phase I work is summarized in *NCHRP Research Results Digest Number 207*.)

In Phase I, the research team conducted an extensive review of the literature, visited state departments of transportation (DOTs), and convened an expert resource panel. Phase I work concluded with the identification of (1) factors affecting the implementation of research findings across applied fields, (2) practices expected to promote implementation, and (3) themes for future research to test the more viable implementation strategies in the surface transportation field specifically. In Phase II, the research team conducted a national survey of officials in state, county, and city transportation agencies in order to determine, from the perspective of user organizations, what influences—positively and negatively—the application and use of research results in surface transportation.

CHAPTER 2

STATE-OF-THE-ART REVIEW

This project is the first to examine technology transfer methods developed and tested in other fields for their applicability to the implementation of research results in the surface transportation industry. A comprehensive review of current knowledge about facilitating the implementation of research results was performed to accomplish the following:

- Compile a summary of implementation practices on the basis of a project-developed definition of implementation,
- Determine the factors most likely to encourage or discourage the implementation of research results, and
- Identify and prioritize research themes that should be pursued to improve the dissemination and use of new technologies.

In addition to reviewing recent studies of the implementation of research results in other fields, the research team conducted a detailed review of relevant surface transportation literature and visited sites to discuss the application and use of new technologies with transportation professionals at different jurisdictional levels in three states. Finally, the research team convened a 2-day workshop to gather information about boosters and barriers to the implementation of research results and future research needs. An expert resource panel composed of representatives of state and local agencies as well as key private sector constituencies in the surface transportation community participated in the workshop.

This multifaceted research approach led to preliminary conclusions about the factors most likely to help or hinder transportation agency use of new products and processes and about research directions that most likely advance knowledge about implementation success in this field.

FACTORS AFFECTING IMPLEMENTATION

The conceptual framework adopted for this project suggests that the factors affecting whether and how quickly research results are implemented can be divided into the following three classes:

- Characteristics of the research results (e.g., their adaptability to various user settings or their ease of commercialization),
- Characteristics of the implementing organization (e.g., its size, resources, and culture) and its institutional context (e.g., political and regulatory constraints), and
- Characteristics of the implementation process (i.e., the activities that put into practice the research output [e.g., how the research is communicated, whether researchers and users interact, and whether users receive output-specific training]).

Implementation "success" was defined in terms of timeliness, effectiveness, and scope of use.

A set of factors within each of the three classes that appeared to have some significant effect on implementation success was identified. The relative importance of these factors was evaluated by workshop participants from various sectors of the transportation industry. These factors were divided into "barriers," (i.e., factors that impede implementation) and "boosters" (i.e., factors that promote implementation). A rating— on a scale of 1 to 5, with 5 being the most important—was assigned to each factor. Recommendations from the workshop, combined with results from the literature, generated the following preliminary findings for Phase I assessment.

Characteristics of Research Results

Some attributes of the research output itself can impede implementation. Most obviously, if the research does not match the needs of potential users, these groups will have little incentive to introduce the results into their own settings. Also, if users do not see evidence that a new product or process has been adequately tested and proven, they may not want to be the guinea pigs. Conversely, research results are more likely to be put rapidly and effectively into practice if research agencies had accounted for users' real-world needs. Thus, high ratings were given to the conduct of pilot projects in real user settings and inclusion of an implementation package as part of the research output. Figure 1 illustrates the relative importance of the factors pertaining to characteristics of research results.

Characteristics of the User Context

The most important context-related barriers to implementation include organizational inertia, risk-averse

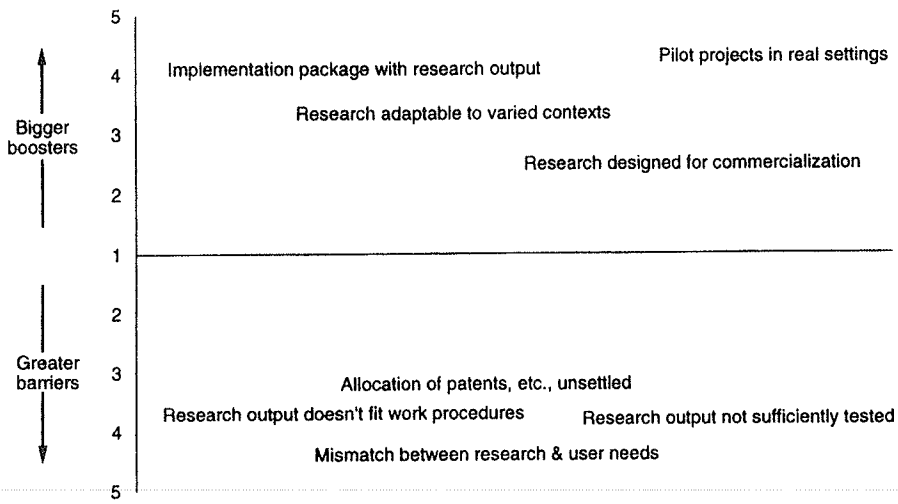

Figure 1. Factors pertaining to characteristics of research results.

behavior, management discomfort with change, and inadequacy of resources. Implementing organizations are often government agencies (e.g., state DOTs and municipal public works departments). Such agencies have been experiencing cutbacks in personnel and other resources and, therefore, may not be able to put in the extra effort required to implement a new product or process. Also, new products and processes entail a degree of risk—some will not prove worth their cost and may even malfunction. Government officials tend to be risk averse: they have much less to gain from research-based improvements that merit complimentary notices in public works journals than they have to lose from a single costly failure that winds up as a front-page news story.

Conversely, if users are provided with incentives to innovate, such as rewards and official recognition, the adoption of new research outputs could be facilitated. Also, the value of authoritative exemplars within a user organization needs to be recognized. These include commitment on the part of senior management to implementing new products and processes and the presence of offices or individuals of long tenure who have served as champions of innovation. Figure 2 illustrates the relative importance of the factors pertaining to the internal organizational context.

Attributes of the external institutional environment are viewed as less critical, though still important in some cases. Implementation of research results can be hindered, for example, by differences between researcher and user cultures. The language of basic research, or even applied research from a different discipline, can sound equally foreign to user organizations in the transportation field. Research conducted in other countries, for instance, may not be implemented because it is published in a foreign language. On the other hand, adoption of new products can be fostered in cases where user organizations form consortia to jointly conduct or evaluate research and implement its results. Figure 3 illustrates the relative importance of factors pertaining to the external organizational context.

Characteristics of the Implementation Process

Cost is frequently a major impediment to user organizations attempting to establish better links between research and use. Cost can also be problematic because of the allocation of responsibility. For example, a state may build a road using an innovative paving material or design, but the responsibility and cost of maintaining it may rest with the counties. Notwithstanding the importance of economic resources, two-way communication and interaction characterize most of the implementation-related barriers and boosters. For instance, users would be more likely to take a chance on new products if successful applications by other users were better publicized. Improving researcher-user interactions was given an especially high priority. Similarly high ratings were assigned to providing for joint researcher-user collaboration in pilot and development projects and to ensuring user participation in designing, evaluating, and disseminating research. These factors are related to the issue of resources because initiatives to increase researcher-user interactions may either increase both researcher and user costs or decrease the attention paid to other aspects of the research and other user activities. Figure 4 illustrates the relative importance of factors pertaining to the characteristics of the implementation process.

PRELIMINARY CONCLUSIONS

Implementation encompasses the series of events that begin when an agency first considers that goals can be met or problems can be solved by the adoption of a new process or product and ends when the process or product has been incorporated into the agency's practice. The intervening activities may include searching, testing, decision making, procurement or contracting, training, modification of the new tools or techniques, adaptation of related task procedures, and evaluation—perhaps iteratively. Implementation success measures include timeliness (relative to the complexity of the effort), effectiveness (in meeting the agency's intended

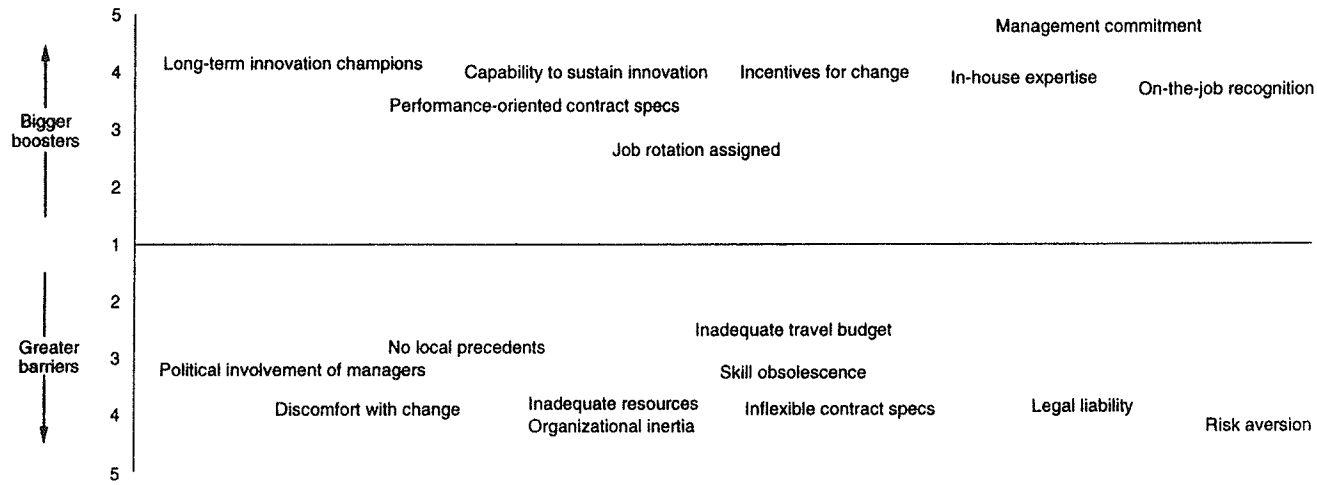

Figure 2. Factors pertaining to internal organization context.

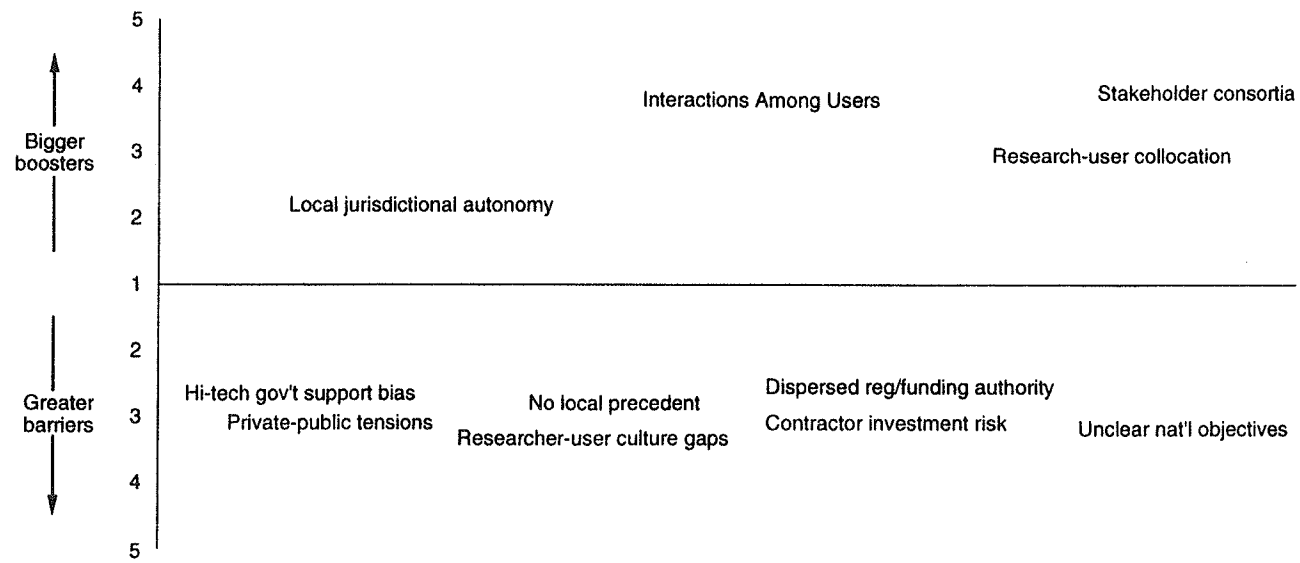

Figure 3. Factors pertaining to external organization context.

objectives), and scope (the proportion of potential users who become actual users of the new process or product).

Two kinds of factors were identified as increasing most strongly the likelihood of implementation success: (1) practices undertaken in the course of particular implementation efforts; and (2) characteristics of the user organization and its broader environment that more generally support its capability to adopt and use innovations. Implementation practices expected to be the strongest success boosters are those that bring research users and research providers in the surface transportation field closer together. Such practices include the following:

- User involvement in real, not token, ways throughout the research and development (R&D) stages;
- Pilot projects in real user settings; and
- Collaboration of key stakeholders—researchers and vendors or contractors as well as agency professionals whose work will be affected by new processes or products—in implementation activities.

Building the capability of agencies to implement research results consistently and successfully requires attention to organizational and institutional context factors. The most significant boosters are likely to be as follows:

- Developing a pro-innovation culture in user agencies (e.g., by senior management's commitment to change, by making implementation activity a real part of professional work and rewarding it, and by publicizing user organizations' implementation successes);
- Taking a proactive approach to technology dissemination 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 areas of concern, and by maintaining high technical skill levels in domains where implementation activity is expected); and
- Establishing interorganizational linkages (e.g., user consortia for sharing implementation knowledge, efforts, costs, and risks and regular two-way communication between research provider and user organizations independent of any particular new technology).

THEMES FOR FUTURE RESEARCH

As part of this work, a comprehensive list of promising research themes was developed; each theme had the potential to generate new information or improve the usefulness of existing information about successful implementation of innovative products or processes in surface transportation. Workshop participants rated the research themes—on a scale of 1 to 5, with 5 being high priority and 1 being low priority—to establish the relative standing of the research themes and generate discussion about the value of the resulting knowledge. These themes (including a brief description and mean rating of each) are as follows:

1. **Interactive Access to Information** (mean rating = 1.4)—Design and test a prototype system interface that relies on more advanced and easier to use technologies (e.g., Mosaic, hypertext links, expert systems) to support users' needs for distributed online information.
2. **Interactive Person-to-Person Contact** (mean rating = 1.5)—Design an interface to networked communication systems (or enhance an existing one) to promote interaction among and between various stakeholders and stakeholder groups. Determine the effects of computer-based communication on subsequent research implementation.
3. **Improving Information Currency** (mean rating = 1.2)—Design and test systems and procedures for organizing and updating distributed databases on innovations during research and implementation stages. Design and test methods for creating and updating information on those responsible for or potentially interested in these innovations. Provide for linkage between the two databases when relevant.
4. **Computer-Based Training and Technical Assistance** (mean rating = 1.2)—Design and test the use of interactive CD-ROM disks or networked-based systems for learning at a distance about new research processes or products.
5. **Quality/Relevance Filters for Disseminated Research Information** (mean rating = 3.0)—Drawing on a cross-sectional sample of user organizations, determine what procedures are employed to sort information about research findings for relevance to a site-specific task for potential implementation. Explore ways to systematize and test the most promising procedures.
6. **Effects of Proximity on Implementation Outcomes** (mean rating = 3.6)—Compare implementation

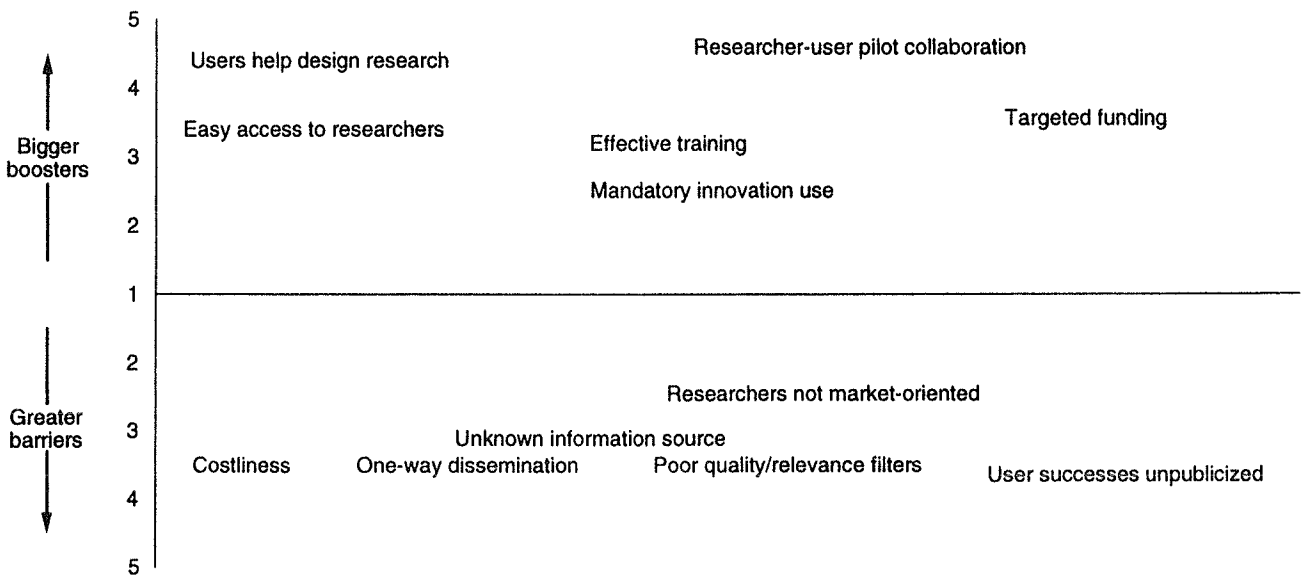

Figure 4. Factors pertaining to characteristics of implementation process.

outcomes in settings where the research provider organization is remote from the user organization with those where the two organizations are in proximity. Gather data about researcher-user interactions in the two types of settings and determine their relations to implementation outcomes.

7. **Risk Simulation and Decision Support** (mean rating = 1.7)—Design and test a computer-based simulation that would allow potential users of research to evaluate the likely risks and benefits associated with adopting an innovation.
8. **Implementation Outcome Assessment** (mean rating = 3.5)—Using detailed data from case samples, develop procedures for grading the extent and success of implementation of research results. Provide measures and assessment instructions for future use, including potential use to estimate outcomes of planned implementation efforts.
9. **Implementation Cost Assessment** (mean rating = 1.7)—Develop protocols and specialized training in the cost analysis of proposed implementations of innovative processes or products, incorporating factors often overlooked (e.g., opportunity costs and lifetime versus initial costs). Test the procedures and evaluate their potential usefulness for estimating cost.
10. **Consistently Successful User Settings** (mean rating = 4.2)—Conduct replicated case studies of implementation processes in states that have long-term track records as effective innovators. Determine the practices and strategies that systematically account for their successes.
11. **Building the Capability for Innovation in User Organizations** (mean rating = 3.3)—Design and conduct a model project aimed at building a user organization's capability to find, adopt, and absorb research innovations. Compare outcomes with those obtained by comparable sites where no systematic capability-building efforts have been initiated.
12. **Reward for Innovation in User Organizations** (mean rating =3.5)—Evaluate the performance effects of adopting a work system that provides positive incentives for change to individuals and groups in user organizations. Explore the extent to which incentives and rewards found to be effective in private-sector settings could be extended to public-sector settings.
13. **Effects of Major Change on Organizational Acceptance of Innovation** (mean rating = 3.9)—Define a sample of organizations where dramatic changes—for example, restructuring—are underway or recently completed; determine whether and how these kinds of changes that "unfreeze" routine behavior influence subsequent implementation of innovations.
14. **Contractors and Contracting Methods as Change Agents** (mean rating = 4.1)—Examine the extent of implementation of selected new products or processes in sites that have adopted contracting methods identified as innovative; compare the results with implementation outcomes for the same products or processes in otherwise similar sites that do not use innovative contracting approaches.
15. **Effects of Privatization** (mean rating = 2.5)—Design and conduct a cross-sectional study of sites to test the hypothesis that a lack of positive economic incentives hinders timely implementation of transportation innovations. Compare settings where government agencies perform the work with settings where the same functions are contracted to private-sector firms.
16. **Risk Management Methods** (mean rating = 2.0)—Evaluate the effects of methods intended to encourage innovation by mitigating risk. Use a comparison group design, involving otherwise similar organizations that do and do not have such systems in place; determine how the studied risk-management methods influence timeliness and effectiveness of implementation processes.
17. **Consultants as Change Agents** (mean rating = 2.9)—Examine the extent of implementation of new products or processes in sites that rely on consultants for expertise in certain areas; compare the results with implementation outcomes in similar sites that rely on internal expertise in those areas.
18. **Systematic Prospective Implementation Research** (mean rating = 4.0)—Follow the implementation progress of various research outputs in a number of user settings that differ in ways hypothesized to have an important influence on success. Identify the factors that are strongly predictive of success and failure.
19. **Comparative Assessment of Implementation Strategies** (mean rating = 2.9)—For a few innovations, design trial implementation strategies that include characteristics of successful approaches. Introduce and follow these model strategies in a number of sites. Compare the implementation outcomes with one another and with those in similar settings where standard dissemination strategies are employed.
20. **Changing Organizational Cultures and Processes** (mean rating = 3.9)—Determine the extent to which organizational process improvement efforts do or can lead to improved implementation (a) in research organizations, by making transfer of findings to users an identified element of high-quality R&D performance, and (b) in user organizations, by making innovation a recognized part of performance improvement.
21. **Effectiveness of Targeted Funding** (mean rating = 2.6)—Design and conduct a study to evaluate the relative effectiveness of targeted funding to speed the implementation of selected innovations in user organizations. Collect similar information about

comparable classes of innovations that were (a) mandated and (b) not subject to special policy intervention.

22. **Lessons from Local Technical Assistance Program (LTAP)** (mean rating = 3.5)—Study a cross section of LTAP-assisted sites to determine the kinds of context factors and inter-institutional relationships that promote local implementation of innovations. Recommend ways of extending the lessons learned across states as well as to other levels of government and institutions engaged in transfer of transportation-related research results.

RECOMMENDATIONS

The state-of-the-art review revealed that the question of how best to facilitate the implementation of research findings has evoked broad, deep, and long-term concern in many disciplines; therefore, the factors found to promote or impede implementation could be identified by drawing on rich experience in transportation and other fields. Identifying untried strategies, recognizing previously unseen barriers, or finding effective systemic ways of augmenting what is known about research dissemination and use proved more difficult. For the surface transportation field, the approaches likely to yield the greatest improvements over present methods appear to be those that concentrate on implementation and that attempt to drive change from the user's perspective rather than the provider's perspective. Research should explore such approaches to implementation in user contexts that have consistently produced successful results. The research indicates that data should be collected at many points over time, ideally in forward-looking rather than retrospective studies. Where possible, experimental or demonstration projects should be undertaken. The following are examples of such approaches:

- **Consistently successful user settings**. Conduct replicated case studies of consistently successful user agencies that have track records as successful implementors of research results. Determine the factors that systematically account for the consistency of their success over time.
- **Building the capabilities for implementation in user organizations.** Design and conduct a few intervention projects aimed at increasing user organizations' general ability to find, adopt, and use new products and processes in surface transportation. Compare outcomes with those obtained by comparable sites where no systematic capability-building efforts have been initiated.
- **Systematic prospective implementation research.** Monitor the implementation progress of selected research results (products and processes) in different user settings (both state- and local-level user agencies). Confirm the factors that are causally related to implementation success and failure.
- **Experimental assessment of implementation practices.** Design trial implementation strategies for a few innovations. Introduce and follow these model strategies at several sites. Compare the implementation outcomes with one another and with those in similar settings where traditional implementation approaches are used.
- **Changing organizational cultures and processes.** Determine the extent to which organizational process improvement efforts create an implementation-friendly environment. These relationships could be examined in (1) research provider organizations, by making dissemination of findings to users an integral part of the R&D process, and (2) in user organizations, by making implementation of research results a serious part of the agency business.
- **Implementation outcome assessment.** Using detailed data from a sample of different cases, develop procedures for grading the success (e.g., effectiveness, timeliness, and scope) of efforts to implement research results and design measures and assessment guidelines for evaluation and decision making, including ways to predict outcomes of planned implementation efforts and ways to incorporate lessons learned from prior trials into subsequent plans and projections.

CHAPTER 3

SURVEY OF TRANSPORTATION AGENCIES

To build on the findings of the Phase I review, the research team surveyed transportation officials from around the nation to learn about the experiences of users implementing research results in agencies at state, county, and city levels. The chief objectives in this survey were the following:

- Identify and describe practices that promote implementation success in the field,
- Learn whether and how successful practices are interrelated or are influenced by characteristics of organizational and institutional contexts or specific research domains, and
- Recommend ways to create implementation-friendly environments.

The research team used a multi-stage, stratified, and clustered random sampling method. Transportation professionals from user agencies in 25 states chosen approximately equally from the four AASHTO Regions were surveyed. The states selected for inclusion, by region, were as follows (see Figure 5):

- REGION I—Connecticut, Maryland, New Jersey, New York, and Pennsylvania;
- REGION II—Florida, Georgia, Louisiana, Mississippi, North Carolina, South Carolina, and Virginia;
- REGION III—Illinois, Indiana, Kansas, Minnesota, Ohio, and Wisconsin; and
- REGION IV—Arizona, California, Oregon, Texas, and Washington.

The research team oversampled agencies thought to be most active in implementing new research results. Participants were selected by role and included CAOs, field engineers, and other technical and professional staff. The final sample (324 respondents from an original pool of 552) represented a range of user settings, making the results generalizable from participating agencies to the surface transportation community as a whole.

Response rates varied among jurisdictional levels. The overall response rate was 60 percent, with an overall state-level response rate of 76 percent and an overall local-level response rate of 47 percent. The high response rate attests to the perceived importance of this topic for officials in state and local transportation agencies. It also makes sufficient data available for assessing policy changes intended to speed the implementation of new products and processes and for supporting the project's findings and recommendations. However, the discrepancy in response rates between state and local levels indicates that state-level results are considerably more robust and that more caution is warranted when generalizing from the sample to the local agency population. Especially at the local levels, it is important to bear in mind that the sample over-represents actively innovative agencies.

FINDINGS

To assess how state and local transportation agencies are using new products and processes, the respondents were asked to indicate whether, in the past 5 years, their agency had attempted to implement results of research in any one of 16 domains and to rate how successful each effort had been. The 16 domains are those used by the NCHRP to categorize research fields. Participants could also include up to five other areas. Although a 5-year time frame was specified, many participants described implementations that had been initiated further in the past but completed within the past 5 years.

Implementation Activity

The number and success rating for implementation efforts reported by the respondents for each of the 16 research domains are listed in Table 1. As indicated, much implementation activity has occurred during the past several years—more so at the state than the local level. An examination of whether the amount of implementation activity reported was related to agency and individual context variables (e.g., AASHTO Region, state planning and research [SP&R] funding level or population size category, and participant's job title or tenure in the industry) revealed very few significant differences within jurisdictional levels. In this context, the term "significant" means that the probability of such a finding occurring by chance is less than 5 times in 100. Nonsignificant findings, therefore, refer to those that, on the basis of empirical analyses, indicate a reasonable likelihood of occurring purely by chance rather than for systematic reasons.

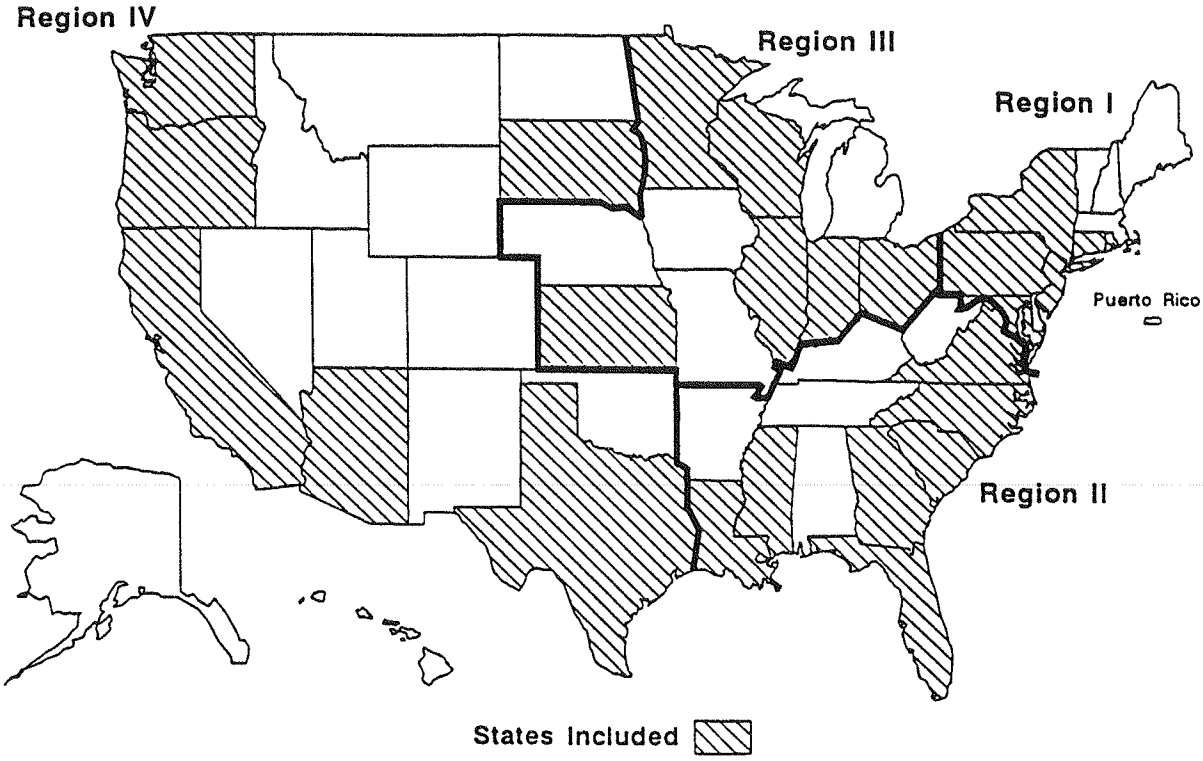

Figure 5. States selected for inclusion, by region.

State-level respondents, proportionately speaking, reported more implementation activity than their local-level counterparts. However, local-level participants rated their attempts as having been more successful in 9 out of the 16 domains. Respondents from both levels judged most of their implementation attempts to have been at least moderately successful—the mean ratings ranged between 2.7 and 3.9, on a 5-point success scale (1 = not very successful, 5 = highly successful).

Respondents were then asked to select and describe the best and, with the exception of the executive-level managers, worst examples of a new product or process implementation in their organizations. Table 2 shows the distribution of the most and least successful examples, broken down by eight domain categories and respondents' jurisdictional levels. These 8 domain categories were formed by combining 13 of the original 16 research fields into 5 broader categories, as indicated by the heavier lines in Table 1. Many state-level (172) and local-level (114) respondents provided examples of best-case implementations. Well over half of the cited success examples related to construction and maintenance (72 and 62 percent of state- and local-level respondents, respectively). Very few participants cited examples of best implementations related to the environment, safety, or transit.

Only 116 participants supplied information on their least successful implementation experiences (72 state- and 44 local-level participants). Because most implementation attempts are related to construction and maintenance and to computer and information systems, it is not surprising that most successes and most failures also are reported in these areas.

A more detailed picture of the implementation process from start to finish resulted from respondent-provided information on how agencies learned of the new product or process. As Table 3 shows, in both successful and unsuccessful attempts, respondents indicated they learn about new products and processes from multiple sources. One striking difference between jurisdictional levels is that representatives from city and county agencies learn about the innovations—both successful and unsuccessful—from private industry (e.g., vendors, consultants, and contractors) significantly more often than their state-level counterparts (i.e., 53 versus 35 percent, and 55 versus 44 percent, for successful and unsuccessful implementations, respectively). In both successful and unsuccessful implementation examples, local-level participants learned of the innovations less often through informal interactions with others than did state-level respondents (i.e., 27 versus 38 percent, and 27 versus 42 percent, for successful and unsuccessful implementations, respectively).

Practices That Promote Implementation Success

To determine the conditions that influence the outcomes of implementation efforts in user settings, the survey listed

TABLE 1 Implementation efforts

Domain	State n[1]	State (%)[2]	Local n[1]	Local (%)[2]
Pavement Design/Performance	92	(59)	59	(42)
Mean success rating	*3.5*		*3.6*	
Bridge Tunnel Design	64	(41)	16	(11)
Mean success rating	*3.7*		*3.7*	
Soils/Geology	66	(43)	29	(20)
Mean success rating	*3.6*		*3.6*	
Cement/Concrete Materials	90	(58)	40	(28)
Mean success rating	*3.4*		*3.6*	
Asphaltic/Bituminous Materials	106	(68)	70	(49)
Mean success rating	*3.5*		*3.6*	
Construction Materials	87	(56)	38	(27)
Mean success rating	*3.6*		*3.7*	
Facilities/Equipment	67	(43)	43	(30)
Mean success rating	*3.1*		*3.4*	
Maintenance Equipment	81	(52)	43	(30)
Mean success rating	*3.6*		*3.8*	
Highway Operations	86	(55)	42	(30)
Mean success rating	*3.7*		*3.6*	
Safety	70	(45)	31	(22)
Mean success rating	*3.6*		*3.9*	
ITS Applications	93	(60)	30	(21)
Mean success rating	*3.7*		*3.7*	
Computer/Information Systems	91	(59)	80	(56)
Mean success rating	*3.3*		*3.5*	
Planning/Forecasting	49	(32)	45	(32)
Mean success rating	*3.3*		*3.6*	
Environment	97	(63)	63	(44)
Mean success rating	*3.7*		*3.5*	
Public Transportation/Transit	39	(25)	37	(26)
Mean success rating	*3.0*		*3.2*	
Intermodal Transportation	27	(17)	27	(19)
Mean success rating	*2.7*		*3.2*	
Total Implementation Efforts	1166		709	
Average Number per Respondent	7.5		5.0	

1 "n" refers to the number of survey respondents providing answers to a particular question.

2 Percentages represent the proportion of respondents within the jurisdictional level who reported implementation efforts in each domain.

practices found to boost implementation success in other research. The respondents were asked to check any practice involved in the success case they had just described and also to judge how important each checked booster had been in making the implementation effort succeed.

State-level respondents reported using more actions to promote implementation of any given innovation than their local-level counterparts. There was, however, an exceptionally high level of agreement about which of these actions are the most important —the same top twelve actions were cited by state- and local-level respondents. The top 12 promoting actions—boosters—and their importance ratings are listed in descending order of importance in Table 4.

Research from many fields has indicated that efforts that incorporate several actions to promote implementation are more likely to be effective than those that rely on a single booster. To learn whether this is true for implementation of innovations in surface transportation, the practices cited by all participants were examined by employing a statistical analysis technique—factor analysis—that can detect patterns of co-occurrence among variables (i.e., whether some practices are more likely to co-occur in success cases than others). An exploratory factor analysis was used to test whether practices tend to group in patterns; because of response rate differences, the factor analyses were carried out separately by jurisdictional level.

Six patterns of co-occurring implementation practices, which may be interpreted as strategies, were identified. These factors are presented in the order in which they emerged from the analysis, reflecting the relative strength of their grouping. For example, the first factor—interpretable as user involvement—is by far the strongest practice in success

TABLE 2 Successful and unsuccessful cases

Domain Type	Jurisdictional Level							
	Successful Case				Unsuccessful Case			
	State		Local		State		Local	
	n[1]	(%)[2]	n[1]	(%)[2]	n[1]	(%)[2]	n[1]	(%)[2]
Design	13	(8)	4	(3)	7	(6)	2	(2)
Construction	72	(42)	36	(32)	18	(15)	8	(7)
Maintenance and Operations	51	(30)	34	(30)	27	(23)	14	(12)
Safety	4	(2)	1	(1)	1	(1)	0	(-)
ITS	11	(6)	5	(4)	2	(2)	1	(1)
Computer and Information Systems	18	(10)	27	(24)	11	(9)	12	(10)
Environment	3	(2)	5	(4)	5	(4)	5	(4)
Transit	0	(0)	2	(2)	1	(1)	2	(5)
Total Cases	172		114		72		44	

1 "n" refers to the number of survey respondents answering a particular question.

2 Percentages represent the proportion of respondents within the jurisdictional level who reported implementation efforts in each domain type.

TABLE 3 Information source for successful and unsuccessful implementation cases

Information Source	Successful Case (n=286)				Unsuccessful Case (n=116)			
	State (n=172)		Local (n=114)		State (n=72)		Local (n=44)	
	n[1]	%[2]	n[1]	%[2]	n[1]	%[2]	n[1]	%[2]
Conferences, workshops, etc.	61	35	51	44	26	36	18	41
Vendors, consultants, contractors	61	35	60	53	32	44	24	55
Professional/trade associations	30	17	37	32	22	31	13	30
Informal interactions with others	65	38	31	27	30	42	12	27
Research reports, journals	64	37	31	27	30	42	12	27
LTAP[3] dissemination	1	1	3	3	0	0	1	2
Other	43	25	13	11	19	26	10	23

1 "n" refers to the number of survey respondents providing answers to a particular question.

2 Column percentages total more than 100 because respondents were asked to check all categories that applied.

3 The LTAP acronym may not have been recognized by respondents in states where local technical assistance programs have different customized names.

cases from a strictly statistical standpoint. Specific practices most critical to this strategy include opportunities for users to interact with researchers and user participation in vital stages of the R&D that preceded implementation. The resulting factors can be described as follows:

- User involvement,
- Organizational and institutional support,
- Viability of the innovation,
- Marketing and other promotional tactics,
- Appropriate human resources, and
- Industry push and other implementation tactics.

The first three factors have highly comparable practices at state and local levels. The last three strategies have some distinctive practices in common, but have more variation from level to level.

CONCLUSIONS

The highest-level conclusions supported by survey data analyses, in abridged form, are as follows:

- Improving the nation's investment in surface transportation research through better implementation and use of new products and processes is important to officials at all levels in state and local transportation agencies.
- More research results are put into use in state- than in county- and city-level agencies. Some local agencies do

not consider themselves in the "implementation business" at all.

- When undertaken, local-level agencies report their implementation efforts are as successful as their state-level counterparts.
- Local agencies often appear to proceed with implementation alone. Interjurisdictional sharing of implementation efforts and experiences seldom occurs among transportation agencies.
- Region of the country, state population size, and SP&R funding level do not have much effect on the implementation of research results—jurisdiction level is the only context variable that significantly affects whether research results will be put into practice.
- Implementation success or failure is seldom attributed to some property of the new product or process. Some agencies reported having best and worst implementation experiences with the same technology (e.g., GIS).
- State- and local-level participants agree on the top 12 practices that promote implementation success.
- Transportation agencies should not be treated as passive recipients of research results—this is not an effective dissemination approach.
- The most important single booster of implementation success is the participation of all key parties. Research producers and end-users (and often others such as vendors or contractors) need to play a role in generating and implementing research results.
- Creating an implementation-friendly environment within user agencies depends on top-level commitment, skilled personnel, targeted resources, and a culture that takes implementation seriously.
- Using a combination of promising implementation strategies yields the greatest implementation payoff. Overreliance on any one specific practice is unlikely to ensure long-term success for a range of products or processes or user settings.

TABLE 4 Top twelve implementation boosters

Practice	Mean Importance Rating[1]
Pilot projects done in real user settings	4.6
Innovation matches users' needs	4.4
Strong commitment from senior management	4.3
Adequate funding	4.3
Collaboration among users, researchers, vendors	4.3
User participation in vital stages of the R&D	4.3
Champion for the project on site	4.3
High level of relevant technical skills	4.2
Implementation package and continued support	4.2
Demonstrable advantages for the innovation	4.2
Clear goals for the implementation effort	4.1
Targeted funding for the implementation	4.1

1 Importance of practices to implementation success was rated on a 5-point scale where 5 = very important and 1= not very important. Means are based on responses pooled over jurisdictional levels. Results are rounded to one decimal place, although item ordering relies on multiple decimal places.

CHAPTER 4

SUCCESSFUL IMPLEMENTATION EFFORTS

As part of the survey described in Chapter 3, qualitative material was collected from state and local transportation agencies about their implementation activities. A compendium of implementation efforts that were described as having significant influences on the agency's ability to put new processes and products to work was developed. The specific purposes of the qualitative compendium are to do the following:

- Document the rich experiences of technical professionals knowledgeable about the implementation of surface transportation innovations; and
- Speed the application of new technologies in surface transportation by providing implementation guidance and examples for others.

The results of this effort corroborate and extend conclusions based on the quantitative analyses performed in the project. They are intended to assist practitioners in effectively introducing new processes and products into the surface transportation system.

Information used for the compendium was drawn from a subset of survey participants: those who provided descriptive accounts of their most, and also sometimes their least, successful implementation efforts (see Table 1). These descriptions were reviewed to determine whether or not they met the following criteria:

- Technically sound;
- Provided evidence that the innovation was implemented;
- Gave specific details concerning the implementation process;
- Reported systematic, unique, or creative implementation practices; and
- Illustrated the need for, or benefit from, the innovation.

Examples that met at least two of these five criteria were included in the compendium. Telephone interviews were conducted with some participants to provide more background and greater detail about implementation strategies in highlighted cases. The examples were categorized into four very general domains (formed by combining the eight domains). The key implementation practices credited for the success (or failure) in each instance were compared and documented to form the basis for the results that follow.

FINDINGS

Numerous implementation efforts were identified from a nationally representative sample of implementation activity in surface transportation. These implementation efforts were chosen from that sample for further qualitative examination because they were regarded as more successful than most innovation attempts both by survey respondents and by the research team. The survey participants offered 286 best-case examples, from which 106 (37 percent) were included in the compendium of successful implementation practices. Also, from the 116 unsuccessful implementation efforts described by the survey participants, 41 (35 percent) were chosen to illustrate frequently encountered barriers. The findings and conclusions developed from such a base should be viewed therefore as the best experienced-based guides available to influence the implementation of research results in surface transportation.

Sources and Goals for Implementation

The most successful implementors rely most often on interactive two-way communication for information about new processes or products. The following three channels were most often cited as information sources by agencies describing successful implementation efforts:

- Professional organizations and associations, including conferences and publications;
- Informal contacts; and
- The private sector, including vendors, consultants, and contractors.

The private sector (in particular, vendors) and in-house development and dissemination of innovations often were cited as the source of information by managers in local agencies.

The most frequently cited reasons for implementing an innovation were cost savings and labor savings. This

suggests that highway innovations that increase costs or require increased labor, even if they represent improvements, are unlikely to be implemented unless driven by strong demand from the public or by regulatory requirements. Legal, regulatory, and safety requirements were mentioned several times as the stimulus for innovation. Improving administration and reducing disruption of traffic were, in contrast, not often cited as implementation reasons.

Implementation Strategy Characteristics

Including multiple stakeholders in the process was the implementation success strategy most often cited by a wide margin. Specifically, many respondents emphasized the need for researchers to consult with users and for users to develop contacts with both researchers and other stakeholders in surface transportation research and development. Depending on the innovation, some or all of these stakeholders may need to be involved. Although these interactions may lengthen the process and even change the nature of the application, they build the broad support and participation necessary for effective implementation of the results.

Many of the participants, including some of those who reported very successful implementations, cited the usefulness of field tests and pilot projects. Such tests can take several forms, including implementing the innovation in a small area or assigning one staff person to incorporate it into his or her regular work. A test may consist of developing a database and software to process it, but scrutinizing the output before using it as the basis for changing procedures is essential. Other strategies included allocating personnel time for training, finding (or being) a champion to present the innovation to users and decision makers, working to change attitudes, and being persistent and patient despite obstacles and inaction.

The Importance of Pre-Existing Context Factors

Conditions that exist prior to the introduction of an innovation can also make the difference between successful and unsuccessful implementation. Perhaps the most important favorable condition is an urgent, widely recognized need for a change. Sometimes budgetary constraints create the need; other cited conditions include the changing operations of private carriers or long-standing needs of agencies that now can be met by new technologies.

The next most cited favorable condition was strong support from top management, including chief executives in state DOTs and city governments. Sometimes only a push from the highest level can overcome problems of inertia or difficulties in acquiring resources. Availability of adequate resources for implementation, including expert or skilled staff, was also mentioned as a favorable condition.

Technology's Part in the Picture

Reliable, adequately tested research results are important to subsequent implementation success, but they do not determine either the likelihood of applications or their outcomes. Further, the very same innovation was reported in both best-case and worst-case examples, sometimes by the same agency. It is the implementation strategy itself—not just the technology—that most often makes the difference between success and failure.

A review of the examples included in the compendium shows that no single type of innovation or technology often has dominated implementation efforts over the last 10 years. Work has continued along several fronts in all the functional areas of highway facilities and equipment. Although increased use of databases and computers was cited, especially in the management area, the prime interest continues to be in the areas of materials, operating equipment, and labor relations.

In sum, user organizations exhibit considerable interest in research and in implementation of findings, but there are areas for potential improvement. In the decentralized surface transportation system, communicating research findings to, and working with, those who can best use them is inherently difficult. More communication between users and researchers is needed. Local government officials have very little interaction with researchers, and only limited communication with other local officials who may be working on the same problems. The accounts from both state and local officials show that it frequently takes 10 years or more for an agency to complete an implementation effort.

RECOMMENDATIONS FOR IMPROVING IMPLEMENTATION

Qualitative material obtained from the survey of state and local transportation officials showed that no one formula will ensure successful implementation of research results, but key elements tend to occur frequently. This finding supports the concept that certain actions enhance implementation efforts—producing financial or other benefits for the agency.

Several implementation practices or strategies are known to those who successfully implement new products or processes. The study confirmed some well-accepted practices and emphasized the importance of others. Furthermore, examples of successful implementation tend to point toward the "more is often better" approach. While a specific practice or strategy may be viewed as most influential in a given case, rarely, if ever, was success based on only one action. Numerous practices customized to the new product or process and agency context are required to address issues on all fronts of the implementation effort.

The following recommendations are derived from the case descriptions and describe practices that promote successful

implementation. In general, these practices should occur in conjunction with one another whenever possible.

- **Plan for implementation.** Conscious, planned efforts directed toward implementation create successful outcomes. Moreover, well-defined, flexible, and comprehensive goals, incorporating all players, are essential to implementation planning.
- **Fund implementation activities.** A modest amount of funding to facilitate implementation activities is a high payback action. When appropriate funds are provided, barriers to implementation often can be overcome easily.
- **Commit qualified people to the job of implementation.** Committing some of the technically qualified people as well as people who have sufficient authority to deal with potential administrative barriers will dramatically advance the implementation effort. Implementation is labor-intensive and should be considered primary work, not a collateral duty. Staff must be given time to perform the effort and credit for accomplishing the work.
- **Always address a genuine need.** Implementation of new products or processes works best when there is a need to change. Various conditions create these needs, and projects with less than genuine motivation rarely were cited as successful implementation experiences.
- **Select products or processes for implementation that have demonstrable advantages.** The implementation effort is enhanced, if users can relate the benefits of implementing a new product or process directly to their responsibilities. Products and processes that do what they are supposed to do and have advantages that can be seen by users were frequently reported as examples of successful cases.
- **Use pilot project, field demonstration, or field test results.** Successful implementation activities usually involve adequately tested (sometimes demonstrated or piloted) and sufficiently developed products or processes. Collaboration with other agencies or states, use of national or regional centers for evaluation, observing "neighboring agencies" efforts, and partnerships with the private sector all can spread cost, reduce the time to implement innovations, and enhance confidence in the technical performance of the products or processes.
- **Elicit strong support from senior management.** Senior management's endorsement and agencywide positive influence can eliminate potential barriers to the implementation of new products or processes. Every effort should be made to get support from the top technical and administrative managers overseeing the area of the agency in which the innovation is to be implemented.
- **Promote continuous collaboration between user and researcher/developer.** Continuous collaboration will enhance the overall implementation. Researchers must be willing to spend time with users to understand their true needs. Users also must be willing to become more knowledgeable, when necessary, to implement research results more effectively. This type of collaboration generally does not occur without encouragement.
- **Choose researchers and vendors with practical experience.** Researchers and technical experts must be able to bridge the gap between theory-driven research process and the users' practical needs. When this happens, the technical merits of the innovation are grasped more quickly, mid-course corrections in the research can occur if necessary, and the final product is customized more effectively to the users' needs.
- **Do it—the final recommendation.** The effectiveness of the key implementation strategies and practices has been demonstrated by state and local transportation professionals throughout the nation. They will work to varying degrees in diverse agencies and will assist in streamlining implementation activities.

CHAPTER 5

CONCLUSIONS AND RECOMMENDATIONS

The following conclusions and recommendations are based on the findings of this research effort as a whole. Many of the conclusions and recommendations are aimed primarily at senior managers and decision makers in the surface transportation community because they can influence systemwide change and can support changes being sought by their own agency's research and technology professionals.

- **Motivation to find and use new research results is high.** Individuals in state and local transportation agencies want to find and use new products and processes that will enable them to serve their constituencies better. Many strategies found to promote implementation are being used effectively. Applying promising strategies to broader technical areas and involving agency personnel in implementation activities should be a short- to medium-term goal.
- **Institutionalizing effective strategies promotes successful implementation.** Some user agencies have institutionalized practices that influence their implementation efforts. Practices such as preparing an implementation plan together with the researcher and developer, introducing a line item in the budget for implementation, using funds targeted for implementation, and establishing mechanisms and opportunities for researcher-user interactions should be shared widely among the community.
- **Active encouragement of implementation is more important than previously understood.** Effective implementation of research results, no matter how good, will not happen without specific guidance from senior management and effort by those with a stake in the outcome.
- **Implementation practices and strategies make the difference.** The ways in which research providers, users, and others approach the transfer of new products and processes into user settings have the biggest influence on outcomes. Although many in the community know the importance of good implementation practices and strategies, senior management and decision makers must also understand the importance of this issue, because they are in the best position to create conditions to support good implementation practices.
- **Opportunity for effective dialog exists.** Individuals in state and local transportation agencies (particularly at the executive management level) believe that sharing implementation experiences with peers is beneficial. Members of the R&D community should capitalize on this receptive environment and seek opportunities now to engage in effective dialog with decision makers and users about implementation.
- **Collaboration and pooling resources will strengthen efforts.** Resources and time can be saved when agency efforts are strengthened through collaborative efforts, particularly for evaluations, field tests, and demonstration projects. Sharing the costs and risks associated with such activities can yield benefits for all parties and can help improve interagency and interjurisdictional interactions.
- **Targeted research leads to better implementation.** Implementation of research results progresses most smoothly when a genuine user need or goal is addressed. Selecting the right problems for research, therefore, is the first step in the process; however, this implies that eventual users are part of the process from the outset to express the objectives of their agencies, to communicate their agency operations, and to help prioritize research efforts.
- **Technically knowledgeable staff are critical for implementation success.** Effective implementation is more likely to occur when the involved users have a high degree of technical expertise in the new product or process domain. However, in this era of cost-cutting, contracted services are often substituted for in-house technical expertise. As agency staff numbers shrink, the level of technical expertise of the remaining employees will become increasingly critical to implementation activities and other agency responsibilities. Staff development should be encouraged and rewarded.
- **Senior management and decision makers can and do play a critical role.** Senior management's role in supporting and promoting an implementation-friendly environment within an agency and throughout the industry is critical. Affecting sustainable, system-level change requires the intervention and commitment of senior management and decision makers. For instance, facilitating information sharing across jurisdictional

boundaries and making solid links between research providers and user organizations need top-level intervention. Senior-level influence can result in a "multiplier effect" on efforts to build capability for change in user organizations and throughout the system.

- **Rewarding high-quality groundwork leads to an increased implementation effort.** Senior management and decision makers should find ways to make visible and reward the high-quality efforts already underway in agencies around the nation to improve the implementation of research results. Such actions will encourage others to pursue innovations in surface transportation.
- **System-level changes are possible but require time.** Broad and deep changes to improve the implementation of research results are possible; however, such changes take time. Implementation activities are labor-intensive and require that multiple participants be involved for a longer time and in a more intense role than in the past. In the coming decade, it will be important to maintain and build on the excellence now part of the transportation community. More effective implementation of research results will speed the accrual of benefits to transportation agencies and to the entire nation.

APPENDIXES A THROUGH G

UNPUBLISHED MATERIAL

Appendixes A through G contained in the research agency's final report are not published here. For a limited time, copies of that report, *Facilitating the Implementation of Research Findings—Appendixes A–G*, will be available for loan or for purchase ($18.00) on request to NCHRP, Transportation Research Board, Box 289, Washington, D.C. 20055. The available appendixes are titled as follows:

- *Appendix A: A National Survey of Implementation Practices in Surface Transportation*,
- *Appendix B: A Synthesis of Successful Implementation Practices*,
- *Appendix C: Survey Instrument*,
- *Appendix D: Survey Sample*,
- *Appendix E: Survey Administration*,
- *Appendix F: Review, Synthesis, and Recommendations*, and
- *Appendix G: Suggested Themes for Future Research.*

NCHRP Report 382

Appendix B

PUTTING NEW RESEARCH RESULTS TO WORK: A SYNTHESIS OF SUCCESSFUL IMPLEMENTATION PRACTICES

Prepared for
National Cooperative Highway Research Program
Transportation Research Board
National Research Council

Project 20-33

T. K. Bikson, S. A. Law, M. Markovich
RAND
Santa Monica, California

B. T. Harder
B. T. Harder, Inc.
Philadelphia, Pennsylvania

January 1996

Acknowledgment

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

CONTENTS

ACKNOWLEDGMENTS

The research reported herein was performed under NCHRP Project 20-33 by RAND and B. T. Harder, Inc. The work undertaken by B. T. Harder, Inc., was under a subcontract with RAND.

Tora K. Bikson, Senior Scientist, RAND, was the principal investigator.
Sally Ann Law, Associate Behavioral Scientist, RAND, was co-investigator. The other authors of this report are: Martin Markovich, Assistant Policy Analyst, RAND; and Barbara T. Harder, B. T. Harder, Inc.

ABSTRACT

Millions of dollars are spent annually on research to address difficult surface transportation problems, but the results are not always effectively implemented to improve the nation's transportation system. Relying on qualitataive analysis, this report presents detailed examples plus conclusions and recommendations from a nationally representative survey of state and local transportation agencies to determine what influences--positively and negatively--the transfer of research results into practice.

Challenges associated with putting research results to work differ somewhat depending on the type of innovation and as a function of various context factors, such as jurisdiction level of the implementing agency. However implementation success is chiefly influenced by the approaches taken by the producers and users of new technologies (products and processes) to move them into practice. There is no one formula for success, but effective implementation is more likely when a number of key strategies are used. Most importantly user agencies should plan for implementation, commit necessary financial and human resources and collaborate with researchers/developers in the research process.

In Appendix A we present the results of the quantitative survey data analysis. This appendix, *A Synthesis of Successful Implementation Practices,* is based on the qualitative survey data and telephone interviews.

LIST OF ACRONYMS

AASHTO	American Association of State Highway and Transportation Officials
DOT	Department of Transportation (used to identify State Departments of Transportation)
FHWA	Federal Highway Administration
ITE	Institute of Transportation Engineers
ISTEA	Intermodal Surface Transportation Efficiency Act of 1991
ITS	Intelligent Transportation Systems
NCHRP	National Cooperative Highway Research Program
TRB	Transportation Research Board

1. INTRODUCTION AND APPROACH

RATIONALE

During phase II of NCHRP Project 20-33, "Facilitating the Implementation of Research Findings," we conducted a nationally representative survey of state and local transportation agencies to learn how they go about moving new research into practice, and the challenges they face.[1] We collected a wealth of both quantitative data (described in more detail in accompanying Appendix A, *Putting New Research Results to Work: A National Survey of Implementation Practices in Surface Transportation*) and qualitative data. Qualitative information was drawn mainly from open-ended questions in the survey (see Appendix C) and follow-up phone interviews with selected respondents. To maximize the sharing of experiences and lessons learned by survey participants, we developed this synthesis of the practices that they reported as influences on their success with implementation of new products and processes in surface transportation.

The specific purposes of this qualitative synthesis are twofold:

- Document the rich experiences of technical experts knowledgeable about the implementation of surface transportation innovations; and
- Speed the application of new products and processes in surface transportation by providing implementation guidance and examples for others.

The report is a collection of examples describing the process of implementing transportation innovations in state and local agencies within approximately the past five years. The examples focus mainly on the key strategies that proved to facilitate the implementation of new research results. We chose this information gathering and reporting mechanism so that others in the transportation community could easily relate the experiences described to their own environment, providing a peer-to-peer exchange. Each description is reproduced largely verbatim in the words of the survey respondent.

The resulting report presents examples from four major technical domains: construction and materials; design; maintenance and operations; and transportation management. Yet implementation practices transcend the technical area in which they are used. Key strategies that occur in one technical domain are often also applicable in others. Therefore, although the descriptions are organized by technical domains, the key implementation strategies for the most part can provide guidance to practitioners in all disciplines. For that reason we have provided an index that cross references specific examples in the four domains by implementation practices (see below).

---

[1]The survey was distributed to 340 state and 299 local transportation officials in 25 states representing the four AASHTO regions. The sample selection and survey procedures are described in detail in Appendices D and E to the quantititative report. The high overall response rate of 60 percent reflects the level of interest and commitment this topic generated among the participants.

In sum, the report is intended to assist the practitioner in effectively implementing new products and processes in surface transportation. There are numerous examples of innovations that have never been put into practice. If barriers to implementation can be overcome, or at least reduced, our nation's transportation system will be more productive. Facilities will have longer life-spans, safety will be increased, quality will be improved, and construction and maintenance of facilities will be more cost effective. The key implementation strategies described here show how transportation professionals are overcoming barriers that stand in the way of putting new research results to work. Creative solutions and persevering champions abound. This report strives to continue and enlarge upon the precedent set by those who contributed such excellent examples of implementation experiences to the project.

APPROACH

Source

All the information used in this report is taken from the responses to the survey on implementation and, for the highlighted cases, from follow-up phone calls made by the project research team. The information on successful cases was taken from all responses to questions 7-14; information on the unsuccessful implementation efforts was taken from the responses to questions 17-24 (these questions were omitted from the executive version). Most of these questions were open ended.

Considerable additional information about the survey results is found in Appendix A, the quantitative report. We also include a copy of the survey instrument as Appendix C. For the qualitative report, some responses were edited to protect confidentiality. References to specific places, specific agencies or other information that could reveal the survey participants' identity were deleted or masked.

Method

All the implelmentation efforts for which substantive descriptions were provided were selected for preliminary inclusion in this report. These materials were all reviewed by two project staff members, and criteria for inclusion in the collection were established. Those criteria were as follows:

- The description provided evidence that the innovation was implemented.
- The description provided specific details concerning the implementation process.
- The description was technically sound.
- Systematic, unique or creative implementation practices were used.
- Illustration of need for, or benefit from, the innovation was provided.

Included examples met at least two of the above criteria; a few exceptions were made for collected observations (see below). The choices were made by project members most familiar with the innovations and the transportation industry. Each assessed the

descriptions individually. They then compared their assessments and attained consensus through repeated discussions.

Many of the selected examples include a recommendations section. Based on the answers to survey questions 25, 26 and 29 (see Appendix C), recommendations may be offered to users of innovations, to researchers and/or to policy makers. These recommendations reflect the conclusions of the survey participants based on the implementation efforts they have experienced and described. They do not necessarily reflect official policy of the NCHRP; nor do they necessarily reflect the recommendations of the project team, which are discussed in the survey report and in Chapter 2 of this document.

The successful implementation examples remaining after the iterative selection process were grouped into four categories:

1. Construction and materials (C), including a few implementation efforts originally placed under various other classifications;
2. Design (D), including some examples previously classified as environmental (other environmental cases were classified under maintenance or under construction);
3. Maintenance and operations (M), including implementation examples originally classified under intelligent transportation systems (ITS); and
4. Transportation management (T), including implementations originally classified under multi-modal or safety.

We separately gathered the examples of unsuccessful implementation attempts into a single findings section (U). Within each section, examples are numbered sequentially.

ORGANIZATION OF THE REPORT

Overall conclusions and recommendations from the research team, based on our detailed review of positive and negative examples, are presented in the next chapter. The last chapter comprises a synthesis of implementation efforts from which useful insights may be drawn.

Successful examples of implementation activity are organized into four sections that reflect the four categories outlined above. In each of these sections, the report includes three kinds of successful example presentation formats: highlighted cases, descriptions and observations. The highlighted cases, of which there are only three or four per section, provide a richer background and somewhat greater detail than do the descriptions. The highlights were developed beyond the information provided in the surveys by telephone interviews. They provide a chronology of events and a results sub-section that details the extent of implementation and its benefits. Highlighted cases tend to be longer (e.g.,around two to three pages in length, single spaced).

The majority of examples included in this report are called "descriptions." The description treatment provides the substantive information given by the respondents themselves in the surveys. In some instances, minimal editing was done to maintain a

consistent format and confidentiality, and also to make the text more comprehensible (for example, by spelling out an abbreviation). The number of descriptions varies by section, and they generally run to about one single-spaced page of text each.

The descriptions provide the name and characteristics of the product or process that was implemented (or not, for the unsuccessful efforts), the reasons for the effort and the key steps or strategies in the process. Elements may be missing, or incomplete, in instances where the survey participant did not provide full information.

Examples of implementation efforts reported here as "observations" generally include only part of the information provided by the survey participant. These examples did not meet the selection criteria set forth above. However, they all make a specific point that provides insight into aspects of the implementation process or that may be otherwise useful to the readers of this document. The observations appear at the end of each section.

The observation format usually provides the name of the innovation that was subject to implementation (although the specific innovation was not stated in a few cases) and the special point that was made by the survey participant. Observations consist of exactly one excerpt from the survey response; we have not added words to any of the responses, nor have we edited the text to improve the flow or reshape the meaning of the description.

The final section, U, includes unsuccessful examples. These are situations in which an innovation was attempted but not successfully completed. They were selected based on criteria similar to those used in selecting the successful examples, primarily reflecting the provision of specific details, technical soundness of the implementation decision, and indication that a genuine effort to implement was made. The unsuccessful strategies may well be as instructive as, or even more instructive than, the successful ones. The worst-case scenariors are all in the description format, where the account of the survey respondent was edited as little as possible.

For each kind of presentation, the accounts from state department of transportation participants come first because these formed the majority of responses; descriptions from local government officials follow. Page numbers where each section and sub-section begin are listed in the table of contents.

The report also includes a summary of implementation practices, with a number assigned to each notable practice found in the successful examples. The practices are coded with numbers from 1 to 46. For each of the Highlight cases, the applied practices and their matching codes are listed immediately under the listing of the implemented product or process. They are listed in the order of their evaluated importance. For the other successful examples in a category, the practice codes alone are listed, again in order of importance, in bold immediately under the product or process listing at the beginning of the description.

The correspondence between the practices and their codes is provided in Table B-1 along with an index linking practices and example implementations (Table B-2). The index

enumerates all the successful highlight and description instances in which each of the listed practices occurred, also indicating the innovation domain. It provides a cross reference tool--leaders interested in a particular practice can look for the situations in which that practice was applied. For convenience, code numbers for implementation practices illustrated by each case are provided in a list of summary practices at the start of the examples.

The use of summary practices and matching codes is intended to make this sourcebook easier and faster to read and use. Additionally, the conclusions and recommendations based on users' successful and unsuccessful experiences are provided in the section that follows; having them near the front of the report will allow readers to learn in advance the major lessons gleaned from these examples. The examples themselves can be read independently of one another, depending on the interests of readers.

2. CONCLUSIONS AND IMPLICATIONS

GENERAL RESULTS

This section synthesizes the findings about implementation efforts based on the qualitataive data reported by respondents. It includes how agencies learn about innovations, the reasons innovations are adopted, conditions necessary for implementation and major implementation strategies--all as reflected in the material presented below.

The following three channels were most often cited as information sources by agencies describing successful implementation efforts:

- Formal professional organizations, including conferences, associations and publications;
- Informal contacts; and
- The private sector, including vendors, consultants and contractors.

The private sector, in particular vendors, is often the source of information for managers in local government. In-house development and dissemination of innovations also is mentioned in many accounts. Surprisingly, universities and government programs aimed specifically at disseminating research and innovations are less frequently cited.

The most frequently cited reason for implementing an innovation was cost savings and, relatedly, labor savings. This suggests that highway innovations that increase costs or require increased labor, even if they represent improvements, are unlikely to be implemented unless driven by strong demand from the public or regulatory requirements. Legal and regulatory requirements were also mentioned a number of times, as was safety. However, improving administration and reducing disruption of traffic were not cited often.

Conditions that prevail even before the innovation is identified can make the difference between successful and unsuccessful implementation. Perhaps the most important favorable condition is an urgent and widely recognized need for a change. This need can be driven by budget limitations, but some of the other needs that were cited include changing operations of private carriers and long standing needs made fulfillable by new technology.

The next most cited favorable condition was strong support from top management, including chief executives in state departments of transportation and city governments. Sometimes only a push from the highest level can overcome problems of inertia or difficulties in acquiring resources. Adequate resources for implementation was also mentioned as a favorable condition, and several participants cited the facilitative role of expert or skilled staff.

Including multiple stakeholders in the process was the implementation strategy most often cited--by a wide margin. Specifically, a very large number of respondents

emphasized the need for researchers to consult with users and for users to develop their technical skills through contacts with researchers. However, numerous other stakeholders were mentioned for inclusion in the implementation process, including vendors, contractors, other divisions within the department, other departments within the jurisdiction, other levels of government, industry associations, elected officials, the public and the press. Depending on the innovation, some or all of these stakeholders may need to be involved. While these interactions may lengthen the process and even change the nature of the application, they build broad support and participation which in turn are clearly associated with effective implementation.

Many of our participants, including a number of those with very successful implementations, cited the usefulness of field tests and pilot projects. A practical test can take several forms. It may consist of implementing the innovation in a small area or of assigning one staff person to incorporate it into a regular work routine. Or it may consist of developing a database and software to process it, but subjecting the output to close scrutiny before using it to change procedures. Other strategies that were cited include allocating personnel time to training, finding (or being) a champion to present the innovation to users and policy makers, working to change attitudes and applying persistence and patience in the face of obstacles and inaction.

A review of the examples that follow will show that there is no single type of innovation or technology that has dominated implementation efforts over the last ten years. Work has continued along a number of fronts in all the functional areas of highway facilities and equipment. Certainly, increased use of databases and computers a mentioned a number of times, especially in the management area, but considerable interest continues in materials, operating equipment, labor relations and other areas.

In conclusion, we find substantial interest in research and innovation, but also areas for potential improvement. In our decentralized system, there are inherent difficulties with communicating new innovations to the persons who can make best use of them. More communication between users and researchers is called for. Local government officials have very little interaction with researchers, and limited communication with other local officials who may be working on the same problems. The accounts from both state and local officials show it frequently takes ten years or more to complete implementation.

RECOMMENDATIONS FOR IMPROVING IMPLEMENTATION PRACTICES AND STRATEGIES

Descriptions of varied implementation efforts obtained from the survey of state and local transportation officials show that there are practices and strategies common to successful implementation outcomes in public sector agencies. Yet these descriptions also show that there is no definitive formula to ensure successful implementation of research results. While there is no one formula for success, the tendency of key elements to occur consistently, strongly supports the concept that certain actions systematically enhance implementation efforts--producing financial payoff or other benefits for the agency.

A number of key implementation practices or strategies will be familiar to those currently striving to implement new products or processes. The study confirms some well-accepted practices and emphasizes the importance of others. Furthermore, the examples tend to point more toward the "more is often better" approach. One specific practice of strategy may be the most influential factor leading to success; but rarely, if ever, was success essentially based on only one action. A host of practices customized to the new product/process and agency are required to address issues on all fronts of the implementation effort.

The following recommendations have been derived from users' descriptions. They outline practices that positively influence success in implementation. In general, the practices should occur in conjunction with one another whenever possible.

Plan for Implementation: The descriptions provided, plus telephone interviews, made it clear that implementation successes originate through planned actions or some defined process--implementation success do not "just happen." Federal mandates and management directives create a platform for implementation of a number of the technologies. Yet, the reviewed examples demonstrate that conscious, planned, effort directed to implementation creates successful outcomes.

Respondents to the survey stressed the value of clearly defined goals as a key implementation factor. The planning mentioned was comprehensive, including participation by all players affected by the product or process to be implemented; flexible, allowing mid-course corrections and user feedback; and practical, working within the given constraints and stretching constraints where appropriate.

Fund Implementation Activities: When some funds are provided to perform implementation activities, multiple barriers to implementation tend to be overcome. With funding, pilot projects, testing equipment, and demonstrations appear; improved communication occurs, within the agency and between researchers and vendors; technical expertise is enhanced, thus promoting use of innovative products; and many similar gains are made. Most important to note is that many of the activities that led to the ultimate successes are relatively small budget items. Assisting in organizing a user-producer group, encouraging a technical expert from central office to spend some time in the field, short training courses, collaborative efforts with other state/local agencies, producing a more user friendly manual, a visit to a successful installation of the innovation ... the list could continue with many other such actions that make a difference.

Commit Some of the Agency's Best People to the Job of Implementation: Implementation of innovations faces significant barriers. The individuals leading or executing implementation of innovations must overcome a multitude of barriers and capitalize on opportunities occurring throughout the agency. Implementation cannot be an assignment given to just anyone, and certainly should not be made because a person in a group has the lightest workload or is the newest in the group--and thus gets all the "odd jobs." Most importantly, implementation requires individuals with a high degree of technical expertise. They must know the technical advantages of applying the innovation. Most often the implementers must know the economic and other benefits

of the innovation as well. Those involved with or leading implementation efforts within the agency also must be champions for the innovation--particularly able to stand firm in support of new products and processes, able to deal with change, be influential with others, able to market or sell new concepts, and more.

While implementation of a new product or process may not be a full-time job, it is a labor intensive activity. Staff assigned to implementation must have the time to accomplish the work. Example after example shows that those involved with successful implementations were given the freedom and opportunity to pursue the task.

Committing some of the most technically competent people to the application of a new product of process is somewhat counter-intuitive. Excellently qualified people are required to perform the design of new facilities or solve critical operating problems or carry out other tasks central to the mission of the organization. However, consider the consequences of less effective staffing of implementation efforts. Consequences usually are extreme. For example, the implementation attempt most often fails because the effort overstepped the competence levels of those involved; cost and time savings that could accrue to the agency as a result of application of the innovation are not realized; and legislated mandates are not met.

We learned, moreover, that it is important to reward implementation successes. In addition to assigning the best people to the job of implementation, agencies should provide career incentives or rewards equalling those given to staff who are fully committed to traditional/technical positions. Making implementation activities a contributing factor to advancement just like any other project responsibility should be considered.

Always Address a Genuine Need: Implementation of new products or processes works best when there is a need to change. The need may be created by various conditions: legislative mandates, employee or public safety, cost savings, failure of current products, or better performing innovations, among other reasons. Likewise projects that are politically motivated, provide self-aggrandizing opportunities for some specific individual, or are a result of succumbing to a vendor's sales pressure rarely are linked to successful outcomes.

Select Products or Processes for Implementation that have Demonstrable Advantages: Products and processes that (1) do what they are supposed to do and (2) have advantages that can be seen by users are included in a high percentage of the examples of successful implementation. Experiences show that if users can directly relate to their responsibilities the benefits of implementing a new product or process, the implementation effort is enhanced.

Make Use of Pilot Project, Field Demonstration, or Field Test Results: State and local transportation agencies implement applied research results--products or processes to be directly put into practice. There are continual problems with implementation of new products or processes in the state and local context because the results of research or the products and processes have not been demonstrated to work satisfactorily in "real life" situations. Descriptions of successful implementation outcomes always involved

adequately tested (sometimes demonstrated or piloted) and sufficiently developed products or processes. Many survey respondents added that it is the implementing agency's responsibility to make sure newproducts or processes performed as described. However, participants noted that it is not necessary to have each agency perform these single-handedly. Collaboration with other agencies or states, use of national or regional centers for evaluation, observing "neighboring agencies" efforts, and partnerships with the private sector all have a role in spreading cost and risk and reducing the time to implement innovations--as well as significantly enhancing confidence in the technical performance of products or processes.

Elicit Strong Support from Senior Management: For the most part in state and local transportation agencies, if the big boss wants "it" done (whatever it is), "it" gets done. Implementation of innovative products and processes is not different. Senior management's positive influence opens many doors, especially when change is occurring. (Note: the management influence credited with implementation success is more often the mentor/catalyst approach rather than the strong arm approach, although both are observed to occur.)

Regardless of whether the innovative comes into the agency from the bottom up (grass roots) or the top down (legislature or council), commitment from he agency's senior management is very important. For those in an agency seeking to implement new products or processes, every effort should be made to get buy-in from the highest levels of management overseeing the technical function. The larger the impact of the implementation effort within the agency, generally, the higher the level of management that should be involved. For implementation of a Pavement Management System, for instance, the chief executive may be the target for eliciting support; for an innovative mowing schedule, the District Director may be the appropriate individual.

Promote Continuous Collaboration between Users and the Researchers/Developers: Clearly collaboration between users and the researchers is essential to successful application of research results. Continuous collaboration throughout the applied research and implementation effort will enhance the overall implementation process. Researchers willing to spend time with users--to understand true needs--and users willing to become more knowledgeable, if necessary--to implement research results--will produce more effective implementation experiences.

Collaboration of this nature requires time, energy, commitment. It is achieved through purposeful action, and generally doesn't occur without encouragement from organizations on both sides of the effort.

Choose Researchers/Vendors Experienced with Practical Application: Unless the research findings to be implemented are handled by a technical expert willing to bridge the gap between theoretical researchers and future users, researchers have to be able to apply their products or processes to practice. Case descriptions are full of credit, for example, to researchers who "went the extra mile" to educate users, and to vendors willing to install or demonstrate products and equipment in full-scale tests. When such experts work with the users it speeds understanding of the technical merits of the

product or process, allows for mid-course corrections in research efforts if required, and helps users customizes the final product to their needs.

Go Do It--the Final Recommendation: Finally, a careful review of the descriptions below will yield additional guidance for facilitating the implementation of research findings. Most importantly, however, are the actions this review will prompt. The measure of effectiveness of this sourcebook is whether it is applied. The key implementation strategies and practices are replicable. They will work to varying degrees in various agencies. They will assist in streamlining implementation. New products and processes can be implemented more effectively through use of key strategies and practices described in the examples. These key strategies and practices have been demonstrated as effective by state and local transportation professionals throughout the nation.

3. SYNTHESIS OF IMPLEMENTATION EXAMPLES

The material in this chapter, as we have explained, represents the implementation experiences of user agencies in their own words. The first four sections involve efforts to put new research results to work that users regard as highly successful; the last includes implementation attempts that users themselves judged not to be successful.

Successful examples are presented sequentially within each of the four categories set out in Chapter 2, in order. These categories are designated by the following abbreviations:

C	Construction and Materials
D	Design
M	Maintenance and Operations
T	Transportation Management

This permits examples to be referenced uniquely by category letter and sequence number. As noted, more detailed "highlighted" examples are presented first in the series for each category.

Because the goal of this study is to facilitate the implementation of research findings, we itemized the specific implementation practices reported for each successful example. These practices are collected together (46 in all), briefly described, and given a numeric code so that the use of a particular implementation approach can be pursued in a variety of examples. For each successful example in this chapter, a list of code numbers for the implementation practices it illustrates is given at the beginning. The code key associating numbers with practices is provided as Table B-1 below.

An index that links specific implementation practices and their successful deployment in particular examples is given in Table B-2. The table briefly represents each of the implementation practices elicited, by code number; under each practice, it cites all of the instances in which the practice occurs, by category letter and sequence number. The index enables readers easily to seek out several examples of an implementation practice in use.

CONSTRUCTION AND MATERIALS (C): OVERVIEW

Innovations abound in the fields of construction and materials. The survey showed that time and time again transportation professionals are implementing new products and processes to enhance the nation's highway system. Complexities of construction and the vast array of materials now available demand better ways of performing the traditional functions of road and bridge building, restoration, and reconstruction. Opportunities for implementing new products or processes reported by the survey respondents focus on new asphalt mixes or additives, high durability concrete, pavement testing and measurement, partnering, and bridge and pavement retrofitting or reconstruction techniques.

Table B-1

CODE KEY FOR SUMMARY PRACTICES

1. Top or senior management support, agency support
2. Collaboration with all stakeholders and/or team approach, good communications during project
3. Product champion(s) and/or personal commitment of participants
4. Economic advantages/cost savings/time savings
5. Field tests, demonstrations, and/or pilot projects
6. Mandated by law or other regulations
7. Product ready for application
8. Addressed a widely recognized problem/recognized need for solution/met user needs
9. Early involvement of users, continuous user involvement, high user and researcher/developer interaction
10. Knowledgeable users
11. User training provided
12. Clear advantages of product, product performance, technical quality of product, practical/reasonable product
13. Early successes encouraged implementation
14. Clear goals, methodologies, and/or plans
15. Funding available for research and/or implementation, other resources made available (personnel or facilities)
16. Available in-house expertise for research and/or implementation
17. Close contact with field personnel or field personnel input
18. Collaboration with regulatory agencies
19. Empowerment of employees
20. Participation of or partnership with vendor, supplier, manufacturer, contractor; user group established
21. Pro-technology implementation, pro-technology culture
22. Partnership with other state or municipal agencies
23. On-site expertise, consultant, researcher, vendor, supplier, manufacturer, or contractor
24. Visits to other agencies or implementation sites
25. Competence of vendor, supplier, manufacturer, or contractor
26. In-house product testing/evaluation
27. Identification of the correct problem to solve, close examination of user needs
28. Enhanced public information, communication with the public
29. Non-proprietary product
30. Agreement with labor union
31. Marketing of product or process to user (by in-house staff or outside stakeholders)
32. Good/objective research, good results documentation
33. Environmentally sensitive condition or solution
34. Time constraints
35. Acceptance of some degree of risk
36. Incremental approach
37. Await DOT approval of product
38. Technology transfer or implementation package provided

39. Particularly helpful support from FHWA
40. Able to use existing personnel and equipment for implementation of the innovation
41. Available examples of other successful comparable implementations
42. Commitment to technology transfer
43. Public pressure for change
44. Used existing contract with research institution
45. Hard work
46. Cost incentive for contractor performance

Innovations for construction and materials clearly were pursued because there was overwhelming evidence that if the agencies implemented the product or process, direct benefits would occur. A number of participants report that new products or construction methods added life to the existing roadway or bridge, whileothers discuss dramatic reductions in cost or time for completion, and some demonstrate that innovative equipment truly can make a difference in the product produced.

Most importantly, the examples in this section (C) show how the techniques used for implementation enhanced the constructed, reconstructed, or rehabilitated facilities or streamlined the processes used for production. Implementation strategies that kept appearing were the presence of knowledgeable, persistent champions, willingness to try a new product or take a calculated risk, the importance of testing and pilots, and relationships with product researchers and developers, among many other strategies.

The material in this section is organized similarly to the other three sections in this chapter, with highlighted examples that have expanded descriptions in the beginning. The highlighted examples here are: seismic retrofitting of pier columns, microsurfacing, partnering between the state department of transportation and contractors, and lateral support systems.

Table B-2

INDEX OF IMPLEMENTATION PRACTICES IN SUCCESSFUL EXAMPLES, BY CATEGORY

1. Top or senior management support, agency support
   C1, C2, C3, C4, C5, C7, C9, C10, C14, C17, C18, C21, C24, C26, C28, D2, D3, D4, D6, D8, M1, M2, M4, M8, M9, M15, M18, M21, M23, M27, T1, T2, T5, T8, T15, T16 during project

2. Collaboration with all stakeholders and/or team approach, good communications
   C1, C4, C6, C12, C19, C23, C29, C34, D4, M1, M2, M8, M15, M25, M26, T2, T3, T4, T11, T13, T14, T16

3. Product champion(s) and/or personal commitment of participants
   C1, C3, C7, C12, C19, C20, C21, C22, C24, C26, C33, D1, D3, D4, D6, M1, M3, M9, M10, M13, M16, M19, M25, M28, T1, T2, T4, T5, T11, T17

4. Economic advantages/cost savings/time savings
C12, C20, C22, C23, C24, C25, C31, C32, C34, D2, D3, D4, D9, M1, M3, M9, M11, M13, M19, M23, T1, T15

5. Field tests, demonstrations, and/or pilot projects
C1, C3, C4, C8, C15, C17, C19, C20, C27, C28, C32, D1, M2, M3, M4, M6, M8, M11, M18, M21, M23, T2, T13

6. Mandated by law or other regulations
C13, C15, C19, C22, C32, D1, M2, M22, M24, T12, T14, M27

7. Product ready for application
C34, D1, M8, M12, M13, M20, T12

8. Addressed a widely recognized problem/recognized need for solution/met user needs
C3, C5 C10, C12, C14, C16, C18, C23, C24, C25, C28, C33, D2, D5, D7, D8, M4, M5, M6, M8, M12, M17, M20, M24, M28, T4, T5, T7, T9, T11, T14

9. Early involvement of users, continuous user involvement, high user and researcher/developer interaction
C4, C8, C9, C12, C13, C16, C18, C23, C27, C28, D2, D3, D5, D7, M6, M15, M16, M21, M27, T2, T3, T6, T9, T11, T13, T15

10. Knowledgeable users
C1, C4, C5, C11, C13, C15, C18, C20, C22, C25, C26, C29, C31, D1, D3, D5, D6, D8, M1, M11, M14, M25, M28, T1, T10, T16

11. User training provided
C2, C9, C23, C24, D8, M21, T4

12. Clear advantages of product, product performance, technical quality of product, practical/reasonable product
C10, C13, C15, C20, C24, C28, C30, C32, C34, D9, M7, M14, M17, M18, M20, M22, T10, T12

13. Early successes encouraged implementation
C2, C3, C7, C10, C17, C30, T4, T13, T15

14. Clear goals, methodologies, and/or plans
C6, C19, C27, C32, D2, M5, M14, M15, M16, M24, T1, T5, T6, T8, T14, T16

15. Funding available for research and/or implementation, other resources made available (personnel or facilities)
C1, C2, C22, C24, C26, C28, D3, D4, D6, D15, M3, M9, M15, M16, M18, M20, M23, M24, M26, M28, T2, T8, T13

16. Available in-house expertise for research and/or implementation
C6, C14, C21, C24, C31, D2, M1, M21, M25, M28, T3, T6, T7, T8

17. Close contact with field personnel or field personnel input
C29, M12

18. Collaboration with regulatory agencies
D2, D3, M2

19. Empowerment of employees
M19

20. Participation of or partnership with vendor, supplier, manufacturer, contractor; user group established
C7, C13, C14, C21, C30, C33, C34, D7, M3, M15, M16, M21, T8, T17

21. Pro-technology implementation, pro-technology culture
C4, C11, C21, C30, C31, C33, D1, D2, M9, M16, M17, M27

22. Partnership with other state or municipal agencies
C3, M9, T3, T6, T14

23. On-site expertise, consultant, researcher, vendor, supplier, manufacturer, or contractor
C17, C27, M17, T6, T12

24. Visits to other agencies or implementation sites
T12

25. Competence of vendor, supplier, manufacturer, or contractor
C1, C3, C10, C29, D3, M10, M12, M17, T10

26. In-house product testing/evaluation
C12, C14, C15, C17, M10

27. Identification of the correct problem to solve, close examination of user needs
C11, M11

28. Enhanced public information, communication with the public
M4, M25

29. Non-proprietary product
M7

30. Agreement with labor union
M4

31. Marketing of product or process to user (by in-house staff or outside stakeholders)
C2, C16, D1, M11, T11

32. Good/objective research, good results documentation
C11, C17, C31, M11, T7

33. Environmentally sensitive condition or solution
C14, C22, C33, M13

34. Time constraints
M13, T17

35. Acceptance of some degree of risk
C5, C20, C26, C31, M16

36. Incremental approach
D36, M14, T1, T8

37. Await DOT approval of product
M22, M24

38. Technology transfer or implementation package provided
C9, C14, C15, M22

39. Particularly helpful support from FHWA
C16, C25, D1

40. Able to use existing personnel and equipment for implementation of the innovation
M23

41. Available examples of other successful comparable implementations
M26

42. Commitment to technology transfer
C8, C9, C27, D6

43. Public pressure for change
D8

44. Used existing contract with research institution
C1

45. Hard work
C6, T9

46. Cost incentive for contractor performance
T17

C1 - HIGHLIGHT

Product or Process:

Seismic retrofitting of pier columns.

Summary of Practices:

10 Knowledgeable users
1 Governor request for action
5 Pilot project
3 Product champion
2 Good communications between department and contractor
25 Contractor flexibility
44 Open contract with research institution
15 Available funding

Characteristics:

Actions were taken by the department to protect infrastructure from earthquake damage. The agency used external steel band, pre-tensioned strand, and advanced composite fiber wraps to enhance the ductility and load resistance of existing pier columns.

Reason for Implementation:

Subsequent to the earthquake in northern California in October 1989 and other influences raising concern about earthquake susceptibility, the governor requested a state-wide review and implementation of earthquake protection measures for all state infrastructure including transportation. The variety of procedures utilized was attributable to astute management by the department's bridge organization. Bridge engineers wanted to provide contractors the maximum variety of options for seismic retrofitting of pier columns. The variety allowed contractors opportunity to provide the department with competitive prices for construction.

Key Implementation Strategies:

The Governor's request prompted action within the transportation department. The bridge engineers took the initiative and "ran with it." The opportunity to do full-scale testing on existing piers was available. An important breakthrough happened when the bridge engineers realized there was a test opportunity--bridge piers were to be removed over a significant highway. The engineers requested incorporating a pier retrofitting project rather than pier removal. The good communications between the department and the contractor and the contractor's willingness to incorporate change into its plans was instrumental to initiate the project. The department had an open contract with the state university. The contract had sufficient funding to perform research as well as the university has excellent talent and experience in the seismic area. Vendors were willing to contribute innovative products and perform installations if the state agency would accurately report its findings of research. Finally, test results proved the original concept to be successful.

Chronology:

The Governor's task committee issued a seismic implementation strategy in late 1989. The transportation department took action in December, 1989, to incorporate the AASHTO guide specification for new construction and the Federal Highway Administration (FHWA) guidelines for retrofitting existing bridges. Simultaneously, the department hired a consultant to prioritize all bridges regarding their vulnerability to damage during a major earthquake.

During this time the bridge engineers located a significant highway scheduled for bridge pier removal. The bridge engineers instituted a research project with the state university, utilizing an existing contract having sufficient funding to initiate the project. The university professor was particularly research oriented and staff at the university had experience with seismic related work on the west coast, giving some California connections and ideas regarding innovative technologies.

The bridge engineers requested installing and testing a pier retrofit project for three columns. The contractor provided a window of time to accomplish the retrofitting effort during bridge closure. Subsequently the contractor provided a similar window of time to retrofit 6 columns located in the adjacent areas of the opposite direction lanes. The number of test columns allowed the department to perform tests on a variety of retrofitting systems. The bridge engineers were innovative in dealing with vendors. Several vendors agreed to provide materials and to perform installations in exchange for accurate reporting of the retrofit system's performance in the department's product evaluation documentation. Based on the 5 ft diameter test columns, retrofitting was done on 7 ft diameter, 75 ft high flyover columns. Since implementation, the area having retrofit projects, including isolation bearings, experienced earthquakes of low magnitude without measurable effect to retrofitted bridge structures. An important feature of the retrofitting systems is that they must meet all other service requirements. Detailed evaluation on the isolation bearings was performed for four years after installation. For all work, there have been no signs of failure, and in general the department is very satisfied with the effort.

Results:

The agency now uses AASHTO specifications for seismic design of new structures and the Federal Highway Administration (FHWA) guidelines for retrofitting. There is good evidence that these measures are allowing the state to give added protection for bridges/flyovers in the event of a major earthquake. Bridges are performing well in all areas of serviceability. The department is proceeding with additional innovative products for more sophisticated seismic problem prevention.

Recommendations:

To Users:

Consider those products and concepts that have good potential. Do evaluations and trial installations. Utilize a team approach.

To Researchers

On new products, have all the data (physical and mechanical properties) and the intended usage or application available to users.

To Policymakers:

Have full data available and define the intended use.

State Jurisdiction

C2 - HIGHLIGHT

Product or Process:

Partnering between the state department of transportation and contractors for construction projects.

Summary of Practices:

3 Product champion
31 Marketing of concept
15 Funding
11 Training
1 Top management support
13 Early successes

Characteristics:

The department determined that enhanced communications between the contractors and its agency staff would benefit overall construction performance. The process centers on an initial formal workshop facilitated by outside professionals. Agency and contractor personnel from all levels of both organizations have an opportunity to understand who is performing what function and why--to gain an understanding of each other's organizational hierarchy, to work on joint goals for the project, and to build trust in one another. The process continues by encouraging decision making at the project level, speeding problem solving, and streamlining communications.

Reason for Implementation:

A formal partnering process was instituted to provide for better and more effective decision-making, to help decrease claims and disputes, and to produce a higher quality product.

Key Implementation Strategies:

The partnering process is successful particularly due to the "follow-up" procedures used by the partnering staff within the agency. In addition, to promote use, these agency employees perform effective marketing of the process to the contractors and district offices. Partnering staff have a budget for their activities and are trained well to keep pace with new techniques. There is strong agency support from top management.

Chronology:

The agency learned about partnering processes from conferences workshops and professional trade associations. In addition, the agency is involved with the National Quality Initiative which strongly supports partnering and teaming concepts. The agency began construction project partnering in 1992. Initial projects showed opportunity for dramatic improvements. Successful projects promoted the use of the process for other projects.

The innovation was a high visibility process and was promoted and continues to be encouraged by top management. The agency chief administrative officer and other senior executives take personal interest in the process.

Successes allowed the process to expand rapidly within the department. Early in 1995 the personnel responsible for partnering were moved out of construction and into a group dealing with department-wide productivity issues. The process is now supported by a staff of three.

The partnering process expanded to the agency materials and test division where partnering is being performed between the agency and suppliers; various customized partnering workshops have been conducted between agency divisions and with the agency and outside partners. Pilots for partnering design projects are now underway, and many requests for additional partnering efforts are being received by the partnering staff.

Agency construction now has a relatively "standard" special provision describing a voluntary partnering process to be used. Not all construction projects elect to use the process, but a significant number do and experience excellent results. For construction projects, facilitators for the workshops are professionals, selected by the contractors. Fees are jointly paid by the agency and the contractors.

The partnering staff is continuing to market benefits of the process to the field offices. The goals of the partnering staff are to have agency employees be progressively more responsible for their work, to have decisions made at the project level, and resolve issues before they become formal claims.

Results:

Since inception of the partnering process, the agency has partnered 214 projects with a contract amount of $2.5 billion. The agency has seen an average time saving of 13.5 percent on projects and experienced a dramatic reduction of contractor claims. A recent survey also reports that contractors and agency personnel determine that relationships have improved, leading to more productive work.

Because of the success of partnering in construction projects, the agency expanded use of partnering and teaming to a variety of technical and administrative areas including using key partnering concepts for the agency's extensive review and reengineering of its organization.

Recommendations:

To Users:

When a new product or process comes in, contact other agencies about their findings in regard to the new product before starting research and implementation.

To Researchers:

Periodic newsletters to divisions and districts updating the status of new products or processes would be helpful. Also, a listing of all new products and processes submitted to the agency, regardless if implemented or not, could be of interest to individuals who might have an idea of how to improve the product or have a different implementation for it.

Local Jurisdiction

C3 - HIGHLIGHT

Product or Process:

Microsurfacing, a slurry seal with an abrasive anti-skid characteristic.

Summary of Practices:

1 Champion
25 Vendor/knowledgeable and committed
5 Field application/pilot project
22 Multiagency cooperation
8 Recognized need
13 Addressed need, early success

Characteristics:

Streets paved within the past several years had become polished, causing slippery conditions particularly in damp conditions and in areas with grades. The agency performed microsurfacing using a 3/8 inch application to the slippery surface areas. The application also serves as a crack sealant as well as gives a good appearance.

Reason for Implementation:

The city found there were a number of streets and intersections experiencing high accident rates. To assist in accident reduction and be responsive to citizens, the agency reviewed alternatives to increase safety: milling the roadway surface, milling and resurfacing, and microsurfacing. Microsurfacing performed well, and it eliminated the high-accident potential; it requires less construction cost; it adds 5 to 7 years to the road surface, and serves as a crack sealant also adding life to pavements. The process promotes good public relations with the citizens because it solves safety problems, and after application the roadways look newly paved.

Key Implementation Strategies:

(1) The enthusiasm of the vendor in presenting the product in a practical type of application, and the vendor's willingness to do field explanation and application. (2) The product proved to be immediately successful in solving the problem. (3) The cooperation among transportation (construction and traffic) and police departments and the citizenry to identify problem areas, coupled with the personal attention by transportation department management in project assessment and programming.

Chronology:

Prior to the 1993 construction season the city transportation department was approached by a vendor for microsurfacing projects. Due to the cost effectiveness of the process and the willingness of the vendor to provide extraordinary support, in 1993, the agency programmed an initial project with three sites. The microsurfacing performed well and prompted the agency to perform an annual microsurfacing project.

The city now contracts for microsurfacing of 3 streets (3 larger sites) or 5 to 7 intersections (or smaller sites) on an annual basis. Candidate sites are received through: the transportation department review of all city streets; traffic engineering recommendations; police requests noted from high accident locations; Council persons' recommendations on behalf of constituents; and from private citizen complaints. Good record keeping assists the transportation department in responding to citizen recommendations. All candidate sites are physically reviewed by senior transportation personnel who prioritize candidates for the annual project.

The agency now reserves specific funds for the annual microsurfacing project. They have saved money in construction particularly through less cost of construction and by providing a treatment that prolongs the life of the roadway for up to 7 years. It was noted that the process can be repeated, providing for additional cost savings.

Results:

An initial trial of the product resulted in an annual project with specific funds reserved to accomplish 3 large or 5-7 small projects. The implementation of this innovation has become a very good public relations tool. Most importantly, it solves a serious safety problem for citizens, it is a demonstration of the city public works professionals successfully responding to citizen complaints, and it is more cost effective than other alternatives.

Recommendations:

To Users:

Be open-minded and willing to try a new product--give it a chance.

To Researchers:

Be willing to show the actual application in the field and to conduct a time-to-time reinspection effort to see how the product holds up.

To Policymakers:

Consider inviting other surrounding agencies to a demonstration of innovative products and processes.

Local Jurisdiction

C4 - HIGHLIGHT

Product or Process:

Lateral support program encompassing planning design, development, and construction phases of wall systems and other support techniques for embankments and other topographical conditions adjacent to the roadway.

Summary of Practices:

1 Support from elected officials and agency administrators
21 Pro-innovation culture
2 Collaboration user, consultant contractors
9 and their involvement from start through finish
10 Knowledgeable users
5 Tours to educate elected officials

Characteristics:

The lateral support program consists of implementing a variety of systems from pre-cast concrete block, concrete cast-in-place, concrete "slat walls", soldier beam and lagging, and rock anchor techniques. Instead of only concentrating on restoration projects requiring reactive treatment, most recently the program is undertaking some preventative projects such as slope control and embankment control.

Reason for Implementation:

Technology and knowledge have advanced the state-of-practice for lateral support systems. The agency had in-place many older systems that were failing and posing a safety hazard to motorists. The agency determined that the existing problems could be solved with state-of-the-art technology which would also prevent future problems and provide highest quality service at the best cost to the agency.

Key Implementation Strategies:

There was excellent support from the elected officials and agency administrators regarding pursuit of quality projects utilizing new technology, methods, products, and procedures. Important also was the cooperation, coordination, and communication of the agency workforce, consultants, and contractors in all phases of the project development and implementation. The engineering personnel conducted personal tours to problem sites to educate elected officials. The appropriate education of decision-makers then enabled the transportation engineers to promptly comply with the directives of the elected officials.

Chronology:

The first project of the program occurred in 1984. The initial efforts and subsequent enhancements to the program were readily accomplished because the decision-makers had an appropriate understanding of the problem. All parties understood that if there were not some remedial actions taken the situation would get

worse. Elected officials and administrators supplied funds to accomplish the lateral support efforts.

Throughout the years the agency engineering staff has maintained a knowledge of state-of-the-art techniques. The Local Technical Assistance Program was beneficial particularly early in the program's development. LTAP helped maintenance and other agency personnel understand the roadway as a full system with environmental constraints. For the most part the agency reacted to problems that could be remedied with wall or other lateral support systems. Currently the agency is pursuing preventative projects, continuing its reach to more complex and sophisticated problem solving.

Since inception of the program the agency has spent about $7-8 million in support of county projects. They have accomplished major wall projects, one 1200 ft in length. The agency bought one variety of lateral support system and developed in-house forces for installation.

Results:

The improvements experienced through implementation of lateral support systems have made significant safety contributions to the roadways in the county. Although the agency has not performed quantitative analysis, there is very good indication that there are substantial energy savings for the driving public and reductions in travel time particularly due to decreased road closings.

Other agencies have learned about this implementation success from American Public Works Association training workshops, formal and informal interactions with vendors, contractors and consultants that promote such projects.

Recommendations:

To Users:

Any agency should have a good understanding of the condition and environment a new product or process will encounter. Do not over-extend the limits of the product.

To Researchers:

Participate in demonstration projects. Join and participate in professional public works organizations. Provide an incentive to users, i.e., discounts, coordination of project, follow-up inspections, and assessments.

To Policymakers:

Have patience and realize several techniques may be required for an agency to achieve maximum benefit when implementing new transportation innovations.

C5 - DESCRIPTION

Product or Process:

Widespread use of a highly porous open-graded bituminous wearing course for paving traffic lanes.

Summary Practice Codes: 10, 35, 8, 1

Characteristics:

The new process originated in-house. The agency learned about this process from conferences, workshops, etc., through informal interaction with others, and from research reports and journals.

Reason for Implementation:

The agency decided on the innovation to solve an existing problem--pooling of water in rutted pavements during rainstorms, which causes accidents.

The innovation is considered a success because it has a very high usage in all geographic and traffic situations, and is performing very well.

Other agencies have learned about this success by word-of-mouth, from conferences, and from published papers.

Key Implementation Steps/Strategies:

The implementation effort succeeded because of good engineering practices and judgment, the opportunity to take a risk, a clear strong need for innovation, and lack of interference by non-technical management.

Recommendations:

To Users:

Let the technical people have free hand to make recommendations. Management should consider taking tolerable risks.

To Researchers:

There are good processes for technical transfer. Use them all.

To Policymakers:

Let the technical people have free hand to make recommendations. Management should consider taking tolerable risks.

C6 - DESCRIPTION

Product or Process:

Polymers in asphaltic concrete.

Summary Practice Codes: 45, 16, 14, 2

Characteristics:

The new product originated in private industry. The agency learned about this product from conferences, workshops, etc., from vendors, consultants, contractors, and from research reports and journals.

Reason for Implementation:

The agency decided to implement the innovation to replace material with a better performing material.

The innovation is considered a success because it was implemented in 100% of asphaltic mix.

Other agencies have learned about this success from research reports and the city contractor magazine.

Key Implementation Steps/Strategies:

The implementation effort succeeded because of hard work, individual efforts from a number of people in research to improve the quality of the hot mix, foresight and imagination to combine existing technologies, and good interchange of technical data between manufacturers and researchers.

Recommendations:

To Users:

Make the users a part of the research process.

To Policymakers:

Closely monitor contract research efforts using the user in the process.

C7 - DESCRIPTION

Product or Process:

System-wide partnering on construction projects.

Summary Practice Codes: 1, 20, 13, 3

Characteristics:

The innovation originated in the Corps of Engineers. The agency learned about this new process from conferences, workshops, etc., from professional/trade associations, and through informal interaction with others.

Reason for Implementation:

The agency decided on the innovation to have a larger construction program and more decision-making at the project level, as well as to reduce construction claims.

The innovation is regarded a success because claims have been reduced and the decisions are being made at the level expected.

Other agencies have learned about this success from when the surveyed agency made presentations in other states and at national meetings.

Key Implementation Steps/Strategies:

The implementation effort succeeded because of strong support by DOT management and staff along with strong support by the construction company owners and chief managing officers.

Recommendations:

To Users:

Must have a champion to push the idea in-house. Must have a commitment from management to proceed and the resources must be committed.

To Researchers:

Must keep it in front of the persons they are trying to sell the idea to. Continued contact.

To Policymakers:

Management needs to listen to their own personnel. The personnel at the on-hands level are best at knowing what they need. The information needs to filter up.

State Jurisdiction

C8 - DESCRIPTION

Summary Practice Codes: 9, 5, 42

Product or Process:

Steel shell column retrofit to increase ductility of bridge columns.

Characteristics:

The new process originated in a university. The agency learned about this process from a collaboration on a research contract with a university.

Reason for Implementation:

To prevent or lessen damage to bridge columns.

The innovation is considered successful because the implemented procedures just withstood an earthquake in which structures not retrofitted sustained major damage.

Other agencies have learned about this success through bridge standard details and memos that are available for all other engineers, public and private.

Key Implementation Steps/Strategies:

The implementation effort succeeded because of meetings between designers and university professors, where questions were exchanged and theories were explained.

Recommendations:

To Users:

Include a technical monitor early in contracted research so that practical tests are performed.

To Researchers:

Disseminate information as soon as results become available.

State Jurisdiction

C9 - DESCRIPTION

Product or Process:

Implementation of the use of a California Type Profilograph to improve pavements.

Summary Practice Codes: 9, 42, 38, 11, 1

Reason for Implementation:

The research unit decided on the innovation to improve the surface profile of pavements.

The innovation is regarded a success because the research unit did a turnkey job--implementation meetings, developed specifications and persuaded the department of transportation to implement them, developed a guide to the use of profilograph, video, and provided training to district/contractor personnel. A formal research project began in 1988, and the use of the equipment has grown over time due to such a well coordinated implementation effort.

Other agencies have learned about this success from the research unit's annual report, newsletters, research reports, presentations, training courses, and video.

Key Implementation Steps/Strategies:

The implementation effort succeeded because of involvement of potential users/decision makers in the project review committee from inception of the project, partnership/cooperation between researchers and tech transfer/training staff in developing implementation package, hands-on users workshop, ability of researchers, support of the DOT administration. Having the "right personalities--pro-active people" to encourage implementation is critical.

Recommendations:

To Users:

Project selection based on implementation potential, involvement of potential users in project review committees, a strong marketing approach using multiple strategies--simple issuance of a technical report will not do the job.

To Researchers:

The agency is gearing up to rely heavily on video production by internal staff to inform/persuade decision makers through "video executive summaries".

To Policymakers:

Allocate a position to focus exclusively on implementation. The agency's implementation engineer is involved in project selection, a member of each review committee, and the facilitator (in conjunction with research personnel) in implementation for all projects. Select the right people for a project review committee. Include people who are technically qualified and also, as important, include people who are in a position to be a champion and help implementation.

State Jurisdiction

C10 - DESCRIPTION

Product or Process:

Modified friction course--an asphalt pavement layer designed for structure and skid resistance.

Summary Practice Codes: 8, 1, 12, 13, 25

Reason for Implementation:

The agency decided on the innovation to solve an existing problem the agency had with open-graded friction courses.

The innovation is considered a success because it now is being used in a routine manner.

Other agencies have learned about this success from when the agency has tried to inform other states at various regional and national meetings they attend.

Key Implementation Steps/Strategies:

The implementation effort succeeded because there was a need and the agency received direction from top management. There was a practical, economical, feasible solution that required minor adaptation by the paving industry. Initial installations were successful.

Recommendations:

To Users:

There should be a culture for continued improvement and there should be needs that can be met by initiated improvements.

To Researchers:

There should be a coming together of the practitioners in the field of transportation.

To Policymakers:

Most transportation departments have small research staffs. With the exception of research papers, it is difficult to maintain a mechanism whereby products would be introduced as part of the routine functioning of the organization.

State Jurisdiction

C11 - DESCRIPTION

Product or Process:

PCC Joint Sealants--The agency evaluated total pavement performance as influenced by joint sealants and found them to not enhance performance--so they passed policy to not use joint sealants.

Summary Practice Codes: 21, 32, 27, 10

Characteristics:

The new process originated in-house. The agency learned about this process from their own insight and experience.

Reason for Implementation:

The agency decided on the innovation because it was based on years of research with proper control sections. The agency proved PCC joint sealants were not cost-effective, so they implemented a no-seal policy.

The innovation is considered a success because of extensive data that did not agree with standard engineering practice. The agency stood alone in this effort. The paving industry supported the agency--very easy implementation. Other states are now considering it.

Other agencies have learned about this success from Transportation Research Board (TRB), AASHTO, Federal Highway Administration (FHWA), department reports, and industry comments.

Key Implementation Steps/Strategies:

The implementation effort succeeded because of: (1) Challenging the accepted. (2) Establishing a research program with proper control sections. (3) Evaluation of parameters important to customer. (4) Proper frequency of monitoring and analysis. (5) Timely reporting of results.

Recommendations:

To Users:

Have valid research--do it right. Have proper control sections. Monitor universities--they get off on tangents and don't see the big picture.

To Researchers:

Too much research is purely academic. Researchers "get off" on procedures that are not good, practical results. Don't accept the work of others without validation.

To Policymakers:

"If you build it, they will come" (i.e., if you do good research, people will accept it and implement it). Acceptance has to be by the practitioners, not top-management hype!

State Jurisdiction

C12 - DESCRIPTION

Product or Process:

Micro-silica based concrete for bridges--high durability concrete.

Summary Practice Codes: 3, 8, 2, 9, 26, 4

Characteristics:

The new process originated in a consortium of organizations. The agency learned about this process through informal interaction with others.

Reason for Implementation:

The agency decided on the innovation to get a longer deck life, life-cycle costs.

The innovation is considered a success because there were many involved, which caused people to buy in. There was real in-house testing done, rather than just buying a research report. The new product is not truly generic.

Other agencies have learned about this success from state contacts, Federal Highway Administration (FHWA), and word-of-mouth.

Key Implementation Steps/Strategies:

The implementation effort succeeded because of a group of people who wanted better decks in bridges, and willingness to revise control (power) so that people can decide based on need.

Recommendations:

To Users:

Give it a good technical review. Products by suppliers need validation. If research papers, read the whole thing, not just the conclusion.

To Researchers:

Get users involved. University researchers need to do research because it is needed, not because they need tenure. Don't act like you know when you do not. To question is not stupid.

To Policymakers:

Quit trying to push innovation just to fill a quota. If management isn't getting new products implemented, check out your staff or qualifications of them, but skip the "I need new products implemented". Generally, people who like their jobs will produce because they feel that it is best for all, not because of some quota.

State Jurisdiction

C13 - DESCRIPTION

Product or Process:

Crumb Rubber Asphalt-Wet Process.

Summary Practice Codes: 6, 10, 9, 12, 20

Characteristics:

Included design, transportation, and laydown of binder and wearing course. Mix appearance is excellent. Workability difficult. The new process originated in private industry. The agency learned about this process from conferences, workshops, etc.

Reason for Implementation:

The agency decided to implement the process because of regulatory requirements and research.

The innovation is considered successful because at least in the short term (less than one year) the product appears to be performing satisfactorily.

Other agencies have not learned about this success because the agency has discussed with other department district personnel, but not with other agencies.

Key Implementation Steps/Strategies:

The implementation effort succeeded because of: (1) Dissemination of knowledge to field personnel. (2) Active research participation. (3) Utilizing successful design techniques of the past. (4) Coordination between supplier, contractor, and agency prior to starting work. (5) Maintaining proven quality assurance techniques and processes during production. (6) Agency and contractor personnel acting together to "make it work".

Recommendations:

To Users:

Always integrate tried and true techniques and processes into the implementation. Make comparisons to "like" construction practices and use experiences and common sense.

To Researchers:

Be sure and include the pitfalls and problems which can occur. Do not "sugar coat" bad experiences as marginal. This only makes users skeptical. Nothing usually works perfectly every time.

To Policymakers:

See above recommendations to researchers. Quite often when new products are presented by industry representatives ("snake oil salesmen") or research facilities (with further grant money determined by the amount of research implemented) the possible problems that may occur are not fully discussed.

State Jurisdiction

C14 - DESCRIPTION

Product or Process:

Non-chlorinated solvent extraction of Hot Mix Asphalt (HMA).

Summary Practice Codes: 8, 16, 20, 1, 26, 38, 33

Characteristics:

The process originated in-house. The agency learned about this process through informal interaction with others.

Reason for Implementation:

The agency decided to implement the process to eliminate chlorinated solvents (hazardous) from field and district labs.

The innovation is regarded a success because it was new, not "off shelf" technology. It addressed a particular problem, involved the cooperation of many groups, and is still being used today.

Other agencies have learned about this success from the AASHTO Subcommittee on Materials, and the American Society for Testing and Materials (ASTM) Committee D-4.

Key Implementation Steps/Strategies:

The implementation effort really worked because of a real need, and because of the in-house capability and attitude in development. Also factors were the cooperation of suppliers and users (agency and contractors), assistance of management in interacting with legal/environmental issues, shaking the bugs out in five district labs before the field implementation, and a comprehensive implementation package including training video, equipment list, and environmental package.

Recommendations::

To Users:

Need in-house technical staff. Focus on solving problems. Money and space are needed. Communication both ways. Stick your neck out.

To Researchers:

Need to work in the real world. Focus on problems and solutions. Work with the user (agency, contractors, and suppliers). Focus on implementation in the solution.

To Policymakers:

Need adequate technical in-house staff and a commitment of equipment and space to support them.

State Jurisdiction

C15 - DESCRIPTION

Product or Process:

Use of ground tire rubber into a binder for hot mix construction.

Summary Practice Codes: 26, 5, 12, 6, 38, 10

Reason for Implementation:

The agency decided on the innovation because of state/federal legislation.

The innovation is considered a success because it identified a need, a definable process of evaluation and development, a process of implementation, and it is working.

Other agencies have learned about this success from technical literature, national workshops, and word of mouth.

Key Implementation Steps/Strategies:

The implementation effort succeeded because lab and field evaluations indicated a workable technology, implementation was driven by legislation, use of showcase projects for technology transfer, and specifications and procedures assured consistent expected results.

Recommendations::

To Users:

Good in-house technical staff. Cultivate an attitude for innovation. Showcase the technology. Communication with users of the technology.

To Researchers:

Need to have specifications/procedures developed to assure the same consistent expected result or product.

To Policymakers:

(1) Good technical staff. (2) Put in writing (specifications and procedures). (3) Communication with users. (4) Showcase technology. (5) Commitment to use (bid) the technology.

State Jurisdiction

C16 - DESCRIPTION

Product or Process:

Use of loaded wheel tester as a specification test.

Summary Practice Codes: 9, 31, 39, 8

Reason for Implementation:

The agency decided on the innovation to solve a problem with proof testing mixes to get a more rut resistant pavement.

The innovation is considered a success because it has helped the agency to almost eliminate the use of pavements that rut prematurely.

Other agencies have learned about this success because this research has received international as well as national attention. Federal Highway Administration (FHWA) has helped in this effort.

Key Implementation Steps/Strategies:

The implementation effort really worked because of involvement of users from the beginning of the study, even during development of the proposal.

Recommendations:

To Users:
Be proactive in marketing your research.

To Researchers:
Involve users up front. For significant products organize user-groups.

To Policymakers:
Make sure that the process or product is validated before attempting to implement it. Use of field testing for validation, where possible.

State Jurisdiction

C17 - DESCRIPTION

Product or Process:
Use of cement-treated, open graded drainage bases.

Summary Practice Codes: 1, 26, 5, 23, 13, 32

Characteristics:
The new product originated in-house. The agency learned about this product from research reports and journals, and through informal interaction with others.

Reason for Implementation:
The agency decided on the innovation to provide positive drainage capability and improve pavement performance.

The innovation is considered successful because it has progressed from a proposed idea to a usable design option. The department is currently considering policy on usage.

Other agencies have learned about this success from research reports that have been published and distributed, from magazine articles, presentations to professional groups, and the publication of a paper in Transportation Research Board (TRB).

Key Implementation Steps/Strategies:
The implementation effort succeeded because of: (1) Full support from top management. (2) Lab tests prior to field construction. (3) Expert on-site to help solve construction problems. (4) Flexibility of specifications to change when needed. (5) Post-construction data collection and analysis to evaluate performance. (6) Excellent report writing for dissemination of results.

Recommendations:

To Users:

(1) Conduct a thorough literature search to determine past practice, if any. (2) If possible, test products or processes in the lab. (3) Write a good specification for construction/installation.

To Researchers:

Prove the usefulness/need. Try to relate the new product/process to improved performance or reduced cost. Be practical. Remember who is your audience.

To Policymakers:

There is substantial inertia in state highway agencies against change of any kind. Most innovation happens in an incremental fashion.

State Jurisdiction

C18 - DESCRIPTION

Product or Process:

Adoption of a transition device between concrete safety shaped median barrier and temporary concrete barriers at work zones that removed blunt end exposures.

Summary Practice Codes: 8, 10, 1, 9

Reason for Implementation:

The agency decided on the innovation for improved safety, reduced liability, reduced maintenance exposure and cost.

The innovation was considered a success because this device, developed from an employee suggestion, was accepted and supported at each step of the process.

Other agencies will learn about this success when it is published in the 1995 book of Standard Plans.

Key Implementation Steps/Strategies:

The implementation effort succeeded because a workable suggestion was presented by a resident engineer with hands-on experience with the problem. A solution to a real problem, not a solution looking for a problem!

Recommendations:

To Users:

Organize a multi-disciplined "New Products Committees" that can jointly recommend an action to a single designated senior manager.

State Jurisdiction

C19 - DESCRIPTION

Product or Process:

Low profile concrete barrier for construction sites (portable) and guard rail extruder device (GET).

Summary Practice Codes: 14, 6, 3, 5, 2

Characteristics:

The new process originated at a university. The agency learned about this process from conferences, workshops, etc., and from video and specs.

Reason for Implementation:

The agency decided on the innovation to solve problems, meet regulatory requirements, and to replace the old product with better ones.

The innovation is considered a success because it was thoroughly evaluated, crash tested, demonstrated and selected sites, videotaped, and then specified.

It is unknown whether other agencies have learned about this success.

Key Implementation Steps/Strategies:

The implementation effort succeeded because the low-profile barrier was a bottom-up approach where the district had a vision and initiated the research and development with support from the department's regional office. GET was in response to federal mandate, but the region had a champion who worked closely with users in districts during field tests and implementation.

Recommendations:

To Users:

Get intended users involved with identifying problems. Allow researchers to take risks to try something new. Don't expect too much at the first initial field test--but do expect to learn from it and *improve*!

To Researchers:

Get users involved. Test at a variety of sites and conditions. Expect feedback from users and listen to their advice to improve the product!

C20 - DESCRIPTION

Product or Process:

Retrofit of dowel bars for the correction of faulting in plain jointed cement concrete pavement.

Summary Practice Codes: 3, 10, 5, 35, 4, 12

Characteristics:

The dowel bars re-establish the load transfer between the faulted slabs. Diamond grinding was used to re-establish a smooth longitudinal profile after installation of the dowel bars.

Reason for Implementation:

The agency decided on the innovation because the dowel bar retrofit was chosen to solve the problem of an increasingly rough ride on the faulted pavement sections. It was also chosen because it was cost effective versus the other most viable option of a thick Asphalt Concrete Pavement (ACP) overlay.

The innovation is considered a success because it solved a particular problem at a cost which was below the next viable option and it appears to be yielding superior performance.

Other agencies have learned about this success from the Federal Highway Administration (FHWA) and the department, which sponsored an open house for other agencies; a Transportation Research Board (TRB) paper was presented; presentations were made to various state and local groups.

Key Implementation Steps/Strategies:

The implementation effort succeeded because of: (1) A champion of the process was located in the region where the problem existed. (2) A complete understanding of the processes that were involved in producing the problem. (3) A complete understanding of the possible solutions to the problem. (4) A pilot installation on a small scale which proved the viability of the methodology. (5) A willingness to take a risk.

Recommendations:

To Users:

Stay abreast of what is current. Be involved in the technical issues of the day. Pick the products or processes which appear to stand the best chance of success and that fit a particular need in your state or agency.

To Researchers:

Make the product you product fit the needs of your client. The only way to ensure this is to be involved with the client during the entire course of the research activity.

To Policymakers:

The single largest factor for successful implementation or use of innovative products or procedures is to know what is going on in a particular area of interest. To do this successfully, staff must attend conferences such as Transportation Research Board (TRB), be involved with national committees, and network with the professionals in that area. Depending on written literature or the claims of salesmen is not as likely to succeed.

State Jurisdiction

C21 - DESCRIPTION

Product or Process:

Bulb Tee Beam: Used since 1986 in many new bridges. Double Tee Bridge System: Used since 1988 in many new bridges. Voided Slab Bridge System: Developed and tested in 1989 and used in the field in 1991.

Summary Practice Codes: 16, 21, 1, 20, 3

Characteristics:

The processes originated in an in-house research lab. The agency learned about these processes from conferences, workshops, etc., through informal interaction with others, from research reports and journals, and from research and development.

Reason for Implementation:

The agency decided to implement the processes to improve old products' performance, to reduce costs, and to provide more alternatives to designers.

The processes are regarded as successes because the interaction with designers and trade professionals in the development of new products insures that the product is practical and cost effective.

Other agencies have learned about this success from research reports, journals, and presentations in national conferences.

Key Implementation Steps/Strategies:

The implementation effort really worked because the availability of credible technical groups in-house and a pro-innovation approach by the senior management are the first steps to initiate any research project. Once the project starts, collaboration between contractors, consultants, and researchers is very important to insure a successful final product. If the user believes in the product he/she will utilize it.

Recommendations:

To Users:

Develop a list of real needs. Make every effort to find out all information/research available on any subject before proceeding. If there is a real need, implementation is easy.

To Researchers:

Interaction with consultants, contractors, and practicing engineers will improve the final product.

State Jurisdiction

C22 - DESCRIPTION

Product or Process:

CAL/APT Program, blend of research (basic and applied) with product testing.

Summary Practice Codes: 10, 3, 6, 4, 15, 33

Characteristics:

Accelerated Pavement Testing (APT): combines full-scale testing and lab testing existing databases to give fast predictions of pavement performance; customer-based, product-oriented; pushing technical and organizational improvements. This new process originated in-house (concept originated in-house; designated roles for in-house, academia, and industry). The agency learned about this process and developed it in-house.

Reason for Implementation:

The organization decided on the innovation to solve an existing problem, to meet regulatory requirements, and to prevent future problems, but especially for improvements in safety to the public (less pavement maintenance and rehabilitation), high benefit/cost ratio, environmental benefits and high-profile (nationally and internationally) so could leverage funds and gain new partners.

The implementation is regarded as a success because the program does what it says it can do, it pushes technical *and* organizational envelopes, and feedback from customers and stakeholders confirms its success.

Other agencies have learned about this success from proactive advertising by proponents and partners, as well as by word-of-mouth from customers and stakeholders.

Key Implementation Steps/Strategies:

The implementation effort succeeded, like any research project and problem-solving, because of identifying problems, doing your homework about "better mousetraps", asking "dumb questions", seeking solutions that *work* but may not be "sexy" new technology (the best technology is the appropriate technology), striving for

simplicity yet potentially elegant solutions, recognize human resource effects on technology and face them head-on, establish credibility and break your back to keep it, be ready to work at any level (clerk up through senior management) to succeed, be flexible, always ask "what can go wrong", learn things outside your expertise (e.g., accounting, budgets, policies), *believe* in your goal ...

Recommendations:

To Users:

Be realistic: structures, policies, and memos will not compensate for not having the right people--in management and in the trenches.

To Researchers:

Pull in customers early, keep them involved and make the product/process *theirs*. This takes guts and a robust, but flexible, constitutional process (in the agency) so the program survives even if some people leave or other changes happen.

To Policymakers:

In the agency, addressing problematic issues will *improve* implementation. The question asks how to "maximize", which the surveyed agency employee related to optimizing. For some agencies, fixing the problematic issues will optimize for a while. However, this may be an irrelevant or unreasonable question for any meaningful time period. Improvement is ephemeral because of dynamic conditions. The surveyed agency employee was unsure if processes can optimize implementation in predictable ways.

State Jurisdiction

C23 - DESCRIPTION

Product or Process:

SHRP mix design.

Summary Practice Codes: 8, 9, 4, 2, 11

Characteristics:

The user (pavement designer) and researcher in the department initiated the program and actively participated in the SHRP research to obtain the final form, then use it. The product originated from the Strategic Highway Research Program (SHRP). The agency learned about this product from SHRP, research reports, journals, and from professional/trade associations.

Reason for Implementation:

The agency decided on the innovation in hopes to produce a cost-effective asphalt pavement with a low life-cycle cost.

The innovation is considered successful because the product has the highest impact to the current state of practice and can yield the most investment return for the department.

Other agencies have learned about this success from regular conferences--ASTM, AASHTO and FHWA sponsoring program. Unfortunately, the SHRP mix design is still under debate regarding its validity. The department currently conducts several validation tests on it.

Key Implementation Steps/Strategies:

The implementation effort succeeded for the following reasons: (1) Clearly specified need. (2) Continue involvement of supplier, researcher, and user in working to satisfy the need. (3) The proposed solution (product) can generate a return way over the investment in the initial price and implementation costs. (4) Good communication and training program. (5) Ownership.

Recommendations:

To Users:

Form a review committee which has all parties involved and use the process described in the attached annual report--it works.

To Researchers:

Focus on the need and the investment return of evaluating/implementing a new product. Money is a finite resource; use it wisely.

To Policymakers:

(1) Meet the "real" needs. (2) All investments in R/O evaluation and implementation must be recaptured by using the new product.

State Jurisdiction

C24 - DESCRIPTION

Product or Process:

High durability concrete has been specified for concrete in severely aggressive environment of sea water.

Summary Practice Codes: 8, 4, 12, 16, 1, 15, 3 11

Characteristics:

Use of Pazzalens & Lew water/content ratio in concrete has been expanded. The process originated at a university and in-house. The agency learned about the process through informal interaction with others, and from conferences, workshops, etc.

Reason for Implementation:

The agency decided to implement the process because epoxy coated steel (ECS) created more problems than benefits. A corrosion resistance system had to be developed to replace the ECS. Focus was placed on improving the durability of concrete.

This process is considered a success because implementing high performance concrete could expand the design life of bridges to 75 years or more, resulting in reduced maintenance costs and prolonged service life of bridges and other marine structures.

Other agencies have learned about this success through personal contacts, exchange of information at Transportation Research Board (TRB), American Concrete Institute and regional meeting of Federal Highway Administration (FHWA) and department quality workshops.

Key Implementation Steps/Strategies:

The implementation effort succeeded because: (1) There was a need to improve quality and durability. (2) Benefits were clear in terms of cost savings and long term performance. (3) Expertise in-house was available. (4) Upper management supported the effort. (5) Facilities were available. (6) Funds were provided. (7) Commitment to implement by making spec. changes and provide training to Department of Transportation personnel and industry.

Recommendations:

To Users:

Willing to make changes and try new approach to solve old problems. Strengthen in-house capabilities to do research and development.

To Researchers:

Provide practical, simple to use and implementable solutions or processes to solve problems or improve current system.

To Policymakers:

(1) Remember, if you do not try new processes or products, you will never realize potential benefits. (2) You probably have excellent in-house talents for research; Find them and give them the opportunity. (3) Support and implement new products. Benefits may be tremendous.

State Jurisdiction

C25 - DESCRIPTION

Product or Process:

Previous to the agency's present wall systems they were needing Federal Highway Administration (FHWA) approval for sole source. The agency now provides (with approval to all bidders) the wall designs that they will accept up front.

Summary Practice Codes: 8, 39, 10, 4

Characteristics:

The new process originated in-house. The agency learned about this process from conferences, workshops, etc.

Reason for Implementation:

The agency decided on the innovation to provide for alternate bidding, thus reducing costs.

The innovation is considered a success because the agency was able to get industry and Department of Transportation to agree on a process.

The surveyed agency employee did not know whether other agencies have learned about this success.

Key Implementation Steps/Strategies:

The implementation effort succeeded because Department of Transportation needed to develop an innovative way to alternately bid various wall designs. The agency's staff, along with industry, set down certain design parameters and worked out the details. Federal Highway Administration (FHWA) was involved and endorsed the process.

Recommendations:

To Users:

In the transportation industry leaders and engineers are inherently conservative. This is based upon the fact that everyone remembers the failures and not the successes. Therefore we need to proceed slowly and not with reckless abandon.

To Researchers:

Our Department of Transportation is just completing a research project on this very item.

To Policymakers:

To proceed cautiously for reasons given above. But do not be afraid to start small and then work bigger. Need sound engineering evaluations and procedures before going to upper management. After the initial information keep the process moving by providing updates and plans for going ahead.

State Jurisdiction

C26 - DESCRIPTION

Product or Process:

The state's development of rut-resistant asphalt pavement and QC/QA specifications is an example of a new product and a new process.

Summary Practice Codes: 3, 10, 15, 1, 35

Characteristics:

The new process originated in a consortium of organizations. The agency learned about this process from conferences, workshops, etc., from vendors, consultants, contractors, from professional/trade associations, and through research reports and journals.

Reason for Implementation:

The agency decided on the innovation to solve an existing problem of pavement rutting.

The innovation is considered a success because a multitude of people from the state and private sector collaborated to achieve success.

Other agencies have learned about this success from word-of-mouth and articles written on the subject.

Key Implementation Steps/Strategies:

The implementation effort succeeded because of: management/contractor desire to improve (continuously championed), knowledgeable people willing to apply energy and sustain effort, careful fact or data gathering, private experts consulted, willingness to succeed by trial and error (i.e., make some mistakes), continually improve products, systematically evaluate the serviceability of the product for improvement, improve product/process based on evaluation, and willingness to fund continued improvement.

Recommendations:

To Users:

Management must firmly support, funding must be available, follow good problem solving process, show acceptable results in as short a period as possible.

To Researchers:

Researchers must stay in close contact with users. Researchers must have practical knowledge as well as be professional researchers. Users must be made aware of new products or processes to be able to find a practical use. Someone of authority must make the decision to implement.

To Policymakers:

There must be a formal and acceptable process in the organization for establishing need, evaluating, funding, implementing, and directing the use of new products and processes, or it will not happen.

State Jurisdiction

C27 - DESCRIPTION

Product or Process:

Microsurfacing with thin overlays (such as RALUMAC).

Summary Practice Codes: 14, 23, 9, 5, 42

Reason for Implementation:

The agency decided on the innovation to restore road profile (rut filling) and skid resistance, thereby extending the useful life of the pavement.

The innovation is considered a success because the product met a need of the department, was evaluated for an appropriate time period, and then was implemented for appropriate applications.

Other agencies have learned about this success from a report of the product evaluation which was published and distributed within the state to appropriate agencies and made available nationwide through Federal Highway Administration (FHWA).

Key Implementation Steps/Strategies:

The implementation effort succeeded because of: (1) A good plan of study initially. (2) Involvement of experts and users. (3) Sufficient field sites to evaluate performance. (4) An adequate performance evaluation period. (5) Report and information dissemination.

Recommendations:

To Users:

Thorough effort in preparing an evaluation plan. Careful selection of field sites with appropriate control sections.

To Researchers:

Think about "selling" the product from the beginning and collect information and slides/photos with presentations in mind.

State Jurisdiction

C28 - DESCRIPTION

Product or Process:

PROSCAN: Automated system for analyzing profilograph traces to determine the "trueness" of a newly constructed highway pavement surface.

Summary Practice Codes: 8, 12, 9, 5, 1, 15

Characteristics:

The process originated from a consortium of organizations. The process was developed through a cooperative research and development program operated by a consortium of department representatives and state universities.

Reason for Implementation:

To solve an existing problem. PROSCAN is faster and provides more consistent and accurate results for analyzing profilograph traces.

The process is considered a successful example because it is a time and labor saving process for which there already exists a need and for which the need is growing. PROSCAN eliminates a laborious, time consuming manual process and provides reliable measurements of the pavement surface's "trueness". It measures the quality of the constructor's pavement product and can be used as the basis for rewarding or penalizing the constructor through the adjustment of the contract unit prices.

Other agencies have learned about this success when a presentation of the research report was included in the program of a recently held 1995 Transportation Research Board (TRB) Conference, distribution of the research report was made nationwide, the Federal Highway Administration (FHWA) prepared and made nationwide distribution of a promotional/advertisement package. The package was distributed to other Departments of Transportation, research organizations, and construction/materials industry agencies.

Key Implementation Steps/Strategies:

The implementation effort succeeded because: (1) The innovative process and equipment matched the users' needs. It provided more accurate/consistent results and greatly reduced the time needed to determine pavement "trueness". The time element provides a significant cost saving for the constructor who must keep personnel and equipment tied up until the Engineer completes his analysis and permits the constructor to vacate the construction site. (2) User/researcher interaction plus user participation during vital stages of the research development. (3) The research development would not have been possible without a strong commitment by senior managers who provided approval and funding support. (4) Field trials and demonstrations clearly showed the advantages to be realized through use of the new process.

Recommendations:

To Users:

The surveyed agency employee has been more successful when he/she has included the following in the implementation process: Defined user needs through solicitation of users for their problems, asked users to become involved during the study/development stages so as to make the problem solution user friendly, provided information for executive staff to solicit their support in the implementation process, and used a marketing plan which included demonstrations, presentation, and product/process information bulletins.

To Researchers:

The product/process must be user friendly. The research should solicit user involvement in all stages of the research work.

State Jurisdiction

C29 - DESCRIPTION

Product or Process:

Drilled shaft foundations.

Summary Practice Codes: 10, 17, 25, 2

Characteristics:

Used to replace cofferdams for bridge pier foundations (old technology, but new organization). The new process originated in-house, in private industry, and in a consortium of organizations. The agency learned about this process from conferences, workshops, etc., from vendors, consultants, contractors, from professional/trade associations, through informal interaction with others, and from research reports and journals.

Reason for Implementation:

The agency decided on the innovation for faster, more economical construction (and eliminated cofferdam-related claims).

The innovation is considered a success because in 4 years of use, only one cofferdam design has been used.

Other agencies have learned about this success from talks given at the Southern Transportation Geotechnical Engineers Conference.

Key Implementation Steps/Strategies:

The implementation effort succeeded because a good specification was written. Designers were the inspectors. A good contractor did the work with no claims.

Local Jurisdiction

C30 - DESCRIPTION

Product or Process:

Placing polymer modified slurry seal on major arterial streets.

Summary Practice Codes: 20, 21, 13, 12

Characteristics:

The new process originated in a research lab and in private industry. The agency learned about this process from conferences, workshops, etc., from vendors, consultants, contractors, and through informal interaction with others.

Reason for Implementation:

The agency decided on the innovation because of rapid curing--much more flexibility in routing through traffic. Superior performance--extended pavement life.

The innovation is considered a success because it has advantages at the "front end" (easily constructed) and at the "tail end" (extended life).

There has been minimal contact whereby other agencies may have learned about this success.

Key Implementation Steps/Strategies:

The implementation effort succeeded because it was an effective joint venture of city staff willing to innovate. The association was willing to develop the product--the contractor was willing to develop the best application procedures at certain financial risk.

Recommendations:

To Users:

Networking/pilot applications. Organization must encourage innovation/risk-taking.

To Researchers:

Network/direct contact (i.e., do not involve future distributors, "middle men").

Local Jurisdiction

C31 - DESCRIPTION

Product or Process:

GeoGrid to reduce required base thickness in reconstruction of flexible pavement.

Summary Practice Codes: 32, 16, 4, 10, 21, 35

Characteristics:

The surveyed agency employee did not know where the new process originated. The agency learned about this process from conferences, workshops, etc., and from vendors, consultants, and contractors.

Reason for Implementation:

The agency decided on the innovation to reduce reconstruction cost but provide the same project performance.

The innovation is considered a success because it provided a total project cost less than conventional methods which performed at a level higher than that achieved by conventional methods.

Other agencies have learned about this success from advertisements in national publications--"Better Roads and Bridges".

Key Implementation Steps/Strategies:

The implementation effort succeeded because of good research by staff, a willingness of the state to educate the consultant, an organizational attitude of innovation, and a willingness to accept some risk of failure in order to achieve.

Recommendations:

To Users:

Scan the literature. Hire smart people with good skills.

To Researchers:

Get information out through many channels. Stress examples.

To Policymakers:

Look at non-traditional user groups (fleets, taxpayers, etc.). Encourage risk-taking by staff. Don't kill staff for failure.

Local Jurisdiction

C32 - DESCRIPTION

Product or Process:

Rubberized Asphalt.

Summary Practice Codes: 6, 14, 5, 4, 12

Characteristics:

While anticipating federal requirement, it was specified as an alternative. Cost was less overall, ride quality and surface have been much better than standard. The new process originated in a research lab. The agency learned about this process from conferences, workshops, etc., from professional/trade associations, and through research reports and journals.

Reason for Implementation:

The agency decided on the innovation because of federal mandate, past experience with the product by some staff, and competitive bidding of products.

The innovation is considered a success because of lower overall cost, higher performance in service, and it cause contractors to re-think old methods and really consider bids.

Other agencies have learned about this success from when their staff has been questioned by other agencies and/or requested specifications.

Key Implementation Steps/Strategies:

The implementation effort succeeded because the mandate on implementation gave clear direction. Although it was not yet effective, the agency "tested" the waters before necessary. With delay in federal mandate, the agency has not used it again because of resistance by local contractors to become proficient in this material.

Recommendations:

To Researchers:

Work on contractors to learn a new process, and offer it at a cost advantage to users.

To Policymakers:

More of what works--less of what does not. Fewer mandates--more incentives.

Local Jurisdiction

C33 - DESCRIPTION

Product or Process:

In the area of asphaltic materials--the use of modified asphalts to address particular pavement problems, i.e., the use of a stress absorbing membrane interlayer to control reflective cracking in pavements.

Summary Practice Codes: 20, 3, 21, 33, 8

Characteristics:

The new process originated in private industry. The agency learned about this process through informal interaction with others.

Reason for Implementation:

The agency decided on the innovation to solve an existing problem and to recycle materials to enhance or help the environment.

The innovation is considered a success because it successfully addressed the problem which the agency was trying to address.

Other agencies have learned about this success from word-of-mouth and advertising by the supplier who developed the process.

Key Implementation Steps/Strategies:

The implementation effort succeeded because of the ability of the government agency and private supplier to work to develop a new idea. Effort of personnel to go beyond the normal level of effort to ensure that the project was a success. Push the bounds of what was the current practice to try something new and innovative.

Recommendations:

To Users:
Go beyond the normal bounds to push innovative ideas, be flexible in methods.

To Researchers:
Put information out as soon as it's available; don't delay or it might be out of date.

To Policymakers:
Make information available and back it up with hard facts to show that the product or idea will work or will be beneficial.

Local Jurisdiction

C34 - DESCRIPTION

Summary Practice Codes: 12, 2, 4, 7, 20

Product or Process:
Adopted the state DOT's new mix designs and specs. for asphalt pavement performance vs. method spec. Did more testing of projects.

Characteristics:
The new process originated in a consortium of organizations. The agency learned about this process from conferences, workshops, etc.

Reason for Implementation:
The agency decided on the innovation to solve problems (rutting), prevent problems (longer pavement life), and shift responsibility to a party who can make the change (contractor).

The innovation is considered a success because it was readily accepted by contractors. It seems to be performing as promised.

Other agencies have learned about this success from when the agency has "talked it up" with underlying government units; they also come to the agency for advice.

Key Implementation Steps/Strategies:
The implementation effort succeeded because the pavement performed as promised. There was an excellent team assembled to study the issue and develop a solution. The solution (3 separate mix designs) was do-able, reasonable, and affordable. The industry had a stake and gave input into the problem. Government listened to and accepted input of contractors.

Recommendations:

To Users:
Use a team concept to develop new ideas.

C35 - OBSERVATION

Product or Process:
Asphaltic and Bituminous Materials: The implementation effort succeeded because of a good track record in other areas/states, good technical advice and knowledge, simple, easy-to-follow directions, support from upper management, an available funding source, and well-trained workers/implementors.

C36 - OBSERVATION

Recommendations To Policymakers:
Eight out of 10 products in the consumer market fail (the new Coke at $325 million is the modern-day Edsel). These products fail because they do not bring added value to the system, not because of organizational inertia. The highway industry is no different. Leadership needs to make a paradigm shift away from the assumption of organizational inertia and into the development and deployment of effective screening systems or techniques which identify selected products/processes for focused, added value implementation. This provides for better resource utilization and significantly higher target hits. Otherwise you miss 8 times out of every 10 shots!

C37 - OBSERVATION

Product or Process:
Use of open-graded drainage layer under [city] cement concrete pavement: The implementation effort really worked because it minimized impact on how the contractors were doing things, everyone perceived the benefits to be derived, the impact of increased cost was kept to a minimum, the industry was well-aware of the changes prior to implementation, and the industry was involved with early demonstration projects.

C38- OBSERVATION

Product or Process:
Unspecified asphalt application: The implementation effort succeeded because of good specifications, cooperation from Federal Highway Administration (FHWA) applications, good communication with Hot Mix Asphalt industries, an in-house champion, and a desire by all involved to make it work.

C39 - OBSERVATION

Product or Process:

Unspecified innovation.

Recommendations To Users:

Have a manufacturer's representative present during initial trials and have someone knowledgeable from the organization there to observe and ask questions.

C40 - OBSERVATION

Product or Process:

Open-graded sub-base: Open-graded sub-base placed under concrete pavement to provide positive sub-base drainage to reduce problems caused by pumping. The implementation effort succeeded because two small test sections were implemented with limited success, but they clearly showed what needed to be modified to allow the sub-base to be successfully constructed on future work.

C41 - OBSERVATION

Recommendations To Researchers:

A published list of users to discuss technical issues. Practical experience exchanges are needed for implementation.

C42 - OBSERVATION

Product or Process:

Partnering with others--contracting industry, other agencies and internal groups within department: The agency decided on the innovation to reduce conflicts in construction administration and to reduce legal issues. The process is regarded as a success because it has changed the attitude from one of conflict to one of cooperation.

DESIGN (D): OVERVIEW

Innovations are being implemented in the design process for a number of reasons. Recent federal mandates governing pavement and bridge design have made a significant impact on agencies through requiring review of the bases for design. Innovative products and equipment are now readily available and agencies are developing the expertise to take full advantage of their technological advances (for example, agencies have better data to support design decisions). Additionally, transportation engineers have seen the results of innovative designs used in other countries and are now adapting such designs to their states' needs.

Implementation examples were not as numerous for design as for several of the other topical areas. However, some very interesting cases are presented in this section. Survey participants particularly highlight responses to the federal mandate for demonstrating pavement design rationale. Additionally, several examples demonstrating the implementation of new bridge component design will be helpful to other design professionals.

Key strategies promoting successes in implementing new products and processes for design functions focused on knowledgeable participants. A number of the descriptions stressed the importance of forming user groups, the need for technical expertise for implementers and users, and particularly the need for expertise to derive the maximum from the researchers/developers. Design examples also showed the importance of researchers being a significant part of the initial application of the research results. Successes pointed to those researchers who could impart knowledge to the use in the user's environment, addressing spescific user problems.

The material in this section is organized similarly to the other three sections in this chapter, with highlighted case descriptions in the beginning. These expanded descriptions are development and adoption of a state's "Thickness Design Manual for New and Reconstructed Pavements"; GIS-HYDRO, a system to support statewide hydrologic modeling; and falling weight deflectometer based overlay design.

D1 - HIGHLIGHT

Product or Process:

Falling weight deflectometer (FWD) based overlay design.

Summary of Practices:

10 Knowledgeable users
5 Pilot project
31 Continual marketing to other agency personnel (users)
39 Support from FHWA
3 Product champions
21 Pro-technology culture
6 Federal mandate
7 Product ready to be implemented

Reason for Implementation:

The department was required by the Federal Highway Administration to have approved pavement design procedures. Considering these procedures were to be put in writing, engineers were concerned that they did not have sufficient confidence in the figures they were to be documenting. The FWD data provided substance to give strength to the pavement design procedures. Additionally, the technology was ready to be implemented. The newly formed pavement management unit took the time to develop the expertise to get the technology implemented in the state.

Key Implementation Strategies:

The critical mass of pro-FWD use personnel in the pavement management unit was essential. Their commitment to gaining expertise through a three year research project and their continual marketing and selling efforts to the field personnel have been instrumental in the implementation process. The agency had excellent support from the Federal Highway Administration (FHWA) division office.

Chronology:

FWD equipment has been around for over twenty years. The department's maintenance division purchased a FWD, and it was unused for six years. There was no one with appropriate skills or the inclination to spend time gaining the expertise. In response to the federal mandate for a Pavement Management System, the state organized a pavement management unit. When the unit was created the agency hired additional staff, particularly personnel with expertise in new technological areas or with motivation to try newer technologies.

In 1989-90 the pavement management unit undertook the task to gain expertise on the FWD equipment. The group organized a three year research project which tested 24 sections every three months. The personnel developed seasonal/temperature variation information and observed changes over time as a result of pavement distress--essentially they did FWD calibrations for conditions in their state. The field experience helped the pavement management unit lead the state in implementing the FWD.

In 1990-91 the department produced a written procedure for use of the FWD. With developing expertise and written procedures, usage of the FWD increased.

All projects on interstates use data from the FWD, except in a few areas where traffic control prevents measurements (such as ramps). With less federal funds available, less usage is occurring on interstates, but the department is now performing more FWD measurements on state routes. They are currently using the FWD for state route overlay projects.

Throughout the experience, the Federal Highway Administration division office was very supportive and encouraged the pavement management unit to stand firm with its designs.

The pavement management unit continues to aggressively market the benefits of the FWD to division and district engineers. Lessons learned in the process were, it is important to be sensitive to people's resistance to change, and it is necessary to lay the groundwork to enable people to change.

Results:

The department instituted the use of FWD as standard practice. There are currently two FWD units used and a third unit is ordered. The equipment is used statewide. The department achieved its goal of developing expertise in a method that produces reliable data and is somewhat independent of engineering judgment.

Recommendations:

To Users:

Implementation must be made a process with a feedback loop. It must also be rewarded. The fact is that implementation makes some projects run more slowly--there are always adjustments needed to the process.

To Researchers:

Include a specific technology transfer plan in the final report. Step 1) pilot project (size, test sites, etc.), include monitoring; Step 2) normal use, review of problems; Step 3) project improvement.

To Policymakers:

Department engineers are bombarded with conflicting information from suppliers--an example of a current no-win conflict is polymer and multi-grade asphalt. There is no mechanism to sort out all the claims and conflicts. The effect of all the supplier calls is to make the engineer want to "stick to the tried and true" rather than use innovative products that may prove to be valuable to the department.

D2 - HIGHLIGHT

Product or Process:

Development and adoption of the state's "Thickness Design Manual for New and Reconstructed Pavements."

Summary of Practices:

1 Strong commitment from senior management
14 Clear goals
8 Recognized need
4 Economic effectiveness
16 Available in-house expertise
9 Researchers worked with users throughout the project into implementation
18 Field personnel input to final manual
21 Pro-innovation culture

Characteristics:

The manual sets the standard for agency-wide design of new and reconstructed pavements. The manual is based on the results of recent research, incorporates use of new equipment and technologies, and provides a rational basis for consistent pavement design.

Reason for Implementation:

Many changes have occurred in the area of pavement design in the past decade. The designs used in the state were decades--as many as 80 years--old. There was no one remaining in the department who was sufficiently familiar with the technical basis for the designs. In general, the designs were based on empirical methods and did not properly serve the state's needs. In addition, the Federal Highway Administration mandated that each state highway agency develop a rational pavement design. Considering the state has excellent research capabilities, there was appropriate talent to develop new designs.

Key Implementation Strategies:

(1) There was strong commitment from senior management. A senior manager participated in one of the European pavement tours. After having seen the results of designs used in Europe, the manager set a course for adapting such technological innovation for pavement design. (2) Earlier procedures were recognized as being inadequate. (3) The federal mandate promoted action. (4) Life-cycle cost analysis was conducted and demonstrated the economic effectiveness of the new design procedures. (5) The available in-house expertise enabled the process to go forward smoothly without delay. (6) Researchers worked with user organizations throughout the research and implementation. (7) The final manual had detailed review by field personnel, and incorporated changes which made the manual significantly easier for them to use. (8) Based on past successes of implementing research, the agency has a pro-innovation

culture. The benefits of research and technology are continually presented to agency management, and attitudes about incorporating innovations have changed.

Chronology:

In 1989/1990 the department was asked whether the AASHTO design standards were useful. In addition the Federal Highway Administration questioned how the state designed pavements. This timing was close to the effective date on mandated pavement management systems. The agency personnel all thought they knew the basis of their design procedure, but found that there was no one knowledgeable about the (in some cases) 80 year old designs. The questions snowballed and initiated thinking of developing new designs. Such a move was not easy. There was significant resistance to making radical changes to the designs that had served the department for so many years. Shortly thereafter a senior manager participated in one of the European pavement tours. The senior manager returned to the state convinced that innovative pavement designs were appropriate. The senior manager used his authority to give high priority to developing new designs.

The implementation would not have proceeded so expeditiously if there had not been strong influence from the senior manager. The new designs would have been implemented eventually, but with a much tougher selling job to technical staff.

The department's research group was the technical engine for development of the designs. The ability for the central office technical staff and the field offices to work closely with the researchers at every step of the process was instrumental. After considerable consultation with field offices, the manual was published by the organization within the department having responsibility for pavement design.

The agency has made presentations at professional meetings, had material published in Transportation Research Board reports, and met with a variety of vendors, consultants, and contractors to promote the new design manual.

Results:

Despite considerable reservations about making dramatic change, the manual implementation was successful, and it revolutionized pavement design in the state. The manual has some limitation to its application due to the topic: new and reconstructed pavements. The department is now working on an overlay design companion manual which will have greater application (the agency is performing more overlay projects than new or reconstruction projects.)

Benefits resulting from the new designs are not readily apparent today other than the knowledge that a substantially higher quality product has been produced. The new designs in general produce thicker pavements and thus higher initial costs. There is anticipated savings from longer lasting pavements requiring less maintenance. Life-cycle cost analysis shows economic advantage of the new designs.

The project has shown the technical advantages of the research group. Research people are continuing to be asked to provide assistance for problems that may not fit standard assumptions in the manual. This expertise provides fast turn-around for answers to questions and enhances project technical quality. In addition, the agency is now developing a group that will continue the innovations in pavement design. The group will incorporate use of the most current equipment and techniques available.

Recommendations:

To Users:

User organizations should critically view their processes, products, and services. They should identify and voice their "needs" in improving their products.

To Researchers:

Work with the users, make them your client. Involve them in research and guarantee training and follow-up services.

To Policymakers:

Sometimes the "marketing" approach in introducing innovations tends to overstate the technical reliability and usefulness of the new products and processes. In attempting to implement these products, the many adjustments and improvements which need to be made cause the users to lose faith. Further, this makes product evaluation very difficult.

State Jurisdiction

D3 - HIGHLIGHT

Product or Process:

GIS-HYDRO, a system to support statewide hydrologic modeling.

Summary of Practices:

9 Excellent relationship between user and researcher
25 Practical hands-on researcher
3 Product champion
1 Support of senior management
10 Knowledgeable user
15 Funding
18 Regulatory body personnel on project advisory panel
4 Potential for big $ savings

Characteristics:

The programs model hydrologic conditions in the state for the bridge hydraulics division. The model applies geographic information systems tools to the hydrologic analyses performed. The model also allows the larger picture view of the state hydrologic conditions required for bridge engineering projects. Developers of the model are continuing to add technical capabilities, including more sophisticated land use capabilities.

Reason for Implementation:

The state is dominated by hydrologic conditions, and the department saw a need to have better tools for analysis of complex situations relating, in particular, to

bridge engineering. The department also sought enhanced responses to environmental issues governed by regulatory requirements.

The department decided on the innovation to save time in analyzing hydrology, plus engineers can conduct in-depth studies within a limited time frame. The model allows consideration of more scenarios of greater complexity and eliminates by-hand computations, thus reducing error potential. The model reduces the overall cost associated with hydrologic studies.

Key Implementation Strategies:

The effort succeeded because of the excellent relationship between the researcher developing the system and the department engineers. The researcher really understood the practical needs of bridge designers and worked on the program until they were happy with it. The researcher went the extra mile, went to department offices or field locations, and in general managed the research very well. Senior engineering management solidly supported the effort and took personal interest in promoting the concepts among the bridge division, environmental design and highway design groups. In addition, the project was managed by a very conscientious bridge hydraulics engineer and performed in concert with other very knowledgeable users. Funding for the effort was also available.

Chronology:

The department began work on this project in 1989-90. It has proven to be a valuable tool and worth continued development. The model development effort has 1 or 2 on-going projects. Currently, the researcher is adding technical capabilities to provide more sophisticated land use analyses.

The model is continuing to be used to perform analyses and provides a better quality product than with older methods.

The initial modeling effort has allowed the state to perform a very large related research project. Success of this large effort is attributable to knowledgeable users within the department, having environmental agency personnel on the project advisory panel--thus providing opportunity for streamlining regulatory approvals, and continued excellent relationship with the researcher.

The department is now working with the Federal Highway Administration to expand the use of the model to other states in the region. Senior management continues to provide excellent support for the innovation.

The successful implementation of this technology did not happen by accident. The key strategies were critical to the success. The department believes the implementation process can be replicated in other agencies with the same degree of success.

Results:

Direct savings as a result of having used the model have not been calculated. However, it was noted recently that, in a $1 million dollar redesign project dealing with environmental concerns, if GIS-HYDRO had been used, the cost of the large research project now underway would have been justified with only this one project. There is great potential for significant savings for the department.

Recommendations:

To Users:

The implementation requires adequate funding and also willingness of the researchers to make changes in the product that ultimately lead to better performance. Have people dedicated to each new idea--keep on top of the researcher. Do not let research run away from your objective.

To Researchers:

A successful implementation takes place if the product meets or at least comes close to meeting the users needs. This requires a good communication process between both sides. Input provided by experienced and knowledgeable users can only help to develop a successful product. Do not be afraid to get your hands dirty in the real world. Make a concerted effort to interact with the user, understand their real problems. They may not know how to articulate them in terms familiar to your research community.

To Policymakers:

Face-to-face interactions among users and between users and researchers is essential, but political perceptions of travel by state employees hinders this.

If something is worth implementing, it is worth putting a top employee on it--not just anyone who is available. Make sure the person's schedule is sufficiently free to spend time on implementation and that this is a consideration for promotions for technical track employees.

State Jurisdiction

D4 - DESCRIPTION

Product or Process:

The Bridge Section of the DOT's Design Division developed a new bridge beam (precast pretensioned concrete U-beam) that is both aesthetic and economical.

Summary Practice Codes: 9, 25, 3, 1, 10, 15, 18, 4

Characteristics:

The new process originated in-house. The agency learned about this process from when it was developed internally.

Reason for Implementation:

The agency decided on the innovation because the agency needed to be building aesthetic bridges; aesthetic bridges have always cost more; the agency needed an aesthetic bridge that was also economical.

The innovation is considered a success because team effort is extremely important. Any entity that is part of the process (e.g., fabricators, formwork producers) and others with experience, are needed *from initiation.*

Other agencies have learned about this success from presentations at technical meetings around the country and publications.

Key Implementation Steps/Strategies:

The implementation effort succeeded because of support/encouragement from top management, teamwork (with all stakeholders involved from the start), and a "champion" of the cause (and the employer must allow that person time and resources to make it happen).

Recommendations:

To Users:

Get all affected parties involved from the start (e.g., researchers, university contracted and also in-house research office staff; construction engineers, bridge engineers, contract administrators, and outside parties such as fabricators).

To Researchers:

Invite Department of Transportation engineers to seminars on new products/processes. Mail summary flyers to Department of Transportation technical experts in that area. Initiate phone calls.

State Jurisdiction

D5 - DESCRIPTION

Product or Process:

The department developed and implemented a new method for pavement overlay design.

Summary Practice Codes: 10, 9, 8

Characteristics:

The new process originated as a development at a university as a contracted research project. The agency learned about this process through informal interaction with others.

Reason for Implementation:

The agency decided on the innovation to replace the old process (Benkelman Beam) with a better procedure. It also solved an existing problem.

The innovation is considered a success because the procedure has completely supplanted and greatly improved the previous unsatisfactory technique.

Key Implementation Steps/Strategies:

The implementation effort succeeded because one of the principal researchers was also one of the main users of the final product. This knowledge allowed the research to be closely tailored to the practical aspects of the problem. Frequently, there

is a "moon-shot" mentality among researchers (and those who contract the research) which drives them to promise to develop breakthroughs rather than make incremental improvements in existing technologies. As a result, agencies get results which are conceptually excellent, but not too useful for practical purposes. The researchers leave behind a string of promising, yet undeveloped products, to chase the next sexy concept. Researchers with more practical bents are not respected by the elite researchers, not funded on a national basis, and not favored for tenure at universities. The system rewards those who promise the most, not those who consistently deliver implementable results.

Recommendations:

To Users:

There must be a real, easily recognized need for a new product or process. The user must be involved in evaluating the new product or developing the process.

To Researchers:

Researchers must keep users informed on the status of research on the new product or process. Also, a seminar, workshop, demonstration, or similar type of meeting should be held with users once research is completed. Researchers must be practical and their results implementable.

To Policymakers:

Have someone reporting directly to the chief engineer or director who has the responsibility for implementation efforts in the department. The person must have specific capabilities and the authority to be effective in this position.

State Jurisdiction

D6 - DESCRIPTION

Product or Process:

Bridge analysis drafting and design software.

Summary Practice Codes: 1, 3, 15, 10, 42

Characteristics:

The new process originated in private industry. The agency learned about this process from a research project.

Reason for Implementation:

The agency decided on the innovation for productivity improvement and product quality enhancement.

The innovation is considered a success because it was later transferred to AASHTO for transfer to other Departments of Transportation, maintenance, and enhancements.

Other agencies have learned about this success from AASHTO and Transportation Research Board (TRB) presentations.

Key Implementation Steps/Strategies:

The implementation effort succeeded because of involvement by top management and several champions that pushed and shepherded the project. There was also funding available, and more was added when required.

Recommendations:

To Users:

Design implementation into the request for proposals and set aside funds to do it when the product is delivered. Track results and advertise them.

To Researchers:

Demonstrations and teleconferences work well. The Local Technical Assistance Program has worked exceptionally well to transfer information/products to municipalities, but the Department of Transportation has no internal technology transfer unit.

To Policymakers:

Top management must appreciate and emphasize both research and technology transfer. A technology transfer unit is essential to making implementation happen. Risk must not be punished but rewarded--public administrators only get grief if a project does not succeed. We need to be on the leading edge with computer hardware/software and the Internet, not 3-5 years behind academia and private industry.

State Jurisdiction

D7 - DESCRIPTION

Product or Process:

DARWIN computer program for the design of pavement structures.

Summary Practice Codes: 9, 36, 20, 8

Characteristics:

The new product originated with AASHTO, and the agency learned about the product from the AASHTO committee.

Reason for Implementation:

The agency decided on the innovation to automate and enhance a process that was already in place. It allowed for uniformity, greater capability, and enhancement.

The innovation is considered a success because it is the one the surveyed agency employee was most familiar with. The product is used daily and has had improvements made because of user input.

Other agencies have learned about this success from the AASHTO newsletter and other publicity.

Key Implementation Steps/Strategies:

The implementation effort succeeded because of user input to the working product, incremental enhancements, and a user group to promote the product's use.

Recommendations:

To Users:

Get a champion of the cause and be willing to share knowledge with the researcher about the problem.

To Researchers:

Ask how the product is to be used, and what would they expect if the research was successful.

Local Jurisdiction

D8 - DESCRIPTION

Product or Process:

Review design mixes–inspect pavement placement–test specified parameters–reject faulty materials and workmanship.

Summary Practice Codes: 8, 43, 10, 15, 11, 1

Characteristics:

The surveyed agency employee did not know where the new process originated. The agency learned about this process from conferences, workshops, etc., from vendors, consultants, contractors, from professional/trade associations, through informal interaction with others, through research reports and journals, and from an inspection staff.

Reason for Implementation:

The agency decided on the innovation to prevent future problems, and assure the best materials and workmanship for the public dollar.

The innovation is considered a success because the agency has better control of the quality, quantity, and workmanship.

Other agencies have learned about this success through informal interaction, and some contractors, engineers, and vendors complain about the agency being too hard on them.

Key Implementation Steps/Strategies:

The implementation effort succeeded because continued failures doing it the old way told the agency something must be done. Strong public outcry plus embarrassment on the agency's part started the ball rolling. The agency then began to specify a better product, but soon found they would have to enforce what they specified. Strict enforcement turned the failures into successes. Implementation required funding, education, training, and management support.

Recommendations:

To Users:

Consistently Quality Assurance/Quality Control (QA/QC) all products and processes. Don't hesitate to reject or exclude any faulty materials, products or processes which don't meet your specs.

Local Jurisdiction

D9 - DESCRIPTION

Product or Process:

Wetlands mitigation.

Summary Practice Codes: 4, 12

Characteristics:

The new process originated in-house and was suggested to state officials. The agency learned about this process from professional/trade associations.

Reason for Implementation:

The agency decided on the innovation because of cost savings.

The innovation is considered a success because it saved $1,000,000 of costs.

Other agencies have learned about this success because the agency brags about it. It was a perfectly sensible application of what had been done in other states.

Key Implementation Steps/Strategies:

The implementation effort succeeded because the agency could save over $1,000,000 of tax funds and do a better job.

Recommendations:

To Users:

Provide detailed success stories of other Public Agencies.

To Policymakers:

Play into innovative groups.

MAINTENANCE AND OPERATIONS (M): OVERVIEW

Maintenance and operations are straightforward concepts, but they encompass a terrific range of activities when applied to highways, streets and roads. Most of the instructive maintenance and operations implementation examples that our survey participants detailed fall into 7 broad categories: (1) removal of snow and debris; (2) maintenance and repair of road surface; (3) collection and processing of information on road surface, (4) traffic operations, including signals; (5) intelligent transportation systems, particularly variable message signs; (6) paint removal; and (7) devices for safety or control.

Because maintenance and operations staff have to take care of so many different areas, it is difficult to concentrate on a sustained program to implement one particular type of innovation. On the other hand, a wide variety of products and processes are available, and opportunities to try innovations on a small scale may pop up unexpectedly. For example, in Case M4 and M34 below, vendors offered equipment at low cost, and it worked! In other cases, environmental or other regulations may require substantial changes in products or processes. Three examples, M2, M20 and M24, involve new procedures for the removal of lead paint which were instituted because of environmental and safety concerns.

The Highlighted cases, M1-M4, respectively involve systemwide photography of pavement and right of way, lead paint removal, screened street sweeping debris and 2-phase 24 hour snow plowing.

State Jurisdiction

M1 - HIGHLIGHT

Product or Process:

Producing and enhancing photographs of pavement and entire freeway right of way.

Summary of Practices:

1 Top management support
2 User/developer/university collaboration
16 Available in-house researcher expertise
10 Knowledgeable users
3 Product champion
4 Big $ savings

Characteristics:

Every year, this DOT photographs its entire highway system using a van specially equipped for this purpose. The photographs are stored on a video disk. Maintenance staff uses specialized software to process the images and generate pavement ratings. The photographs have been used to defend the Department of Transportation in court and for other purposes.

Reason for Implementation:

This began with a moment of inspiration. As the state has developed and improved the innovation, more uses have materialized. Roadway inventory data are now more complete and consistent.

Key Implementation Steps/Strategies:

Staff have followed this technology over a period of 25 years. Top management support has been instrumental. Staff at all levels of the organization are encouraged to work with the photographs and are recognized for their contributions.

Chronology:

About 10-12 years ago, the State converted to using videotape for the photographs and using video software to enhance the images. The software development was a multi-institutional effort; the state university did much of the initial work on a contract, but private vendors and Department of Transportation staff made substantial contributions.

The Department of Transportation used their federal-aid state planning and research funds to support this innovation. One of the state commissioners has played an especially significant role in the effort. The DOT Director of Research is the product champion, and has significant assistance from the research staff.

The software permits assessment of the length of cracks and prioritization of these segments to facilitate rehabilitation or reconstruction decisionmaking. Besides being used for maintenance and repair, these photographs are used to defend the state

in litigation. Other possible uses include bridge maintenance, accident prevention and sign placement.

The innovation has been disseminated through several publications. AASHTO, FHWA and TRB have all publicized it.

Results:

This innovation is fully implemented throughout the state. It saves the residents of the state $1,000,000 per year in reduced travel time due to better road maintenance and less disruptive construction work. Additionally, the use of one of the photographs in a court case generated significant savings for the department.

Recommendations:

To Users:

Base a decision to attempt implementation on a firm understanding of existing problems/needs.

To Researchers:

Develop the communication skills within your staff so they can all adequately explain to users the benefits and the features of the new products and processes.

To Policymakers:

There have been repeated examples of defining moments of leadership by agency executives. Success and failure in implementation can often be traced to such moments where decisive action was taken with good results. Failures are often marked by executive procrastination that lead to the "wrong" message - promising new products and processes have simply withered and died following lack of interest and resource support by top and middle managers.

State Jurisdiction

M2 - HIGHLIGHT

Product or Process:

New procedures for removal of lead based paint.

Summary of Practices:

18 Collaboration with regulatory agencies
5 Pilot project
2 Communication
1 Top management support
6 Mandated regulation

Characteristics:

The area where the sandblasting is done is enclosed; lead particles fall to the floor and are vacuumed at the end of the paint removal. Fans and filters are used to

protect workers. The Department of Transportation continues to refine the method and look at new techniques.

Reasons for Implementation

The primary reason for implementation was to meet newly created state environmental regulations. Previously, pulverized lead got into the air and posed a hazard to the general public. The Federal Occupational Safety and Health Administration got involved to protect the workers.

Key Implementation Steps/Strategies:

(1) Close cooperation between Department of Transportation staff and the staff of the regulatory agencies. (2) Conduct of a pilot project. (3) Involvement of Commissioner and Assistant Commissioner.

Chronology:

The new processes were generated in-house. According to one of our respondents, new methods were first tried in 1992 when the Department was removing paint from a bridge in a metropolitan area. This served as a pilot project. The new policy was promulgated in 1993. Because of the expense and trouble involved, the Commissioner and Assistant Commissioner made the final decision.

The Environmental and Health departments were heavily involved in developing and implementing the new policies. This communication was essential; it sped up approvals. The regulatory agencies gave very positive feedback for the new procedures.

Some people within the DOT were not entirely happy about the changes because paint removal took longer and cost more money. Contractors tended not to like the new procedures for similar reasons even though their payments were increased. Unfortunately, some small contractors went out of business because they could not make the capital investments now required. Some current thinking on this process indicates there may be opportunities to modify the regulations to distinguish between urban and rural areas.

Further refinements of the method were made especially for the purpose of improving worker safety. Copies of the specifications were forwarded to local governments and other state agencies. Best estimates show that all local governments in the State have adopted this method.

Results:

The implementation is complete and successful. The new methods work. This was a quick response to a new regulation. It enabled a $30 million bridge painting program to continue.

The methods provide the intended benefit in terms of protecting the environment and the general public. However, there is concern that (1) the worker protection component was not as effective because workers may be placed under greater exposure to lead, (2) there may be a loss of quality to the paint removal process because of the difficulty of removing paint, and (3) the requirement of inspecting the results in the dark hot enclosures. The outcome of this would be that bridges will have to be repainted more often.

Recommendations:

To Users:
Maintain a continuous dialogue throughout the development and implementation between researchers and eventual users.

To Researchers:
Keep users informed continually, throughout development. Personal contact is best; this maintains the interest of both parties and allows for mid-course corrections.

To Policymakers:
Include in the original plan a budget for a separate implementation step. This step should be specific and possibly include training in the new area, a technology transfer activity such as a seminar, or organizing a task force to develop policy for implementation.

Local Jurisdiction

M3 - HIGHLIGHT

Product or Process:
Commercial product that separates dirt and sand from street sweepings.

Summary of Practices:

5	Equipment field demonstration
3	Product champions
4	$ savings
20	Good relationship with vendor
15	Adequate funding (eventually)

Characteristics:
Every night, the day's worth of street sweepings are front loaded into the product. The product shakes and sifts the sweepings using a 6 milimeter (approx. 1/4 in) filter. All the dirt and sand is shunted to one side while the refuse remains. The process is repeated.

Reasons for Implementation
The local landfill started to charge the city tip fees for street sweepings. The first year, the charges were over $250,000. Additionally, there were concerns that the sweepings were environmentally hazardous.

Key Implementation Steps/Strategies:
A surprise demonstration of the product to the Finance Director, whose approval was needed to make the $60,000 purchase.

Chronology:

About 5 years ago, because of a shortage of landfill space, the local landfill started to charge the city tip fees for street sweepings. The landfill did not charge residential users, and there was legal wrangling, but the city lost the dispute. The street sweepings include significant amounts of sand and salt that is used to mitigate public inconvenience from snowfalls. The first year, a heavy snow year, the charges were over $ 250,000.

After talking with professional peers, the Director and Deputy Director of Public Works found out about this product. The separated sand, dirt and salt would not be subject to tipping fees because it is not considered refuse; in fact the separated material is useful to the landfill as cover. They borrowed the product from the vendor and learned to operate it. One day they took the City Finance Director to a parking lot and demonstrated the machine. The Finance Director was impressed, and the purchase, for $60,000, was authorized from capital funds.

After an initial "shakedown" period, the public works department developed a reliable procedure for using the machine. After the screening is done, it is necessary to mix the material and let it dry out. The material can then be sent to the landfill without any tip fees. The state environmental department had some concerns about the separated materials, primarily because of the salt content. However, the separated materials were tested, and the levels of salt and other potentially hazardous materials were found to be acceptable.

The department received favorable feedback from the city's internal auditor and from the City Council. In addition, the innovation was the subject of a favorable newspaper story.

Public Works management has shared the success of this innovation with other jurisdictions. The vendor is marketing the product, and they have prepared a videotape featuring public works employees of this city.

Results:

This innovation is completely implemented. Besides the substantial savings in tip fees, the sand is used for cover and fill, both by the landfill and by the department for its operations. There may be environmental benefits from the separation. Several smaller Facilities are considering joint purchase of one of these machines.

Several smaller municipalities are considering similar programs through joint ownership of this type of equipment.

Recommendations:

To Researchers:

Literature, video tapes, equipment shows, computer software, demos in the field.

Local Jurisdiction

M4 - HIGHLIGHT

Product or Process:

2 Phase 24 Hour Snow Plowing

Summary of Practices:

30 Agreement with union
28 Enhanced public information
1 Strong mayor/top management support
5 Pilot project
8 Addressed user needs

Characteristics:

The innovation responds to major snow storms by plowing 1 side of some residential streets (either E-W or N-S) as well as major arterials in first phase of plowing. The remaining residential streets are plowed during the second phase. Two Phase plowing uses a larger staff for a shorter period of time.

Reasons for Implementation:

There was some dissatisfaction with the length of time it took to complete snow plowing in this large city. The job was being done faster in some suburbs, and residents wanted similar performance even though conditions were different.

Key Implementation Steps/Strategies (in summary):

Obtaining agreement from unions to create unified job titles that allowed more employees to work on snow plowing. Enhanced public information and awareness has also been critical.

Chronology:

The DOT started thinking about this process in the late 1970s. However, there was considerable opposition from the city employee unions, and negotiations ran for several years. Ultimately a strong mayor prevailed upon the unions to accept broader job categories. These permitted laid-off workers and sewer workers to contribute to snow plowing efforts.

Major components of the process involve declaration of a snow emergency, accurate signing of the streets, and public awareness of where to park. A successful pilot project was operated in one neighborhood during the winter of 1989-90, and 2 Phase plowing was implemented citywide for the winter of 1990-91.

Subsequently, the system was improved by assigning personnel to one route for the entire winter and having them drive through that route before the first major snowfall. Further flexibility was added by designating the 2 phases "Day" and "Night"; this enables the plowing to begin earlier following a storm. The city is currently switching to equipment that allows to snow plows to sand the streets while plowing.

The public loves this system, and feedback in general has been very positive. Both our respondents indicated that. Employee unions are satisfied because there are

now fewer layoffs of seasonal workers. There has also been substantial and favorable press coverage. Furthermore, another large city in the state is trying to implement the process.

This implementation program was chosen as a semi-finalist in a prestigious national competition.

Results:

Two Phase 24 Hour Snow Plowing is fully implemented for this city.

The main benefit is that the city is usually completely plowed within 20 hours; it used to take as long as 44 hours. Because residential streets are cleared earlier, the snow becomes less packed and the plows do a better job. Additionally, the city has been able to reduce both the number of layoffs and the total number of employees working on street and sewer services.

Recommendations:

To Users:
Involvement by decision makers (including politicians), citizens and workers.

To Researchers:
Demo projects and document benefits.

To Policymakers:
Provide for/accept the possibility of failure - without punishment. Allow flexibility.

State Jurisdiction

M5 - DESCRIPTION

Product or Process:
Guard rail end treatment.

Summary Practice Codes: 14, 8

Characteristics:
The product produced was used and the rights purchased by a private manufacturer and is currently being used across the nation.

Reason for Implementation:
The agency decided on the innovation because it provided a safer roadway for motorists.

The innovation is considered a success because it has had a national impact throughout the transportation departments.

Other agencies have learned about this success from the manufacturers now producing this project.

Key Implementation Steps/Strategies:

The implementation effort succeeded because of having a brief, clear, and concise methodology in order to conquer a concern of the public. This method normally produces results that are cost-effective, practical, and easily implementable.

Recommendations:

To Researchers:

Place information on test results of new products or an on-line user format--easily accessible around the world.

State Jurisdiction

M6 - DESCRIPTION

Product or Process:

Worked with a private vendor to develop a debris removal machine (pre-sweeping) in a prototype stage.

Summary Practice Codes: 9, 5, 8

Characteristics:

The developer sold the product to TORO, and the department is now preparing a test of the first production units. The agency will measure effectiveness. The product originated in private industry. The agency learned about this product through informal interaction with others.

Reason for Implementation:

The agency decided to implement the product to eliminate the need for workers to manually clear debris prior to sweeping.

The product is considered successful because the process solved a major safety issue with minimal fiscal risk and a successful solution.

Other agencies have learned about this success because TORO is now marketing the machine.

Key Implementation Steps/Strategies:

The implementation effort succeeded because the machine's potential to automate a manual process allowed involved users the opportunity to see benefits to them early on.

Recommendations:

To Users:

Do not force a group to "test"; find a group which wants to do it--one who sees the benefits to them. If none is found, hold off and "sell" the project at a later date.

To Researchers:

Remember that users can "break" anything if they are forced to take something they do not believe in.

State Jurisdiction

M7 - DESCRIPTION

Product or Process:

Use of changeable message signs (CMS) in work zones (portable, Light Emitting Diode (LED) display).

Summary Practice Codes: 12, 29, 12

Characteristics:

The new product originated in private industry. The agency learned about this product from vendors, consultants, contractors, from professional/trade associations, and through informal interaction with others.

Reason for Implementation:

The agency decided to implement the product to replace old flip-disc technology CMS.

The innovation is considered successful because it improved performance of the product--better visibility for motorists and improved maintenance by contractors.

Other agencies have learned about this success because industry passes the word around. The agency has not tried to get the information out.

Key Implementation Steps/Strategies:

The implementation effort succeeded because a good product was developed. Everyone involved could determine the advantages of making the change. The product was non-proprietary, so others could compete.

Recommendations:

To Users:

Have a formalized process with personnel devoted to the process.

To Researchers:

National testing of products is a definite step in the right direction (e.g., the American Association of State Highway and Transportation Officials' National Transportation Product Evaluation Program). This reduces the amount of testing that each state is required to do.

M8 - DESCRIPTION

Product or Process:

Cracking and seating concrete pavement.

Summary Practice Codes: 8, 5, 1, 2, 7

Characteristics:

The agency began studying this rehabilitation process in 1986. The project was completed in 1992 and implementation began immediately. The new process originated from other states trying it, and the surveyed agency "picked up on it". The agency learned about this process from conferences, workshops, etc., from research reports and journals, and through informal interaction with others.

Reason for Implementation:

The agency decided to implement this process to replace the old procedure with one that performed better longer.

The innovation is considered a success because the technique has been enthusiastically adopted, leading to improved pavement performance at a lower cost.

Other agencies have learned about this success from presentation and papers at national/regional conferences, Transportation Research Board (TRB) most notably.

Key Implementation Steps/Strategies:

The implementation effort succeeded because of the following: (1) Addressed a widely recognized problem. (2) Practical solution, readily implementable. (3) Pilot project demonstrated success. (4) Project had strong support from the top down. (5) Researchers and users worked together.

Recommendations:

To Users:

Test out products on pilot scale before wider implementation. People's first impressions ("This doesn't work", for example) are hard to overcome.

To Researchers:

Involve the users (not just management) from the beginning throughout the project.

To Policymakers:

Be supportive. Involve users and lower echelon employees to get them committed to the project/product.

State Jurisdiction

M9 - DESCRIPTION

Product or Process:

Highway Operations--Over a period of the last 9 years (aggressively in the last year), the agency has been successfully implementing a Road Weather Information System.

Summary Practice Codes: 21, 15, 3, 22, 1, 4

Characteristics:

The new process originated in private industry. The agency learned about this process from vendors, consultants, contractors, and from research reports and journals.

Reason for Implementation:

The agency decided on the innovation to better manage snow and ice control operations (e.g., reduced salt usage, improved motorist safety), and to be more informed of what is or is almost to happen on the highway system relative to pavement and atmospheric conditions.

The innovation is considered a success because it involved interaction with several state agencies (e.g., for communication, system sharing), and because of potential cost savings in operating accounts.

Other agencies have learned about this success from when the agency reached out to other agencies to let them know what direction they were heading.

Key Implementation Steps/Strategies:

The implementation effort succeeded because: (1) New administration who was pro-technology. (2) Federal Highway Administration (FHWA) participation in funding effort. (3) A champion who wouldn't give up.

Recommendations:

To Users:

Make sure there is support by upper management. Aggressively go after Federal funding. Try to promote partnering with other agencies.

State Jurisdiction

M10 - DESCRIPTION

Product or Process:

Traffic Operations--Approval of the Red Light Emitting Diode (LED) Traffic Signal.

Summary Practice Codes: 25, 3, 26

Characteristics:

The new product originated in private industry. The agency learned about this product from vendors.

Reason for Implementation:

The agency decided to implement the product for power savings (18 watts vs. 135 watts per signal) and because it has a life expectancy of seven years or more.

The innovation is considered successful because this office developed a set of guidelines for certifying traffic control devices while evaluating the product.

Other agencies have learned about this success from Certification Activity Reports, which are distributed to all of the district Traffic Operations offices quarterly.

Key Implementation Steps/Strategies:

The implementation effort really worked because of the manufacturer's patience. It took about four years of testing various Red LED samples and fine tuning the agency's set of guidelines (or "Choir Book", as nicknamed by the author). The agency emphasized that they can not show favoritism to a manufacturer or inventor; everybody has to follow the agency's guidelines.

State Jurisdiction

M11 - DESCRIPTION

Product or Process:

A cathodic protection system was installed on a coastal bridge as part of a demonstration project funded by the Federal Highway Administration (FHWA) and the department of transportation.

Summary Practice Codes: 27, 4, 10, 5, 31, 32

Characteristics:

As a result of the research, several other cathodic protection systems were installed on coastal bridges in the state and consequently, the life span of those bridges was extended, thus, saving millions of dollars. The new process originated in-house and with the Federal Highway Administration (FHWA). The agency learned about this process from conferences, workshops, etc., from vendors, consultants, contractors, from professional/trade associations, through informal interaction with others, from research reports and journals, and from the Federal Highway Administration (FHWA).

Reason for Implementation:

The agency decided on the innovation because the Department of Transportation decided to implement cathodic protection systems to save bridges, and consequently, money.

The innovation is considered a success because numerous historic coastal bridges that were deteriorating rapidly were saved from being replaced and the Department of Transportation has saved millions of dollars.

Other agencies have learned about this success by reading the Department of Transportation research unit reports regarding cathodic protection. In addition, a subsequent research project regarding using titanium as an anode for cathodic protection is in progress; the surveyed agency employee is the chairperson for the technical advisory committee (TAC) and periodically sends information to people on the TAC and other interested parties including: [State] Department of Transportation Project Manager's offices, Department of Transportation Geotechnical engineering unit, Federal Highway Administration (FHWA), other state Departments of Transportation, the state university, and U.S. Bureau of Mines.

Key Implementation Steps/Strategies:

The implementation effort succeeded because of the following: identifying the appropriate problem to research; the potential return on investment was high; prior to the start of the research, a lot of effort was made to learn about cathodic protection systems in other locations (e.g., Florida, Illinois, Montreal, etc.) and about the "state of the art" cathodic protection technical information that was available; the cathodic protection system was installed in a "real" user setting; objective research was conducted and reported to the users; the system was demonstrated by the researchers to the users; the expected benefits of the system were determined and "marketed" to the user.

Recommendations:

To Users:

Before effective implementation is done, objective research should be conducted.

Keys to research and implementation: brainstorm and generate many ideas; choose the ideas that have the greatest estimated return on investments; form a technical advisory committee (5-10 people) that includes potential users of the information for each project; conduct objective research; the technical advisory committee (TAC) should meet at least every four months; implementation should occur at any time during the research project, implementation does not need to wait until after the project is over; results of the research should be documented in reports, newsletters ("research notes"), letters, and memos (then this information should be disseminated to potential users and other interested parties); additional methods to disseminate the information should be considered, including workshops, presentations, one-on-one training, telephone calls, etc.; it is important not to attempt to implement new products or processes that have a poor expected return or investment.

To Researchers:

The most important element to consistently improve the transfer of new products and processes to users is to form a technical advisory committee that includes users. The users can implement new products and processes at any time during the research project.

To Policymakers:

As stated above, the key to implementation is to form a technical advisory committee for each research project that includes potential users. The users can implement new products or processes at any time during the research project.

State Jurisdiction

M12 - DESCRIPTION

Product or Process:

Fiberglass sign support for signs up to 16 square feet.

Summary Practice Codes: 25, 8, 7, 17

Characteristics:

The support is yellow in color and is 3 inch outside diameter, round in shape. The new process originated in private industry. The agency learned about this process from vendors, consultants, and contractors.

Reason for Implementation:

The agency decided on the innovation because they have been looking for a yellow sign support system that will be low on maintenance costs. At the same time the agency wanted the sign support to be able to be recycled.

The innovation is considered a success because field people indicate that the support is easy to work with, yellow color does not require painting as with metal coated posts, and yellow color has cut down on number of knockdowns.

Other agencies have learned about this success from conferences, meetings, surveys, and questionnaires.

Key Implementation Steps/Strategies:

The implementation effort succeeded because of vendor credibility and the time was right, as the agency needed this type of improvement to their sign support system.

Recommendations:

To Users:

Work closely with field personnel to clear up questions and misconceptions as quickly as possible.

To Researchers:

Same as above.

To Policymakers:

Field evaluations conducted by individuals that are willing to make the effort and not just to go through the motions to tell you what they think you want to hear.

State Jurisdiction

M13 - DESCRIPTION

Product or Process:

Intelligent Transportation Systems (ITS)--Advanced Traffic Management System--Preparation for large-scale sporting event.

Summary Practice Codes: 3, 7, 33, 4, 34

Characteristics:

The process originated in Intelligent Transportation Systems (ITS). The agency learned about this process from conferences, workshops, etc., from vendors, consultants, contractors, from professional/trade associations, through informal interaction with others, and from research reports and journals.

Reason for Implementation:

The agency decided to implement the process to manage traffic in preparation for the large-scale sporting event (Advanced schedule).

The innovation is considered a success because it meets the customer needs/desires, is environmentally sensitive, and economical (best use of resources).

Other agencies have learned about this success from conferences, workshops, etc., from vendors, consultants, contractors, from professional/trade associations, through informal interaction with others, and from research reports and journals.

Key Implementation Steps/Strategies:

The implementation effort really worked because it was driven by a need to meet the schedule for the large-scale sporting event, but, more importantly, because of a personal commitment by employees of the Department. It also worked because of the desire to see the programs implemented and the willingness to devote 50-60 hours per week to get the project moving.

State Jurisdiction

M14 - DESCRIPTION

Product or Process:

Intelligent Transportation Systems (ITS) Application--variable message signs and control center.

Summary Practice Codes: 14, 10, 12, 36

Characteristics:

The product originated in a consortium of organizations. The agency learned about this product from conferences, workshops, etc., from vendors, consultants,

contractors, from professional/trade associations, and through informal interaction with others.

Reason for Implementation:

The organization decided on the implementation to deal with incidents on interstates. The agency had Freeway Incident Management teams in place to deal with the incident but no means of notifying motorists in advance of incidents and congestion; also means to suggest alternate routes.

The innovation is considered successful because it provides the best visible assistance to motorists during accidents.

Other agencies have learned about this success from shared knowledge through presentations and field visits.

Key Implementation Steps/Strategies:

The implementation effort really worked because of: (1) Identified goal/what wanted to achieve. (2) Knowledge of technology. (3) Commitment to not over-complicate. (4) Practical application based on objectives. (5) Avoidance of "Star Wars" approach to technology.

Recommendations:

To Users:

(1) Set objectives. (2) Reality check during process. (3) Continual monitoring/re-assessment to keep focused.

To Researchers:

Simplification.

State Jurisdiction

M15 - DESCRIPTION

Product or Process:

Pavement Markings--Material selection, design, application, placement, testing, and evaluation.

Summary Practice Codes: 1, 2, 14, 20, 9

Characteristics:

The new process originated in-house. The agency learned about this process from conferences, workshops, etc., from vendors, consultants, contractors, from research reports and journals, and through informal interaction with others.

Reason for Implementation:

The agency decided on the innovation for road safety for users, excessive wear, visibility issues, durability issues, brightness issues, cost factors, and understanding by users.

The innovation is considered a success because of team effort, which resulted in new specifications, new standards, new configurations, new warrantying and use criteria.

Other agencies have learned about this success through some written reports, meetings and conferences, through advance specification reviews, and through trade organizations.

Key Implementation Steps/Strategies:

The implementation effort succeeded because of clear direction from/to upper management, a team approach--practically leaderless (No Turf!), involvement of all concerned units/parties, adopted time-lines, industry involvement, and it truly fulfilled a recognized need.

Recommendations:

To Users:

Involve "everyone" at the outset. Good organization with well-conceived time-lines. Understanding of what the end-product will be.

To Researchers:

Monthly/quarterly updates. Invitations to tests/evaluation meetings. Dissemination of "field reports". Specification reviews for input.

To Policymakers:

Probably more than any other government agency, the transportation field is never at rest. Change is essential to keep abreast of changing needs, priorities and values.

State Jurisdiction

M16 - DESCRIPTION

Product or Process:

Pre-wetting of road salt or road salt/sand mixes with liquid salt brine and/or other liquid chemicals.

Summary Practice Codes: 9, 3, 16, 15, 21, 35, 14. 20

Characteristics:

The new process originated within the Department of Transportation. The agency learned about this process from conferences, workshops, etc., from vendors,

consultants, contractors, through informal interaction with others, from research reports and journals, and through interaction with peers/colleagues from other countries.

Reason for Implementation:

The agency decided on the innovation to reduce operational costs and the potential for environmental impact.

The innovation is considered a success because the product/process users, highway maintenance workers, were involved in the research and development and thus were willing to use the new process. In fact, the other workers quickly began to ask for it when benefits became evident.

Other agencies have learned about this success from the group's annual report, "one-pagers", highlighting research projects presentations at conferences, seminars, etc., and from networking with colleagues.

Key Implementation Steps/Strategies:

The implementation effort succeeded because of: (1) Having users-workers involved in field research. (2) Having a "champion" in the field--usually a supervisor or superintendent. (3) Continuing moral and financial support from our maintenance research office. "Stretched" the working culture to make things happen. "Expanding the envelope" in terms of what are acceptable practices, acceptable limits. (4) Trying to prevent/minimize failures of research for wrong reasons--needed to maintain clear goals. (5) Perseverance to overcome established/entrenched paradigms. (6) Organizing a support team with representation from vendors, users, equipment support personnel, etc.

Recommendations:

To Users:

Have an enthusiastic and open-minded champion. Involve potential targeted users early in research and development process. Provide continuing visible moral and funding support for research and development.

To Researchers:

See recommendations to users. Have users involved in research. Inform peers through informal, formal contacts.

To Policymakers:

Involve targeted users early-on. Top staff "laying on" an idea or innovation on the user doesn't work very well. Have an enthusiastic champion for innovations.

M17 - DESCRIPTION

Product or Process:

3M's Light Pipe--Videos and brochures on product accurately described the intent and capabilities of the product.

Summary Practice Codes: 12, 25, 23, 21, 8

Characteristics:

The new process originated in private industry. The agency learned about this process from vendors, consultants, and contractors.

Reason for Implementation:

The agency decided on the innovation to solve an existing accident problem by improving the delineation of the roadway.

The innovation is considered a success because it has reduced the number and severity of accidents.

The surveyed agency employee was not aware of whether other agencies have learned about this success.

Key Implementation Steps/Strategies:

The implementation effort succeeded because of: (1) A top-quality product that performs as per the manufacturer's videos, brochures, and personal comments. (2) A top-quality manufacturer that stands behind their products and provides the technical expertise to assure the product is used in the correct setting and properly installed. (3) Users that have an open mind to new and innovative products.

Recommendations:

To Users:

Good products are easy to receive approval if they perform in a satisfactory manner when tested under actual field conditions.

To Researchers:

(1) Adequately perform your homework on a product prior to contacting a user. (2) Adequately, precisely define the capabilities of the product.

State Jurisdiction

M18 - DESCRIPTION

Product or Process:

Portable rumble strips and flashing stop/go paddles. The new process originated in the Strategic Highway Research Program (SHRP).

Summary Practice Codes: 5, 12, 1, 15

Characteristics:

The agency learned about this process from conferences, workshops, etc., and from SHRP.

Reason for Implementation:

The agency decided on the innovation to improve safety in construction/maintenance work zones.

The innovation is considered a success because it was a short term evaluation with results quickly available. Many evaluations take more time and more complex evaluation which, although necessary, slows implementation.

Other agencies have learned about this success from when the agency distributed a newsletter on implementation of SHRP products. Once a product is approved for use, the agency notifies all engineering districts by letter.

Key Implementation Steps/Strategies:

The implementation effort succeeded because there is strong level management support for implementation of SHRP products, which results in the allocation of personnel and funds to implement these products. The SHRP name elicits cooperation from the users, whereas at times it is difficult to find sites for other products.

Recommendations:

To Users:

Gain top level support for new product implementation, promote the successes, and involve the users.

To Researchers:

Probably need to do more promotion or "selling" of the new ideas. The problem is that with limited staff it is difficult to evaluate and promote.

To Policymakers:

Provide some "risk capital" to encourage district participation and to replace failures. Field people are reluctant to try innovations when they know that they will have to fund the replacement or increased maintenance of a failed product.

M19 - DESCRIPTION

Product or Process:

A new Incident Response Program in reducing congestion, accidents, and air quality problems on the city's expressway.

Summary Practice Codes: 19, 3, 4

Characteristics:

The new process originated in-house. The agency learned about this process from research reports and journals, and through informal interaction with others.

Reason for Implementation:

The agency decided to implement the process because this problem is a new, cost-effective approach for solving congestion problems on busy interstate highways.

The innovation is regarded a success because the results exceeded the agency's expectations. One in ten motorists assisted returns a response card (all have been favorable reviews). Several lives have been saved. The expressway is not closed down nearly as often.

Other agencies have learned about this success from news media reviews, word-of-mouth, Federal Highway Administration (FHWA) commentaries, and professional publications.

Key Implementation Steps/Strategies:

The implementation effort succeeded because the empowerment of frontline employees was a key factor. The agency needed a lot of flexibility on their part as they identified and developed procedures. The employees were then extremely innovative and suggested some valuable ideas.

Recommendations:

To Users:

Obtain input from the end user to make sure implementation can and will take place and will be cost effective.

To Researchers:

Solicit involvement and study the advisory committee.

To Policymakers:

Policy and decision makers need to solicit input from the lowest level user to be successful.

State Jurisdiction

M20 - DESCRIPTION

Product or Process:

Containment, collection of lead based paint.

Summary Practice Codes: 8, 15, 7, 12

Characteristics:

The process originated in-house. The agency learned about this process from conferences, workshops, etc., from vendors, consultants, contractors, from professional/trade associations, and from research reports and journals.

Reason for Implementation:

The agency decided to implement the process because of extensive concern with environmental impact of lead paint removal and worker safety issues.

The process is considered successful because it has virtually eliminated environmental complaints related to lead paint removal, improved the quality of the end product, and reduced worker lead poisoning incidents.

Other agencies have learned about this success from papers presented at AASHTO, trade groups, articles in journals, personal contacts with other agencies, consultants, etc.

Key Implementation Steps/Strategies:

The implementation effort really worked because of a realization by all parties involved that a problem did exist, a reasonable solution was presented, and because of the willingness of the agency to pay the cost of implementation to protect the environment and the public from lead paint debris.

Recommendations:

To Users:

Identify the problem clearly and concisely. Seek information from other users as to the benefits and costs of the product/process.

State Jurisdiction

M21 - DESCRIPTION

Product or Process:

Cathodic protection of bridge substructures.

Summary Practice Codes: 11, 9, 16, 20, 5, 1

Characteristics:

The process originated in-house. The agency learned about the process from conferences, workshops, etc., from vendors, consultants, contractors, from professional/trade associations, and from research reports and journals.

Reason for Implementation:

The agency decided to implement the process to solve existing corrosion problems.

The innovation is regarded a success because cathodic protection has been successful in preventing substructure corrosion.

Other agencies have learned about this success from trade associations and industry contacts.

Key Implementation Steps/Strategies:

The implementation effort really worked because of involving and training other groups within the department. on the concept before letting them contract. People who developed change were well respected. Active support from industry. Good training plan, successful pilot projects, agency support.

Recommendations:

To Users:

Good documentation of field test projects.

To Researchers:

More contact and presentations to user groups. Get users' input along the way.

ocal Jurisdiction

M22 - DESCRIPTION

Product or Process:

Use of new equipment to remove lead based paint from the exterior of a building.

Summary Practice Codes: 37, 38, 6, 12

Characteristics:

The new process originated in private industry. The agency learned about this process from vendors, consultants, contractors.

Reason for Implementation:

The agency decided on the innovation to comply with state laws.

The innovation is considered a success because it worked well. The process was inspected by health agencies and found to be acceptable.

Key Implementation Steps/Strategies:

The implementation effort succeeded because the agency has not pushed for the use of new products, etc. The agency typically waits until their use is approved by the state department of transportation.

Recommendations:

To Users:

The state university has developed a "technology transfer bulletin" which has been helpful.

Local Jurisdiction

M23 - DESCRIPTION

Product or Process:

Polymerized Asphalt (Styrelf): used for sealing operations on existing paved surfaces and conversion of gravel roads to paved roads.

Summary Practice Codes: 1, 15, 5, 40, 4

Characteristics:

The new process originated in private industry. The agency learned about this process from vendors, consultants, contractors, from professional/trade associations, through informal interaction with others, and through research reports and journals.

Reason for Implementation:

The agency decided on the innovation because of the potential for doubling the useful life at a cost which is less than double the existing method.

The innovation is considered a success because the agency was able to use existing equipment and personnel for the application. Thus it was not necessary to have an additional capital outlay to try a new product.

Other agencies have learned about this success possibly from asphalt producer representatives.

Key Implementation Steps/Strategies:

The implementation effort succeeded because the most important step was convincing the Board of Commissioners to fund the test (experimental) project. This enabled the agency to experiment with the application procedure as well as to observe the material in place.

Recommendations:

To Users:

To develop a state of mind or culture within our county to try or experiment with new ideas or processes on a regular basis with "Experimental Projects" and to expect that some or many will fail.

To Policymakers:

Experimental projects for testing and trial need to be able to circumvent the normal channels of review, etc. before implementation. This problem slows the innovation process dramatically.

Local Jurisdiction

M24 - DESCRIPTION

Product or Process:

Development of I-5 Generation Signal Coordination System.

Summary Practice Codes: 15, 8, 6, 14, 37

Characteristics:

The new process originated in-house. The agency learned about this process from conferences, workshops, etc., through informal interaction with others, and through research reports and journals.

Reason for Implementation:

The agency decided on the innovation because the time of day coordination was not sufficient–volumes were too variable, lack of staff resources to monitor traffic conditions.

Other agencies have learned about this success from a paper presented at an Institute of Traffic Engineers meeting and through new proposals to develop similar systems in the interstate corridor running through two other counties.

Key Implementation Steps/Strategies:

The implementation effort succeeded because of sufficient funding, a clearly perceived problem (arterial with over 85,000 ADT), legal requirements (a mitigation of impacts), a clear definition of project functional requirements, a clear definition of success criteria, and the state department of transportation approval for Type 170 exception.

Recommendations:

To Users:

Be involved and current in new techniques/practices. Do not be afraid to *use* computers. Think positively (it *can* be done).

To Researchers:

Write summaries of technical research in popular journals. After research results are in, think of the implications in a broad context.

To Policymakers:

Technical–no problem, just make sure you have an aggressive, trained staff and some for training and conferences. Policy-related (like ramp metering, demand management, pricing, etc.)–no way. The public (hence, elected officials) are not there yet–and heavy-handed efforts like trip reduction for air quality will be repealed by legislature. "I have no succinct advice here".

Local Jurisdiction

M25 - DESCRIPTION

Product or Process:

Used TRAF-NETSIM model in highway planning public meetings to show alternative designs and impact.

Summary Practice Codes: 3, 2, 28, 16, 10

Characteristics:

The new process originated at a university. The agency learned about this process from professional/trade associations.

Reason for Implementation:

The agency decided on the innovation because the public did not seem to understand design alternative data--TRAF-NETSIM showed the impact.

The innovation is considered a success because the public seemed to understand the presentation, and following it they were able to focus on viable alternatives.

Other agencies have learned about this success from the agency verbally spreading the word.

Key Implementation Steps/Strategies:

The implementation effort succeeded because of dedication by the team to try and present information to the public in a way that the public got the message.

Recommendations:

To Users:

Design team must be unified in their vision of a project and should spend time to create that vision.

To Researchers:

Use known professional organizations to get the word out.

To Policymakers:

Use video conferences.

Local Jurisdiction

M26 - DESCRIPTION

Product or Process:

Installation of "closed loop" traffic signal system to increase traffic efficiency and coordination.

Summary Practice Codes: 41, 15, 2

Characteristics:

The new process originated in private industry. The agency learned about this process from conferences, workshops, etc., from vendors, consultants, contractors, from professional/trade associations, and through informal interaction with others.

Reason for Implementation:

The agency decided on the innovation to replace old, out-of-date traffic signal controllers with new ones.

The innovation is considered a success because traffic flow has improved and equipment does not break down as it used to.

The surveyed agency employee was not sure whether other agencies have learned about this success, since all other agencies they knew of with this product implemented it before they did.

Key Implementation Steps/Strategies:

The implementation effort succeeded because of finding other agencies who had this product working successfully, obtaining funds, and constant correspondence between the manufacturer and the agency.

Recommendations:

To Users:

View it in action and use it only if successful.

Local Jurisdiction

M27 - DESCRIPTION

Product or Process:

The agency has recently converted a gasoline-powered vehicle to natural gas. Also, the agency is in the process of installing the region's first Natural Gas Pumping Station.

Summary Practice Codes: 6, 21, 1, 9

Characteristics:

The new process originated in a research lab and in a consortium of organizations. The agency learned about this process from conferences, workshops, etc.

Reason for Implementation:

The agency decided on the innovation to meet regulatory requirements and to prevent future problems.

The innovation is considered a success because it is one which has been talked about for quite some time and it has finally taken off.

Key Implementation Steps/Strategies:

The implementation effort succeeded because of a new administration committed to the environment and new ideas.

Recommendations:

To Users:

A management team open to new concepts.

To Researchers:

Make everything very simple to understand!

To Policymakers:

The most important aspect is believing that anything is possible. Commitment and a working relationship with researchers and "hands-on people".

Local Jurisdiction

M28 - DESCRIPTION

Product or Process:

Replacing steel guard rail crash attenuator with a precast lightweight aggregate/concrete attenuator system.

Summary Practice Codes: 3, 16, 15, 10, 8

Characteristics:

The new process originated in a consortium of organizations. The agency learned about this process from conferences, workshops, etc., from vendors, consultants, contractors, and through research reports and journals.

Reason for Implementation:

The agency decided on the innovation because the agency needed it.

The innovation is considered a success because it solved a significant recurring problem with replacement of a bridge median crash attenuator which was impossible to keep repaired. It reduced replacement from twice a year to none in the past three years.

Other agencies have learned about this success through the manufacturer.

Key Implementation Steps/Strategies:

The implementation effort succeeded because of first, an in-house champion for innovation which allows the staff to research new products/ideas and knows that for well researched/tested products funds will be made available. Second, a pro-innovation culture exists which will support new ideas. Third, a diversely educated staff opens avenues into numerous areas: bridge design/construction, road design/construction, computers, traffic safety and management systems.

Recommendations:

To Users:

Gather good field data on existing conditions. Ask too many questions about product.

To Researchers:

Provide accurate information on products, start-up cost, implementation cost and maintenance cost.

M29 - OBSERVATION

FALLING WEIGHT DEFLECTOMETER FOR PAVEMENT ANALYSIS AND DESIGN:

The implementation effort succeeded because of a small group of people who wanted to make it happen and found a way to side-step obstacles.

M30 - OBSERVATION

DYNAMIC CONE PENETROMETER:

The Dynamic Cone Penetrometer was a new technology to this state Department of Transportation. The implementation effort succeeded because the problem was widespread and of universal concern. It was also successful because the solution was simple and thus easy to disseminate. Also, the fact that a relatively small amount of funding was available for implementation was key. "If you are willing to spend money for research you should be willing to spend money on implementation."

M31 - OBSERVATION

DEVELOPMENT OF A "BLACK BOX" TO MONITOR AND DETECT PROBLEMS IN TRAFFIC CONTROLLERS:

Recommendations To Policymakers:

Convey an atmosphere or environment of being progressive and interested in trying new products. Assure technical staff that failures are tolerated and part of the learning process.

Local Jurisdiction

M32 - OBSERVATION

HOT AIR LANCE TO DRY OUT CRACKS IN PAVEMENT PRIOR TO CRACK SEALING:

The implementation effort succeeded because it was a simple product that seemed to make sense. The product was relatively cheap ($2,000) so there was a small risk in trying it.

M33 - OBSERVATION

MILLING OPERATIONS TO SAVE THE COSTS OF DRAINAGE IMPROVEMENTS WHEN RESURFACING ROADS:

The implementation effort succeeded because the agency had to have funding, and it takes a strong campaign to get it in today's tight budget. The biggest constraint to a successful project implementation is long term tight budgets which kill the initiative to even try.

M34 - OBSERVATION

IMPLEMENTATION OF TRAFFIC CONTROL DEVICES–TRAFFIC CIRCLES:

The agency decided on the innovation because of Board of Supervisors direction and public input. The innovation is considered a success because it changed community perception of Department. Worked with community rather than against it.

M35 - OBSERVATION

Recommendations To Policymakers:

Keep it simple: We are not dealing with rocket science. Remember most of the nation's road network is *not* the freeway or interstate system. We have a backbone network of several county and local roads, a good portion of which was built around the turn of the century and which do not meet cement design or maintenance standards. These roads are often very expensive to maintain--but are very important to the local community.

TRANSPORTATION MANAGEMENT (T): OVERVIEW

In the 1990s, major targets for innovation in the management function for highways, streets and roads include using computers to make good use of information (Cases T1, T4, T10, T15 T18, T19), supervising quality control for contractors and internal operations (Cases T3, T8, T11, T16,), finance (Cases T9, T13), initiating new research and implementation efforts (Cases T5, T6, T14, T17) and other functions (Cases T2, T7, T12). The first 3 cases are highlighted.

Most people would agree that innovation is a major part of a manager's job. However, the consensus of the literature and of our respondents is that innovation imposed from the top often doesn't work. One proposal is for managers to encourage their employees to take risks and not punish staff for one failure. Naturally, managers must consider how to reconcile this principle with the pressures they feel for successful outcomes to every effort, along with their organizational cultures and their own management styles.

In some cases, an enthusiastic champion whose main tool is persuasion rather than command can play a key role. However, this seems to be have happened in only a minority of cases in this section (and in this sourcebook generally). In most instances, positive working relationships and awareness of new innovations by all staff ultimately set the stage for successful implementation.

T1 - HIGHLIGHT

Product or Process:

Bridge Management System (BMS)

Summary of Practices:

36 Incremental approach
14 Well-defined goals
1 Senior management support
10 Knowledgeable users
3 Champion
4 Big cost savings

Characteristics:

BMS is a computerized bridge maintenance system containing operational programs and a database of about 17,000 bridges, culverts and comparable structures in this department's state. The data cover all parts of the structure, including the approach roadway. Input to BMS includes average daily traffic (ADT) counts and global assessments of the condition of each bridge among other items. The system produces schedules and budgets for construction and maintenance work. The system also permits adjustment for changing total budgets or other changes in conditions.

Reasons for Implementation:

The state had to collect the data for federal requirements. Senior management saw this as an opportunity to improve programming and management!

Key Implementation Steps/Strategies:

An incremental approach over a period of years with well defined goals for each stage.

Chronology:

This began with a vision to optimize the use of systemwide bridge condition inventory data. The Department of Transportation started from scratch and contracted with a state university to begin the system. Initial research and development began in 1981 with the first of seven contract research studies. The software was developed by a professor and graduate students.

The initial inventory data was generated in the early 1980s and is constantly being updated. Limited data analysis trials were done in 1985. The initial series of schedules and budget allocations was generated in 1989. This kind of system was mandated for all states by January 1, 1995 by ISTEA. This one has been fully certified by the Federal Highway Administration. The incremental approach has served to build confidence and acceptance.

The state bridge maintenance engineer was and is the main champion for this innovation. The director of research approved and supported the program. Top management was completely supportive of the incremental approach. The program

pioneered the bridge management system, and it was an enormous undertaking. Once approval was given for the initial project in 1981, management and staff never again had to jump through a lot of hoops to keep it going.

During the initial development the bridge maintenance division had very little personnel turnover. Additionally, top Department of Transportation management consisted of engineers who had worked their way up the ranks. Headquarters and field bridge maintenance staff were kept informed of the program. The maintenance staff made several useful suggestions, most notably to enhance the collection and quality of data.

Implementation of BMS received relatively little feedback from the press and public. However, one newspaper story in the early 1990s helped the bridge maintenance division receive more funding from the state legislature. It is thought that funding was still not adequate to replace all the bridges that were built in 1920s and meet other outstanding needs.

This system has been described or cited in numerous publications, including *Better Roads* magazine, research publications of the state university and federal regulations. The DOT has received about 50 requests for its documentation.

Results:

The system is fully implemented. Most of the software maintenance is done by a team of two people, one of whom is an engineer, the other is a computer programmer. The main frontier in terms of improving the system is to integrate it with systems for safety, pavement management and congestion. Preliminary research on this has been done.

The system has produced tremendous benefits. It continues to save a great deal of construction and repair expenses, and drivers have directly benefited from fewer detours required by construction. Finally, the improved condition of the bridges has reduced accidents.

Recommendations:

To Users:

Major commitment from responsible managers and key technical people is required from the beginning. Implementation goals must be established as early as possible, preferably before the start of formal research.

To Researchers:

(1) Keep formal research efforts on schedule. (2) Use and iterative approach throughout the formal phases of investigation to evaluate the incremental results.

To Policymakers:

Policymakers and decision makers need to be informed on a regular basis of the status of specific research implementation measures. Unfortunately, this type of interaction is not nurtured in a systematic way in many states.

State Jurisdiction

T2 - HIGHLIGHT

Product or Process:

Incident Management Program

Summary of Practices:

1 Cooperative relationships with other agency, university and state legislature
5 Pilot project
3 Champions
9 Involvement of researcher and user throughout effort
15 State legislature funding
1 Top management support

Characteristics:

This program, primarily oriented toward rush hour incidents, has several components: (1) Incidents are detected through sensors, closed circuit TV and citizen call in;. (2) The Department of Transportation response team, and their vehicle, can direct and control traffic and perform other functions, such as pumping spilled diesel fuel. (3) Traffic Control Center disseminates information using variable message signs, traffic reporters, links to major employers and the Internet. (4) Tow trucks are stationed on two of the major traffic bottlenecks for rapid response.

Reasons for Implementation

The state has been working on traffic congestion in the largest city, and in other cities, for many years. The Department of Transportation saw a need to address and improve incident response in a systematic way.

Key Implementation Steps/Strategies:

Cooperative relationships with other organizations, including the state university, the Highway Patrol and the state legislature.

Chronology:

In the late 1980s the DOT looked at incident management programs in other cities and decided to develop their own program. The program was conceived and expanded incrementally. One early pilot project involved deploying a 1-person 1-vehicle (not a tow truck) incident response "team". This person did whatever was necessary, including putting down flares and nudging disabled vehicles off the roadway. Another pilot project involved extensive availability of tow trucks during a special event.

The department has a very close relationship with the state university. Since 1987, department staff have been assigned to work on campus with university researchers on several areas. This program is one of the fruits of that policy. One professor and several graduate students drafted guidelines and addressed problems during program development and implementation.

The state legislature was very supportive with funding during the critical stages of implementation. There was no single champion; the commissioner of transportation and many managers all played important roles. The state patrol plays a critical role because they are usually the first ones to hear of an incident. DOT maintenance staff are also involved, particularly with responding to incidents during off hours.

The program was expanded every two years, sometimes more often. Since inception, the geographic area covered was greatly expanded, and similar programs are in place in several other cities. The Federal Highway Administration (FHWA) cited the program as a model for other departments of transportation. There has been some press coverage.

Currently the goal is to accelerate response to less severe incidents and deploy roving tow trucks. There are issues of who controls this round of expansion as well as budget issues.

Results:

This program covers a wide area, and is heavily used. In the recent past, the 2 special tow trucks made 2400 calls annually. On average, there is about 1 incident per day that requires the complete incident response program. It was noted that the program has kept the traffic from getting worse in this growing city.

Recommendations:

To Users:

Development must be based on needs. Users must be involved in development/implementation. Investigate others' programs, but tailor to local needs. Implement through pilot projects. Show results to assure funding support.

To Researchers:

Involve users throughout the process. View users as customers. Include them as members of a research team. Develop strong documentation and training.

To Policymakers:

Implementation must be top down (for organizational support) and bottom up (for assuring the product will meet users' needs and will be successfully implemented).

Local Jurisdiction

T3 - HIGHLIGHT

Product or Process:

Mechanic Career Ladder

Summary of Practices:

2 Close communication between management and users
9 Users participation in decisionmaking/feedback
16 In-house expertise
22 Multi-department approvals

Characteristics:

In this city, many mechanics are hired as Mechanic Helpers. Based on their expertise and productivity, a career ladder program enables them to rise to Mechanic I, Mechanic II and Senior Mechanic. This city has about 110 mechanics, who maintain a fleet of about 3400 vehicles, including ambulances and boats.

Reasons for Implementation

The city had higher mechanic staff turnover than thought appropriate. Very qualified mechanics couldn't move up because there weren't any openings at the next level. They got frustrated and left the employ of the city.

Key Implementation Steps/Strategies:

Close communication between management and mechanics. When adjustments are needed, the mechanics participate in the decision making process.

Chronology:

This program was suggested in 1985 and implemented in 1986. Major adjustments were made in 1991, and the program continues. The career ladder concept was primarily worked out within the department, and approval was secured from the Human Resources, Legal and Financial departments and from the City Manager. The union local provided input and approved the change.

All mechanics became eligible for advancement when the program was implemented in 1986. Only a small percentage were promoted the first year. By now, about half have been advanced; this includes staff who have gone from being Helpers to Senior Mechanics within a few years.

The mechanics were involved in the development and implementation of the program. They have provided very positive feedback. There is a committee of 9 mechanics who represent the entire group to management. This committee meets regularly and has met with management many times over the years.

Within the city administration the program is perceived positively. Other departments in the city have expressed interest in doing something similar. The department gave them copies of the Fleet Policy and Procedures Manual. It is thought that a few other agencies have tried to implement comparable programs, but the degree of implementation is not known.

In 1991, a formal grievance process was implemented, and more documentation was required for the promotions. However, as before, it is up to the mechanic's own initiative to apply for advancement. The Fleet Operations manager did not hold that position when the program was implemented, but this person considers himself to be the program's champion today.

Recommendations:

To Users:

Communicate, communicate, communicate. If people don't understand, you will have problems implementing.

State Jurisdiction

T4 - DESCRIPTION

Product or Process:

Computer system--the group effectively used a network system.

Summary Practice Codes: 11, 13, 8, 3, 2

Characteristics:

The project leader supported this vision and championed its implementation--he made it a common goal. Did not know where this new product originated, but learned about it from vendors, consultants, contractors, through informal interaction with others, and from conferences, workshops, etc.

Reason for Implementation:

The agency decided on the innovation to do "more with less". The agency saw the need to automate, since expanded stuff is not likely. The agency also felt that communication is critical; this enhances communication.

The product is considered a success because the agency now has an operating, effective network system. Things are better than they were before.

Other agencies have learned about this implementation success through communication--discussion with co-workers (not vendors) gets the word out.

Key Implementation Steps/Strategies:

The implementation effort succeeded because, once training was provided, people saw that it could benefit them in their everyday work (not just a few "privileged characters"). Quick successes reinforced the feeling that everyone can benefit and contribute.

Recommendations:

To Users:

(1) Be patient. (2) Perform controlled tests and document results. (3) Participate in funding projects. (4) Assume liability where questions persist. (5) Follow up. (6) Adopt an integrated approach.

To Policymakers:

Encourage innovation. Top management needs to foster an environment of risk-taking and indemnify employees if "it doesn't work".

State Jurisdiction

T5 - DESCRIPTION

Product or Process:

The planning, design, and construction of a new state-of-the-art pavement research facility, which was the manifestation of previous research project recommendations.

Summary Practice Codes: 14, 8, 1, 3

Reason for Implementation:

The agency decided on the innovation because current pavement design methods were based on AASHTO Road Test results from 35 years ago. Heavier loads now prevail, plus climate differences exist and instrumentation is now available to develop mechanistic design procedures.

The innovation is regarded a success because it is a unique facility, developed via numerous committee processes involving hundreds of experts, but done via technical commitment and leadership to forge required partnerships.

Other agencies have learned about this success because extensive marketing has been done at the international level via conferences, technical displays, publications, videos, media events, and annual project conferences.

Key Implementation Steps/Strategies:

The implementation effort succeeded because of the project complexity (e.g., numerous sensor systems, communications, etc.) and detail changes required flexibility and adaptations. Unresolved details were resolved via a construction stage partnering process commitment.

Recommendations:

To Users:

For large projects, partnerships help provide the breadth and depth of skills needed. Also, prior thought and agreement on measurable goals will help focus on implementation decisions and results.

To Researchers:

Incorporate implementation and evaluation elements in the project planning phase processing.

To Policymakers:

Responsibility for implementation follow through must be clearly identified and monitored by a second agent with oversight and reporting responsibility to ensure integrity of the program evaluation.

T6 - DESCRIPTION

Product or Process:

Research implementation--Executive Management hears research results, identifies div/office to be responsible for implementing and charges them with implementation.

Summary Practice Codes: 9, 22, 14, 9, 16, 23

Characteristics:

The new process originated in-house (and from the research task force from across department and outside parties involved--may be done in-house or through consultant). The agency learned about this process from conferences, workshops, etc., from vendors, consultants, contractors, from professional/trade associations, through informal interaction with others, through research reports and journals, from Local Technical Assistance Program dissemination, and from department-wide solicitation of ideas.

Reason for Implementation:

The agency decided on the innovation because the problem is identified, studied (in-house or with consultant) with recommendations given to Executive Management--All is done on a research panel/task force representing all attacked parties, both within the department and outside, if relevant.

The innovation is considered a success because of cross agency involvement choosing knowledgeable/productive consultants, when needed, to work with internal expertise.

Other agencies have learned about this success from project ideas, selection progress reports, and final recommendations and actions which are circulated throughout the department.

Key Implementation Steps/Strategies:

The implementation effort succeeded because of broad-based participation throughout the process of offering ideas through implementation.

Recommendations:

To Users:

Get involvement of all affected parties (or reps. of all areas). Select people who are respected by their co-workers. Don't look at the problem within just it's area--but across enterprise.

To Researchers:

Good participation (solicitation of ideas, inputs, criticism, etc.) in the total process. Also keep Management informed--so they don't have surprises or complaints from others that they are not equipped to handle.

To Policymakers:

Develop a process of review, recommendation, and action with management. If management helps to develop the process they will understand and support it.

State Jurisdiction

T7 - DESCRIPTION

Product or Process:

Road damage methodology which has been used by other state transportation agencies, universities, etc., to assess the impact of rail abandonment on roads.

Summary Practice Codes: 8, 16, 32

Characteristics:

The process originated in-house. The agency learned about this process because it was needed by the DOT.

Reason for Implementation:

The agency decided on the innovation because it was needed at a time when the state was faced with a lot of potential rail abandonments.

The innovation is regarded a success because it has been used outside the DOT and has been cited in many research publications as a successful methodology.

Other agencies have learned about this success mostly through the Federal Railroad Administration, US Department of Transportation and Transportation Research Board (TRB).

Key Implementation Steps/Strategies:

Recommendations:

To Users:

Hire competent people who can "complete" the transfer. We need more researchers, not research administrators.

To Researchers:

Research publications from the Transportation Research Board and the Transportation Research Forum, etc., have done their job well as far as documenting new products and processes. What are needed are in-house researchers who have the expertise to "complete" the transfer and make the process useful to his/her agency.

To Policymakers:

Document successful implementation for wider readership.

State Jurisdiction

T8 - DESCRIPTION

Product or Process:

Hot Mix Asphalt (HMA) Quality Control/Quality Assurance (QC/QA) Implementation--requires contractor to do his own quality control on Hot Mix Asphalt production.

Summary Practice Codes: 1, 15, 14, 36, 20, 16

Characteristics:

The surveyed employee did not know where the process originated. The agency learned about this new process from conferences, workshops, etc., from research reports and journals, and through informal interaction with others.

Reason for Implementation:

The agency decided to implement this process because QC/QA removes both existing and future problems which result from the department both controlling Hot Mix Asphalt (HMA) production and then accepting the mix on the job site.

The innovation is regarded a success because analysis has shown significant improvement in variability of Hot Mix Asphalt (HMA) mixes compared to the previous method, and there was a relatively smooth transition through the fourth year of the 5-year implementation plan.

Other agencies have learned about this success from a talk at a Federal Highway Administration (FHWA) seminar, from informal discussions at various conferences, and from telephone conversations with other state Departments of Transportation.

Key Implementation Steps/Strategies:

The implementation effort succeeded because of upper management support, funding, clear goals, an incremental approach, industry participation in program development, strong technical staff, and continued evaluation/adjustment of the program.

Recommendations:

To Users:

Do the following: upper management support, funding, clear goals, an incremental approach, industry participation in program development, strong technical staff, and continued evaluation/adjustment of the program.

State Jurisdiction

T9 - DESCRIPTION

Product or Process:
Cash flow forecasting model.

Summary Practice Codes: 9, 8, 42

Reason for Implementation:
The agency decided on the innovation to replace old processes and prevent future problems.

The innovation is considered a success because the original model was implemented in 1983 and the agency has revised it several times ... It remains alive.

The surveyed agency employee did not know whether other agencies have learned about this success.

Key Implementation Steps/Strategies:
The implementation effort succeeded because of the long-term close working relationship between the research division and the user of the research.

Recommendations:

To Users:
Strong user/researcher relationship is a key. Stakeholders must be made a part of the research process the entire way.

To Researchers:
Work closely with the customer. Remember that the product is *NOT* a report.

State Jurisdiction

T10 - DESCRIPTION

Product or Process:
Geographical Information System.

Summary Practice Codes: 25, 9, 12

Characteristics:
The agency employee did not specify where the product originated. The agency learned about this new product from conferences, workshops, etc., from vendors, consultants, contractors, from professional/trade associations, and through informal interaction with others.

Reason for Implementation:

The agency decided on the innovation to implement/utilize state-of-the-art technology that reduces time and provides information displayed on a rational database.

The innovation is considered successful because implementation, near completion, will be used statewide within department and local transportation agencies.

Other agencies have learned about this success from a feasibility study report.

Key Implementation Steps/Strategies:

The implementation effort succeeded because industry knowledge of a product made many aware and eager to implement it. Involvement of others early-on that would be users later. Receptiveness of needs of other disciplines was critical.

State Jurisdiction

T11 - DESCRIPTION

Product or Process:

Established a quality control/quality assurance process for asphalt paving.

Summary Practice Codes: 8, 31, 3, 2, 9

Characteristics:

Organized a user/producer group, developed a strategic plan (work plan) and assigned a champion with responsibility. Tracked the process on a monthly basis.

Reason for Implementation:

The agency decided to implement this innovation to improve the quality of asphalt pavements. There was a definite need!

The innovation is considered a success because the final process resulted in better asphalt pavements and the same process has been used successfully on many other projects.

Other agencies have learned about this success through committee work with AASHTO and the organization of a regional asphalt user/producer group.

Key Implementation Steps/Strategies:

The implementation effort succeeded because there was a demonstrated need. All major users and producers involved were sold on the need and were actively involved in the development and implementation of the final product. YOU NEED A CHAMPION(S)!

Recommendations:

To Users:

Involve users in the research process and cause researchers to stay involved during the implementation process.

To Researchers:
Involve users in the research process.

To Policymakers:
A cost/benefit ratio is normally developed for all implemented research.

State Jurisdiction

T12 - DESCRIPTION

Product or Process:
The development and implementation of a network pavement management system (PMS).

Summary Practice Codes: 6, 23, 24, 7, 12

Reason for Implementation:
The agency decided on the innovation because the Federal Highway Administration (FHWA) required this system to be implemented.

The innovation is considered a success because, for an agency which had no formal PMS, the development and implementation of such a system required many changes of doing business as usual.

Other agencies have learned about this success from meetings with other PMS experts in other Departments of Transportation.

Key Implementation Steps/Strategies:
The implementation effort succeeded because: (1) Consultant on site. (2) Visits to other states. (3) Software that works in your shop. (4) Results from system.

Recommendations:

To Users:
Research and know what is available in the field of interest.

To Researchers:
Be attuned to users and provide the needed technology.

Local Jurisdiction

T13 - DESCRIPTION

Product or Process:
Bus tube pilot program.

Summary Practice Codes: 2, 13, 15, 5, 9

Characteristics:

The new process originated in a consortium of organizations. The agency learned about this process from conferences, workshops, etc., from professional/trade associations, and from government organizations.

Reason for Implementation:

The agency decided on the innovation to test new technology, to provide additional transit service, and as a cooperative venture with other city.

The innovation is considered a success because implementation was quick and efficient, many parts of the agency worked together efficiently, and people utilized and enjoyed the service.

Other agencies have learned about this success from brochures, reports, and papers.

Key Implementation Steps/Strategies:

The implementation effort succeeded because of teamwork, people liked the innovation, it was a unique type of service, bus service was free, and an outside organization provided financial support.

Recommendations:

To Users:

Ensure that potential users have input--so they get the services they want. The project should have a "user-friendly" design and public information documents prior to implementation. Ensure that the agency is committed and unified to support the project.

Local Jurisdiction

T14 - DESCRIPTION

Product or Process:

Transportation Bond Program approved by voters on 11-5-91 (month before the Intermmodal Surface Transportation Efficiency Act (ISTEA)) for $175 M.

Summary Practice Codes: 2, 22, 14, 8, 6

Characteristics:

Included $20 M for intersections and traffic signals plus $4 M for traffic management. Provides local funding for ISTEA matching. The new process originated in a consortium of organizations. The agency learned about this process from conferences, workshops, etc., from vendors, consultants, contractors, from professional/trade associations, through informal interaction with others, from research reports and journals, and from Local Technical Assistance Program dissemination.

Reason for Implementation:

The agency decided on the innovation because of a cooperative, inter-agency development of multi-modal transportation improvement program that greatly expanded upon more traditional mud-engineering (streets/bridges) program.

The innovation is considered a success because the process was new and timely, leading to a product unique to early employment of ISTEA funds.

Other agencies have learned about this success from professional meetings and word-of-mouth (e.g., Transportation Research Board (TRB), Institute of Traffic Engineers (ITE), Intelligent Transportation Systems (ITS)).

Key Implementation Steps/Strategies:

The implementation effort succeeded because of: (1) Involvement of all players (stake-holders). (2) Prior track record and elected leadership. (3) Timing with regard to ISTEA. (4) Communication and cooperation of multi-jurisdictional community. (5) Sound basis/fact and figures. (6) Luck.

Recommendations:

To Users:

Monitor the environment and political winds of change.

To Researchers:

Involve the users (stake-holders) in the research efforts. Offer a PPRP (Public/Private Research Partnership) in all phases of work/faster early deployment.

To Policymakers:

Invest in training, travel and technical expertise transfer. Encourage partnering among all players. Prior planning prevents poor performance--don't try to make a planning professional into a mud-engineer!

Local Jurisdiction

T15 - DESCRIPTION

Product or Process:

The city modified/re-engineered its process for evaluating new products.

Summary Practice Codes: 9, 1, 13, 4

Characteristics:

The agency now uses private consultants with work paid for by the manufacturer/supplier of the product being considered. The new process originated in-house. The agency learned about this process through informal interaction with others.

Reason for Implementation:

The agency decided on the innovation because their old process of product evaluation was done "in-house", but not effectively. The new process is much faster with little or no cost to the city (just administration of the process).

The innovation is considered a success because the previous process resulted in one new product review and approval in approximately two years. The agency now has nine products in some stage of negotiation, review, or ready for final decision. And the agency expects 3-5 new products approved per year after they are fully operational.

Other agencies have learned about this success from word-of-mouth from vendors/manufacturers who may be going through the agency's process.

Key Implementation Steps/Strategies:

The implementation effort succeeded because the partners (city and consultants) worked together with support from the administration to develop this new approach. Because vendors/manufacturers can see the benefit in shorter time to complete the process, they are usually willing to invest money in order to reduce the time until they can market the product for city/infrastructure work.

Recommendations:

To Researchers:

Researcher must be more concerned with the actual field process of the products vs. lab work.

Local Jurisdiction

T16 - DESCRIPTION

Product or Process:

Conversion of an older Geographical Information System (GIS) to state-of-the-art ARCInfo.

Summary Practice Codes: 10, 14, 2, 1

Characteristics:

The new process originated in private industry. The agency learned about this process from conferences, workshops, etc., from vendors, consultants, contractors, from professional/trade associations, and through informal interaction with others.

Reason for Implementation:

The agency decided on the innovation to solve capacity problems, reduce processing problems, and to provide greater accessibility by more staff and improve efficiency.

The innovation is considered a success because the GIS system in use prior to this application had been used only by the department for 8-10 years. After

implementation numerous cities and private entities began using the application and expanding its use.

Other agencies have learned about this success from a structured volunteer collaborative process, to which any interested parties were invited to participate.

Key Implementation Steps/Strategies:

The implementation effort succeeded because of: staying current with new technology, setting clear goals, developing a team approach, strong commitment from management, preparation of a detailed implementation plan, having regular progress meetings at all levels, and spreading the word when successfully completed.

Recommendations:

To Users:

Stay abreast of latest technology and best applications. Do full-blown demonstrations or pilot projects.

To Researchers:

Work directly with users during early development stages. Sponsor pilot projects for demonstration of applicability.

To Policymakers:

Stay current with new technology, set clear goals, develop a team approach, strong commitment from management, prepare a detailed implementation plan, have regular progress meetings at all levels, and spread the word when successfully completed.

Local Jurisdiction

T17 - DESCRIPTION

Product or Process:

Renegotiated contractor's bid according to engineer's estimates.

Summary Practice Codes: 34, 3, 20, 46, 3

Characteristics:

Rejected contractors' original bid and negotiated contract to be tracked as time-material with city to share the differential between time-material cost and the original low bid on a 50%-50% basis. If time-material cost exceeded the original rejected bid amount, the bid amount would act as cap to the contract. The new process originated in-house. The agency learned about this process through informal interaction with others.

Reason for Implementation:

The agency decided on the innovation because of time constraints placed on the original contract, along with limited soils knowledge.

The innovation is considered a success because it is very seldom that local agencies use cost incentives in a construction contract.

Other agencies have probably not learned about this success, since "this project has not been publicized".

Key Implementation Steps/Strategies:

The implementation effort succeeded because: (1) The city was in a time bind to meet other commitments. (2) Contractor wanted the project and felt he had bid it properly for the soil conditions. He was willing to share any lost saving with the city if the conditions warranted. (3) The net effect was a spirit of partnering to accomplish the project.

Recommendations:

To Users:

Be alert to what is going on in your field via personal contact, going over trade literature, being aware of what other agencies are doing.

To Policymakers:

Most local agencies are not research and development oriented and normally rely on the state or large jurisdictions for this function.

T18 - OBSERVATION

Product or Process:

The state's ongoing project called "Implementation of Research Findings": The innovation is regarded a success because it is an ongoing process incorporating needs assessment, research, and implementation as part of the process. The implementation effort succeeded because of a standing committee with rotating members and permanent members with a focus on implementation.

T19 - OBSERVATION

Product or Process:

GIS

Recommendations To Users:

Be sure that you know what you want. Have a clear written plan and needs--don't do it yourself; ask others for their input.

T20 - OBSERVATION

Product or Process:

Computer and information systems including GIS: The agency decided on the innovation to effectively manage the City's infrastructure facilities. The innovation is considered a success because it has helped to continually satisfy (meet) the agency's mission with quality products at reduced costs. Along the way the agency developed future leaders. Other agencies have learned about this success from the agency's encouragement to employees to attend national and state conferences to publicize efforts.

UNSUCCESSFUL IMPLEMENTATIONS (U): OVERVIEW

Just as survey respondents (with the exception of executive level managers) were asked to select and describe an example of a particularly successful implementation effort, they were asked to do the same for an implementation attempt that did not go as well as hoped. Over a hundred survey participants provided us with information about unsuccessful implementations--either those that never came to fruition or those that did not yield the expected payoff for one reason or another. In the following section we present several of these examples, again staying as close as possible to the words of the respondents themselves.

The cited unsuccessful examples cover all four of the categories that were used to classify the successful cases, namely Construction and Materials, Design, Maintenance and Operations, and Management. The unsuccessful cases are not organized according to the four categories. In each instance, however, the innovation category is noted on the top line of the case.

Some of the unsuccessful examples are quite similar to those reported as successes by others, and in many instances, similar recommendations for improving implementation chances are suggested. Further, an innovation that was successfully implemented in one agency may have been the subject of a failed attempt in another. This finding underscores the important influence of context and implementation strategy on the eventual outcome. One notable example occurs with Geographic Information Systems (GIS), which have been of interest to transportation agencies for a number of years. GIS was implemented successfully in several agencies and cited in examples earlier in this report. However, it was also the described as the most significant failed implementation attempt by others. We represent this and several other illuminating examples in the following section.

State Jurisdiction

U1 - DESCRIPTION

Product or Process:

Asphaltic and bituminous materials--The department has implemented the use of crumb rubber in Asphaltic Concrete Pavement.

Characteristics:

The new process originated in-house. The agency learned about this process from professional/trade associations.

Reason for Implementation:

The agency decided on the innovation because, due to legislative mandate, tire rubber was to be recycled and used in 10% of the agency's construction projects. The use of crumb rubber in ACP seemed the most efficient way to meet these goals.

The innovation is considered unsuccessful because crumb rubber was being included in all types of ACP mixes without conferring with other states about their experiences with the material.

The agency has learned valuable lessons from this experience; although crumb rubber could not be used in all applications, it could be used in certain applications and mixes with success.

Key Implementation Steps/Strategies:

The implementation effort did not succeed because, industry had, in the past, used recycled rubber in asphalt for seal coats and, in other states, Asphaltic Concrete Pavement. When the mandate was set requiring the use of recycled rubber, the agency should have contacted other agencies or industry to ask about their successes or failures with these types of mixes. These mixes were then applied in large quantities on high volume roadways with conventional methods, and failed. Contact with other agencies would have given the agency information to design a good mix and problems associated with it.

Recommendations:

To Users:

When a new product or process comes in, contact other agencies about their findings with regard to the new product before starting researching and implementation.

To Researchers:

Periodic newsletters to divisions and districts updating the status of new products/processes would be helpful. Also, a listing of all new products/processes submitted to the agency regardless if implemented or not, could be of interest to individuals who might have an idea of how to improve the product or have a different implementation for it.

U2 - DESCRIPTION

Product or Process:

Effort to implement a Lab Information Management System which would log, track, do calculations, state and report on Lab test samples.

Characteristics:

The new process originated in private industry. The agency learned about this process from vendors, consultants, and contractors.

Reason for Implementation:

The agency decided on the innovation to reduce costs/staff through electronic tracking, storage, and reporting of lab testing. The old systems were cumbersome and labor-intensive.

The innovation is considered unsuccessful because the agency "went cheap", the goals were not well-defined, it was an unorganized implementation effort, and it was the wrong product for this application.

The agency has learned valuable lessons from this experience: know what you want to accomplish, then buy the right product, not the cheapest one.

Key Implementation Steps/Strategies:

The implementation effort did not succeed because the project should have been abandoned when the investment was minimal. At that point a suitable system could have been pursued. Every effort since then has been to make an inadequate system perform "good enough". In short, it was the wrong system and should have been abandoned.

Recommendations:

To Users:

Let the technical people have free hand to make recommendations. Management should consider taking tolerable risks.

To Researchers:

There are good processes for technical transfer. Use them all.

To Policymakers:

Let the technical people have free hand to make recommendations. Management should consider taking tolerable risks.

U3 - DESCRIPTION

Product or Process:

There was an attempt to develop a "user-friendly, state of the art" interface for a database containing large amounts of research data from pavements.

Characteristics:

The new process originated at a university. The agency learned about this process from a contract with the university to develop the product.

Reason for Implementation:

The agency decided on the innovation because they were developing a large and complex data base for pavement research and they wanted the researchers to be able to quickly and easily access and analyze large amounts of data. At the start of the project the agency was not aware of any tools that could do the job.

The innovation is considered unsuccessful because the end-users did not use the interface. The new interface was state-of-the-art but had some problems that drove the users back to the tried-and-true tools--spreadsheets and writing programs for reports.

The agency has learned valuable lessons from this experience: timing is everything. As the interface development came to a close and the market had tested and supported tools of a similar capability as what the agency had tried to develop.

Key Implementation Steps/Strategies:

The implementation effort did not succeed because timing is everything. But good timing needs to be based on more than luck. It needs to be based on the end-users' needs, on knowledge about the state of the market, on the interests and abilities of product developers, and on knowledge about what the future directions of a market will be.

A university is not a good environment to develop, implement, and support a large, complex production-oriented computer system.

Recommendations:

To Users:

Implementation needs to be considered (as much as possible) at the beginning of a research project. Project evaluation needs to occur, also starting at the beginning but also followed up on during the project and after implementation.

To Researchers:

Improved and more frequent interaction between researcher and user is important. Facilitated dialogue, site visits, etc.

To Policymakers:

Need to identify (as best we can) the anticipated, measurable outcomes from a research project. This will help to make better decisions about project selection and support the justification of research funding.

State Jurisdiction

U4 - DESCRIPTION

Product or Process:

GIS

Characteristics:

The new process originated in an unsolicited proposal. The agency learned about this process from vendors, consultants, and contractors.

Reason for Implementation:

The agency decided on the innovation because the proposal was submitted to an administrator or legislator.

The innovation is considered unsuccessful because the research was inadequately performed and documented by an independent agent.

The agency has learned valuable lessons from this experience. Unsolicited proposals need to be reviewed for basic ingredients including the destined user and implementor.

Key Implementation Steps/Strategies:

The implementation effort did not succeed because of lack of knowledge and interest in validity and reliability of results versus personal impression and testimony.

Recommendations:

To Users:

Involve research results users, responsible units, related units, key interested influential professionals, and key experienced professionals early in planning and milestone stages.

To Researchers:

Provide interim or early results or ask opinions about direction without more than 6 to 9 month intervals.

To Policymakers:

Support involvement of researchers and key technical professionals interested in innovation at Transportation Research Board (TRB) meetings.

State Jurisdiction

U5 - DESCRIPTION

Product or Process:

Used portable rumble strips--truckers' dislike made it impossible to keep them in service--they braked on the strips and destroyed them.

Characteristics:

The new process originated in private industry. The surveyed agency employee did not know where the agency learned about this process.

Reason for Implementation:

The agency decided on the innovation because they felt that rumble strips were needed and didn't want to scar pavement.

The innovation is considered unsuccessful because the intended user (traffic) didn't like them.

The agency has learned valuable lessons from this experience; trying to use rumble strips in a construction zone with heavy truck traffic is a waste.

State Jurisdiction

U6 - DESCRIPTION

Product or Process:

New guardrail designs.

Characteristics:

The new process originated in a consortium of organizations. The agency learned about this process from research reports and journals.

Reason for Implementation:

The agency decided on the innovation because somebody wanted to implement new technology.

The innovation is considered unsuccessful because it did not follow Rule 1: Use what will improve, not just what is new. The project was implemented because someone said we would implement it, not because the item was better.

Some individuals in the agency have learned valuable lessons from this experience, but the surveyed agency employee did not think that the agency did. "The goal is to implement NEEDED technology!".

Recommendations:

To Users:

Give it a good technical review. Products by suppliers need validation. If research papers, read the whole thing, not just the conclusion.

To Researchers:

Get users involved. University researchers need to do research because it is needed, not because they need tenure. Don't act like you know when you do not. To question is not stupid.

To Policymakers:

Quit trying to push innovation just to fill a quota. If management isn't getting new products implemented, check out your staff or qualifications of them, but skip the "I need new products implemented". Generally, people who like their jobs will produce because they feel that it is best for all, not because of some quota.

State Jurisdiction

U7 - DESCRIPTION

Product or Process:

Assumption of quality control responsibilities by contractors for asphalt concrete paving.

Characteristics:

The innovation originated from Federal Highway Administration (FHWA)/other state DOT's. The agency learned about this process from conferences, workshops, etc., and from Federal Highway Administration (FHWA) Implementation Efforts (Demo Projects).

Reason for Implementation:

The agency decided on the innovation because, as staff cutbacks continue, there are insufficient numbers of trained state personnel to perform the quality control function for the contractor.

The implementation is considered unsuccessful because the effort was undertaken without laying the groundwork to prepare contractors to take on this new responsibility. The agency's actions tended to be unilateral, and prejudice existed on both sides (state and contractor).

The agency learned valuable lessons from this experience. The total cost of the agency's quality assurance efforts plus the contractor's quality control efforts (as reflected through increased unit costs bid) exceeded costs for the current process.

Key Implementation Steps/Strategies:

The innovation really was unsuccessful because, as the expression goes, "It takes two to tango." A more apt description of this implementation would be a shotgun wedding. The powers that be wanted to make a big splash with this implementation and catch up fast to other Departments of Transportation that have been working in this area for years. That was a mistake. Industry needed to buy into this experiment wholeheartedly before the pilot studies began. A plan to slowly wean contractors from their dependency on state personnel for quality control feedback needed to be formulated by both parties and then followed. Going "cold turkey" did not work!

Recommendations:

To Users:

Before trying any new product, perform a "needs assessment". Do not waste resources evaluating a product if it is clear from the start that it will not be used, is not cost-effective, or poses safety or environmental risks.

To Researchers:

Each major phase of a Departments of Transportation operation should have a new product evaluation committee that includes members from the user districts.

To Policymakers:

One of the biggest barriers to the introduction of new products is finding the staff time and resources to evaluate the product and to change existing specifications. Traditional Department of Transportation resourcing practices are heavily weighted towards business-as-usual activities. True, there are mandated allocations for planning and research, but the results of these activities are too often "ivory tower" and non-inclusive of the user. A separate funding allocation from Federal Highway Administration (FHWA) for new product evaluation and implementation would permit resourcing of staff to perform the evaluations and get the specifications changed in a timely manner.

State Jurisdiction

U8 - DESCRIPTION

Product or Process:

Alternative fuels for traffic vehicles.

Characteristics:

The new process originated in the Department of Administration. The agency learned about this process from the Department of Administration.

Reason for Implementation:

The agency decided on the innovation for clean air and fuel conservation in the [City] area.

The innovation is considered unsuccessful because the concept was mandated and operators indicate that vehicles do not have good acceleration characteristics—a safety issue on high speed freeways.

The agency has learned valuable lessons from this experience; opportunities should be tested/developed, but users need to have related concerns properly addressed.

Key Implementation Steps/Strategies:

The implementation effort did not succeed because of a lack of open-mindedness and willingness to negotiate areas of difference.

Recommendations:

To Users:

Ensure that there is a process in place that measures the results of the product or process implementation. (Performance measures.) Poor/no follow-up kills/stifles other future efforts.

To Researchers:

Through national or regional resources like SHRP, LTAP, NTPEP. E-mail or Internet access to trade journals, data information, etc., would be great.

To Policymakers:

Obtain broad-based support. Means a considerable up-front effort in establishing the need(s) and how the product or process will meet that/those need(s). Good data/information.

State Jurisdiction

U9 - DESCRIPTION

Product or Process:

Temporary Traffic Signals to replace flaggers.

Characteristics:

The new process originated in private industry. The agency learned about this process from vendors, consultants, and contractors.

Reason for Implementation:

The agency decided on the innovation because it improves worker safety during flagging operations.

The innovation is considered unsuccessful because the equipment was more complicated to use than telling someone to go out and flag traffic.

The agency has learned valuable lessons from this experience; maintenance and contractor crew leaders are slow to change and acceptance of new technology.

Recommendations:

To Users:

Work closely with field personnel to clear up questions and misconceptions as quickly as possible.

To Researchers:

Same as above.

To Policymakers:

Field evaluations conducted by individuals that are willing to make the effort and not just to go through the motions to tell you what they think you want to hear.

State Jurisdiction

U10 - DESCRIPTION

Product or Process:

Efforts to implement innovative contracting procedures are not progressing fast enough.

Characteristics:

The new process originated on a European study tour. The agency learned about this process from conferences, workshops, etc., from professional/trade associations, and from research reports and journals.

Reason for Implementation:

The agency decided on the innovation to replace the existing low bid contracting process with a better one that focuses more on quality and consumer service.

The innovation is considered unsuccessful because it was only tried on a few jobs. It was not progressing fast enough to make a real difference.

The agency has learned valuable lessons from this experience: to be successful you need a strong "push" from upper management and you need industry "buy-in".

Key Implementation Steps/Strategies:

The implementation effort did not succeed because the advantages of trying the new technique were not well defined or well-documented, so the urgency to implement the innovation did not exist.

Recommendations:

To Users:

Define needs and objectives, strong management interest and "driving force", involve users and industry in implementation planning, assign responsibility for implementation and hold them to it!

To Researchers:

First, address significant needs. Involve end-users at "check points" during the research process. Always include a suggested implementation plan as part of the research report.

To Policymakers:

The key is to define champions in the organization who have the zeal and technical capability to drive the implementation of a specific product or process. Then,

give them the time, the resources, and the authority to make the implementation happen. Finally, track the status to ensure that milestones are met.

State Jurisdiction

U11 - DESCRIPTION

Product or Process:

Tire Noise Effect of Roadway Wear--project measured tire noise generated by various types and ages of pavements.

Characteristics:

The data was thought to be useful in Noise Abatement program. The new process originated as a joint effort between a university and in-house. The agency learned about this process from conferences, workshops, etc., through informal interaction with others, through research reports and journals, and partially from university development.

Reason for Implementation:

The innovation is not so much considered unsuccessful, as it is bad research. Pavement (paving) decisions are not based on noise characteristics. Tires are only one source of many, and measuring at the source (tire-pavement) disregards transmission loss and receiver problems.

The agency has learned valuable lessons from this experience; the approach to the project lacked identification of a real "problem", with an implementable product as a project goal. Need to state "problem" and garner support prior to commencing on the project.

Key Implementation Steps/Strategies:

The implementation effort did not succeed because the project was rapidly conceived and poorly thought through, and was not discontinued when "implementation problems" surfaced.

Recommendations:

To Users:

From project inception, have an implementation goal that all understand and agree with.

To Researchers:

Always have a committed "advocate" within the sponsoring agency who has the authority to implement.

To Policymakers:

"Field people know best--Listen to them!"

State Jurisdiction

U12 - DESCRIPTION

Product or Process:

Crack and Seal Pavement Rehab.

Characteristics:

The new process originated at a university and from reports from various Departments of Transportation. The agency learned about this process from conferences, workshops, etc., and from research reports and journals.

Reason for Implementation:

The agency decided on the innovation because many old concrete pavements needed rehab, but there was excessive cost to reconstruct them. The agency had the hope of retaining the pavement.

The innovation is considered unsuccessful because the results were highly variable, too many items were field decisions and could not be foreseen during design, and the effects of poor subgrade/locations could not be determined in advance.

The agency has learned valuable lessons from this experience. Need a much more controlled project selection procedure. Need a mechanism to allow reconstruction if the cracked pavement is too variable--This will not happen!

Recommendations:

To Users:

Implementation must be made a process with a feedback loop. It must also be rewarded. The fact is that implementation makes some projects run more slowly--there are always adjustments needed to the process.

To Researchers:

Include a specific technology transfer plan in the final report (i.e., Step 1: Pilot project: size, test sites, etc. Include monitoring. Step 2: Normal project use. Review of problems. Step 3: Project improvement).

To Policymakers:

"I am bombarded with conflicting info from suppliers (an example of a current no-win conflict is polymer and multi-grade asphalt)--I have no mechanism to sort out all the claims and complaints. I hope that PG asphalt grades will help, but then new suppliers will be muddying the waters on some other issues. The effect of all the supplier calls is to make me want to 'stick to the tried-and-true'."

Local Jurisdiction

U13

Product or Process:

Slurry sealing small to moderate-sized parking lots is problematic–A.C. overlay rolled in place is a better alternative to prevent ripping up the new surface.

Characteristics:

The new process originated in private industry. The agency learned about this process through informal interaction with others.

Reason for Implementation:

The agency decided on the innovation because they were slurry sealing many streets and also did a couple of small parking lots as part of the contract.

The innovation is considered unsuccessful because the slurry seal mix was somewhat unstable, possibly due to a record heat spell, thus causing curing problems in some areas.

The agency has learned valuable lessons from this experience; the agency will not use slurry seal in areas such as parking lots where high-use is found. They will overlay with A.C rolled in place.

Recommendations:

To Users:

Contact the people who will be maintaining the new product/process for their input prior to product implementation.

To Researchers:

The best way for the agency, in a small city, is through workshops (free) and presentations to professional organizations.

Local Jurisdiction

U14 - DESCRIPTION

Product or Process:

Implementation of a countywide GIS system.

Characteristics:

The new process originated in a consortium of organizations. The agency learned about this process from vendors, consultants, contractors, and from professional/trade associations.

Reason for Implementation:

The agency decided on the innovation because new maps were needed for re-appraisal and it was thought that money could be saved by combining mapping into one department.

The innovation is considered unsuccessful because the implementation period took 7 years instead of 3 years. Costs were twice as much as expected.

Recommendations:

To Users:

Because of sheer volume and in-house expertise the state transportation agency has to take the lead in new materials research. Smaller government agencies don't have staff or money to advance new materials.

To Researchers:

Smaller agencies don't have the built-in status quo and purchasing constraints, so they can react faster to simpler and cheaper innovations.

To Policymakers:

See above; competitive bidding requirements make it difficult to try innovative products.

Local Jurisdiction

U15 - DESCRIPTION

Product or Process:

Computer and information systems--GIS Development and Implementation.

Characteristics:

The new process originated in another public agency. The agency learned about this process from conferences, workshops, etc., from vendors, consultants, contractors, and from research reports and journals.

Reason for Implementation:

The agency decided on the innovation because the agency attempted to consolidate and standardize information management systems by a GIS system.

The innovation is considered unsuccessful because there were inadequate funds and trained personnel.

The agency has learned valuable lessons from this experience; the development stages were very valuable, but implementation problems and funding became a problem.

Key Implementation Steps/Strategies:

The implementation effort did not succeed because of a poor understanding of the program objectives where the agency members "operate" but do not "co-operate".

Recommendations:

To Users:

An agency should have a good understanding of the condition and environment of a new product or process they will encounter. Do not over-extend the limits of the product.

To Researchers:

Participate in demonstration projects; join and participate in professional public works organizations; provide an incentive to users; i.e., discounts, coordination of project, follow up inspections and assessments.

To Policymakers:

Have patience and realize several techniques may be required for an agency to achieve maximum benefit when implementing new transportation innovation.

Local Jurisdiction

U16 - DESCRIPTION

Product or Process:

Automation of a particular customer service area.

Characteristics:

The new process originated in-house. The agency learned about this process from conferences, workshops, etc., and through informal interaction with others.

Reason for Implementation:

The agency decided on the innovation to replace old products/processes.

The innovation is considered unsuccessful because: (1) Implementation efforts were not well organized. (2) Personnel, especially Supervisors of the W.W.II Vintage. (3) The agency "must have brought in 'Star Trekkies' earlier into this organization".

The agency has learned valuable lessons from this experience; you can't teach some old dogs new tricks, but the old dogs are very valuable in other ways; use them.

Key Implementation Steps/Strategies:

The implementation effort did not succeed because more and more it has become very important to find out or pay attention to employee "values". In most cases we must let them experiment a little; accept their mistakes in the early stages of implementation.

Recommendations:

To Users:
Open organization. Respect employees. Tell them you have not hired a body but a bubbling brain!

To Researchers:
Get the users involved in early development.

Local Jurisdiction

U17 - DESCRIPTION

Product or Process:
Most of the tested work has had good results. When working with state or federal agencies these projects are not fundable. Therefore, the agency had no choice but to not use their tested ideas unless they have been well tested over the years by the Federal Highway Administration or Department of Transportation.

Characteristics:
The new process originated in private industry and in a consortium of organizations. The agency learned about this process from conferences, workshops, etc., from vendors, consultants, contractors, from professional/trade associations, through informal interaction with others, and from research reports and journals.

Reason for Implementation:
The agency decided on the innovation to find new methods or products that give more value for the tax dollars.
The agency has learned valuable lessons from this experience; in using products and finding, on a small scale, that they don't provide what a vendor stated, the cost is minimal, plus, there may be a side benefit not thought about at the beginning.

Key Implementation Steps/Strategies:
The implementation effort did not succeed because of a lack of training of personnel in proper methods, the contractor losing money/cutting corners, and the vendor (asphalt supplier) supplied a sub-standard product.

Recommendations:

To Users:
State and federal agencies should extend their projects to test quality products and participate by paying their share.

To Researchers:
By the use of LTAP or T^2 agencies in their states. Seminars would help.

Local Jurisdiction

U18 - DESCRIPTION

Product or Process:

Attempted to furnish contract inspectors with cellular telephones for improved communication/interface with "service" contractors working many sites/locations concurrently.

Characteristics:

The new process originated in-house. The agency learned about this process through informal interaction with others.

Reason for Implementation:

The agency decided on the innovation to improve day to day communication with privatization contractors working on vital operations daily, i.e., tree trimming and potholes repair throughout entire county.

The innovation is considered unsuccessful because of the failure of agency administration to support the program by removing funding.

The agency has learned valuable lessons from this experience; the agency learned that using the cellular phones to communicate with vendors works well but are still regarded by some Executive Managers as "toys" rather than productivity enhancing tools.

Key Implementation Steps/Strategies:

The implementation effort did not succeed because in the push to privatize work, communication between the agency and contractor is essential. The cellular phone filled this communication gap. Unfortunately there are still those who view cellular phones as toys. But, "basically our efforts worked well."

Recommendations:

To Users:

Seek the assistance and advice of vendors manufacturers.

To Policymakers:

Governmental regulations, both state and local, frequently inhibit innovation and change. While intended to promote economy and accountability they frequently contribute to inefficiency and higher cost by making "innovation" too hard to do.

Local Jurisdiction

U19 - DESCRIPTION

Product or Process:

Van pools, ride share have high cost and little if any benefits.

Characteristics:

Tracking, incentives, etc., have high cost, yet still end up paying for parents to drive kids to school in the wrong direction as a carpool participant. The new process originated at AQMD. The agency learned about this process from regulations.

Reason for Implementation:

The agency decided on the innovation to meet regulations set down by the Air Quality Management District.

The innovation is considered unsuccessful because there are more miles driven by carpools and vans, but incentives are given for participation. Excess time spent in tracking and reporting.

The agency has learned valuable lessons from this experience; incentives must be closely checked to ensure that the ultimate goal is achieved, not just compliance with the law.

Recommendations:

To Researchers:

Work on contractors to learn a new process, and offer it at a cost advantage to users.

To Policymakers:

More of what works–less of what does not. Fewer mandates–more incentives.

Local Jurisdiction

U20 - DESCRIPTION

Product or Process:

The agency's attempts to create a computer-based maintenance management system (to include work control aspects) was a complete failure.

Characteristics:

The new process originated in-house. The agency learned about this process from in-house identification of a problem and realization that commercial products must exist that could solve it.

Reason for Implementation:

The agency decided on the innovation to solve an existing problem. The Department receives approximately 25,000 maintenance-related work requests each year, but does not employ computer automation to track or manage the work load.

The innovation is considered unsuccessful because of research by data automation officials in County which failed to identify commercial work management programs that could be used with little or no modification. There was no funding to support the effort and insufficient personnel to staff the function.

Recommendations:

To Users:

Encourage an organizational culture that searches for new ideas and methods. Reward initiative that attempts to effect change.

To Researchers:

There must be a much better effort made to make agencies more aware of new ideas, equipment, methods. Professional journals work well, but it is not enough.

To Policymakers:

Do a better job of getting the word out. New ideas are not any good if no one knows about them.

U21 - OBSERVATION

RESILIENT MODULUS OF SUBGRADE FOR DESIGN PURPOSES:

The innovation never got off the ground due to lack of reliable test protocol.

U22 - OBSERVATION

CRASH ATTENUATION BARRIERS:

The innovation is considered unsuccessful because crash barriers are hard to evaluate cost-effectively and very difficult to field evaluate. Unless there is a perceived need that existing barriers are adequate, it is hard for decision makers to change policy to more expensive barriers. Due to liability, most people do not want to change unless national standards are changed.

U23 - OBSERVATION

PLUSSRIDE RUBBER ASPHALT PAVEMENT WAS NOT SUCCESSFULLY IMPLEMENTED IN THE STATE:

The implementation effort did not succeed because the basic cause of failure was that the vendors did not understand their own product. Trial section after trial section was put down across the U.S. with some successes, but many failures. The vendors did not understand what was happening to their product that led to success or resulted in failure. Also, the cost of the product was double that of conventional asphalt pavement. The trial sections provided no evidence that the service life of the PlusRide pavement was any longer than conventional pavement.

U24 - OBSERVATION

IMPLEMENTATION OF SPRING LOAD RESTRICTIONS:

The innovation is considered unsuccessful because it was not well accepted by the field (they were under-represented on the research panel). The innovation required extra work from field personnel; efforts may be technically unreliable.

U25 - OBSERVATION

RAPID TEST METHOD FOR ASPHALT CONTENT:

The innovation is considered unsuccessful because the method was never fully implemented due to resistance from the users and a weakening of support from upper management, compounded by technical problems that could/should have been solved before implementation.

The agency learned valuable lessons from this experience; researchers learned to involve users from the beginning and to get the process/product right before attempting implementation.

U26 - OBSERVATION

DEPARTMENTAL IMPLEMENTATION OF GIS:

The agency decided to implement the innovation because the database management advantages of GIS are well-documented and everyone seems to see the benefits, but they fail to recognize how to share data. "I have to be separate because..."

The innovation is considered unsuccessful because both implementation efforts were not organized, nor were the proper resources selected. Many resources were used, but not managed or planned.

The agency did not learn any valuable lessons from this experience. "We are still fighting any and all corporate data systems because of the 'I lose control' mind set."

U27 - OBSERVATION

AUTOMATED SNOW PLOW TRUCK ROUTING-OPTIMIZATION:

The implementation effort did not succeed because: (1) The vendor system proved to be technically insufficient to meet-address the agency's operational philosophy. (2) The agency was pretty much left on its own to determine how to apply software to many unique operational situations.

U28 - OBSERVATION

PAVEMENT REHABILITATION MANUAL:

The implementation effort did not succeed because there is no internal technology transfer unit in [State] Department of Transportation. In less than desired or more obscure projects, someone must push and track implementation. [State] Department of Transportation is decentralized into eleven districts, and technology transfer does not happen in a lot of them simply because no one ensures that it will happen.

U29 - OBSERVATION

Scour monitoring devices: The agency decided on the innovation to detect scour problems that could lead to foundation failures.

The innovation is considered unsuccessful because the device was not field tested and its relative cost was high.

U30 - OBSERVATION

THE STATE'S FLEXIBLE PAVEMENT DESIGN SYSTEM:

The implementation effort did not succeed because researchers did little documentation during development, so bugs in the system were hard to find and eradicate. Turnover at the university, especially grad students, resulted in lost knowledge/experience on how the system was put together.

U31 - OBSERVATION

A NEW PAVEMENT MIX DESIGN:

It *appears* that the technical limits of the mix design were not respected (for economic, political, and other reasons) so it was pushed until it failed--sort of a 'Peter Principleí of technology.