

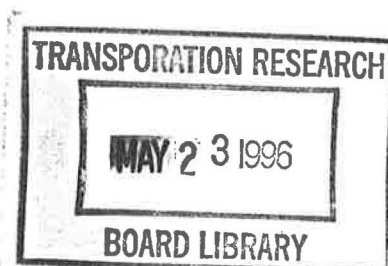
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**CIRCULAR**

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**Conduct of Research  
&  
Technology Transfer  
Workshop Proceedings**



**CONDUCT OF RESEARCH  
&  
TECHNOLOGY TRANSFER  
WORKSHOP PROCEEDINGS**

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The **Transportation Research Board** is a unit of the National Research Council, which serves as an independent advisor to the federal government on scientific and technical questions of national importance. The Research Council, jointly administered by the National Academy of Sciences, the National Academy of Engineering, and the Institute of Medicine, brings the resources of the entire scientific and technical community to bear on national problems through its volunteer advisory committees.

## FOREWORD

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Administrative issues that relate to the Conduct of Research and Technology Transfer procedures were discussed in a July, 1996 workshop sponsored by the two TRB committees associated with these topics. Four topics were addressed which represent primary areas of concern for administering research and technology transfer activities within transportation agencies. This Circular outlines specific follow-up actions.

Topics and specific issues addressed during the workshop are as follows:

- Bridging the Gap Between Research and Implementation
  - Management in the Implementation of Research Findings and Results*
  - Bridging the Gap Between the State of the Art and the State of the Practice*
- Measuring the Effectiveness and Benefits of R, D, & T<sup>2</sup>
  - Benefits vs. Effectiveness*
  - Measuring the Value of "Failures"*
  - The Complexity of Research Evaluation*
  - What are the Value Expectations? What Measures are Convincing?*
  - Canada Study Example*
- Cooperative Efforts with the Private Sector
  - Models of Successful Public/Private Partnerships*
  - Procedures for Developing Partnerships*
  - Barriers to Partnerships*
  - Private Sector Involvement in Research, Development, and Technology Transfer*
  - Modal Balance in Research, Development, and Technology Transfer Activities*
- Marketing the R, D, & T<sup>2</sup> Program
  - Marketing the R, D, & T<sup>2</sup> Program*
  - Public Affairs Office Involvement*

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## WORKSHOP PROCEEDINGS

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### BACKGROUND

The research community would benefit from an improved understanding of valid and accepted analysis procedures used in conducting research and technology transfer. To that end, there is a need for guidelines and associated training. Academia has traditionally not addressed this issue. When researchers are not familiar with the proper research methodologies, the result is flawed findings and wasted resources.

The Transportation Research Board Committees on the Conduct of Research (A5001) and Technology Transfer (A5012) serve the transportation research community by addressing issues related to the processes of conducting research and transferring technologies to the user. As part of the two committees' joint activities, a workshop was held in July, 1996 to address related topics. The workshop was held in conjunction with an AASHTO Research Advisory Committee (RAC) meeting in Princeton, New Jersey.

### 1994 WORKSHOP—FOLLOW-UP ACTIONS

A previous workshop, sponsored by the committees during the summer of 1994, is documented in Transportation Research Circular 448, "Conduct of Research Workshop Proceedings." Both meetings were held in cooperation with the Federal Highway Administration.

Topics addressed at the 1994 workshop included:

- Program Development
- Research Methodology
- Dissemination of Information/Information Exchange
- Research, Development, and Technology Transfer Coordination

A variety of follow-up activities resulted from the 1994 workshop and are summarized here.

#### Program Development

This 1994 workshop topic has been presented to the AASHTO RAC for that committee to consider. Specific issues include the following:

- What Makes People Support Research?
- Strategic Planning.

- Public/Private Partnerships.
- Personnel Development and Training in Research.
- What Makes a Program Effective?

Discussion has taken place within the committee on these issues and subsequent action is being considered. This was also a discussion topic at the wrap-up session of the 1996 RAC meeting.

#### Research Methodology

In May 1996 the AASHTO Standing Committee on Highways approved funds for a manual that describes accepted processes and techniques used in the conduct of research. It is anticipated that the manual will be useful, especially for new researchers, in that it shows different approaches used for research investigations and analyses. It is not intended to be a textbook. The first draft has been completed, and the AASHTO RAC provided input at their annual meeting. The manual will be distributed to AASHTO members along with a list of recommended reference books on this subject.

#### Dissemination of Information/Information Exchange

The FHWA has taken the lead on a study related to the value of information. It will address cultural issues, existing information systems, and electronic dissemination. It also will identify information users such as researchers, administrators, managers, public and private agencies.

The information issues that the study will address include Internet access, emerging technologies, resources and data bases.

The study objectives are to demonstrate cost savings of information accessibility, to show how to exchange information more effectively, and to recommend marketing strategies. With the help of an expert task group, FHWA is currently developing the scope of work for a proposed RFP.

#### Research Development and Technology Transfer Coordination

This topic is currently being reviewed by a task force of TRB Committee A5001. The TR Circular 448 discussion on this topic is the main focus of this activity. A research problem statement will be prepared, along with the

identification of research plans to avoid duplication and to encourage cooperation. Avoiding duplication is essential considering that funding for research is limited and a continuing source of concern.

These 1994 workshop topics will continue to be addressed by various agencies, committees, and task forces in addition to being monitored by both TRB committees.

## 1996 WORKSHOP TOPICS

The following topics were identified by the committees as the most important, supplementing the 1994 workshop topics, to address immediate concerns of research and technology transfer agencies:

- Bridging the Gap Between Research and Implementation;
- Measuring the Effectiveness and Benefits of R, D, & T<sup>2</sup>;
- Cooperative Efforts with the Private Sector; and
- Marketing the R, D, & T<sup>2</sup> Program.

## BREAKOUT SESSIONS

The four breakout sessions identified actions needed to address each topic and specific recommendations for follow-up action—what and by whom.

Appendix A contains the detailed summaries from each of the four breakout sessions. The overall goal of these sessions was to discuss the assigned topic and prepare suggested actions to resolve the issues presented. The actions could be in the form of a research problem statement, study proposal, suggestion for implementation, etc. It is anticipated that the suggested actions would be appropriate for follow-up by a national agency (TRB, FHWA, AASHTO, etc.) or groups of agencies.

The workshop attendees were also encouraged to identify approaches to carrying out these recommendations for presentation to the appropriate agencies. Such activities as synthesis studies, research, training, marketing, and applications of state-of-the-practice were to be considered.

Appendix B of this report contains the agenda for the workshops and a listing of those attending.

## WORKSHOP FINDINGS

### Bridging the Gap Between Research and Implementation

The implementation of research findings is a prime emphasis area if an individual study or entire program is to be successful (i.e., having "value"). It is essential that this concern be addressed at the time of project initiation and

funding and be an integral part of the research study or program.

Those involved with the process at all levels must recognize the need to move new technologies from the state of the art to state of the practice.

This workshop discussed several related topics worthy of consideration. However, the group felt that they could only address two within the time frame and immediate capabilities.

### *Management of the Implementation of Research Findings and Results*

The risk associated with implementing new technologies within the transportation sector is relatively unknown, especially when compared to other industries. A systematic approach for dealing with risk is needed as it relates to transportation infrastructure design, construction, maintenance, and operation. However, in order to assess risk, long-term performance of materials and systems must be known along with associated cost of success or failure. It is anticipated that researchers would be the direct users of the analysis procedure with ultimate impact on administrative decisions.

It is recommended that a manual be developed to identify and manage risk on a systematic basis. The manual would:

- Identify techniques and practices in systems analysis.
- Identify examples of unreported significant failures that could have been prevented and practices now in place to deal with these issues.
- Emphasize the systems approach to identifying and managing the risks associated with changes and in their impact on performance.
- Describe a training course to provide practitioners with the necessary skills in these areas.

It was recommended that a problem statement be developed for initiating a study within the National Cooperative Highway Research Program.

### *Bridging the Gap Between the State of the Art and the State of the Practice*

Several action items were identified within this session. They included the following:

Professional Capacity Building—Academic programs typically do not include research procedures or the scientific approach to research in their curriculum. An educational process is necessary to provide researchers

with the tools to carry out credible research with implementable results. It was felt that the transportation industries need to partner with academia to foster a better appreciation for research and its benefits. Professors and students at the academic level as well as administrators in industry need to be aware of the benefits of good research.

Considerations of Implementation/Practice during R&D—Strategies for implementation of research findings must be an integral part of the research plan. Each research study is unique and its implementation plan should be tailored to fit the user needs.

Marketing—Marketing of the research product should include the process of distributing and promoting the study findings. Identification of the users as well as developing a strategy to sell new technologies to them should be considered in the research implementation plan.

A research problem statement for NCHRP should be prepared to develop guidelines on quality control and management within the research program. A users manual along with videos and other training aids should be prepared for use by academia and other training agencies such as the FHWA, National Highway Institute. An ad hoc committee, with volunteers from Committee A5001 and A5012, was formed to develop the proposed NCHRP problem statement.

### **Measuring the Effectiveness and Benefits of R, D, & T<sup>2</sup>**

When a technical problem arises it is important for the operations staff to recognize the researcher as one who can provide a solution. The benefits of research also can provide justification and credibility to the research program when administrators make funding and organizational decisions. Specific examples of cost savings, research pay-offs, and other benefits are often needed on a short term basis. Five topics on this issue were discussed during this workshop session.

#### *Benefits vs. Effectiveness*

A total systems approach is needed to integrate research, development, and technology transfer. The differences between each must be recognized. Further, the benefits and effectiveness of each must also be recognized individually as well as in combination. An important issue is whether or not benefits and effectiveness are the same and whether they should be measured in the same way.

#### *Measuring the Value of "Failures"*

There can be value in failure but is failure worth the risk? How is failure measured? How does one define "failure" - by lack of results or by performance less than expected? When failure is programmed as part of research, within the experimental design, it can be useful for establishing conditions that require change.

#### *The Complexity of Research Evaluation*

The research process quite often incorporates the value-added concept with no one study being complete within itself. Incremental changes contribute to small improvements which are difficult to measure. In addition, benefits are often long term and intangible. Maintaining a long-term staff can also have short-term benefits when day-to-day issues need to be resolved. Thus, program evaluation and project evaluation are distinct and separate processes.

#### *What are the Value Expectations? What Measures are Convincing?*

Although quantitative measures are more desirable, qualitative measures are often necessary to define the benefits of research. Credibility and funding are often based on the convincing level of these measures when presented to administrators and the user. It is important for goals to be defined early in the process in order to have a standard by which to measure effectiveness. However, due to the nature of research, goals often must be modified with the original purpose of the research kept in mind. Finally, feedback mechanisms are also needed to track applications and benefits.

#### *Canada Study Example*

A recent Canadian study found most organizations had a means of evaluating proposals but not results. Evaluation categories included peer and client reviews, cost-benefit, case studies, and performance indicators.

To address the five topics listed above, it is recommended that several tools be considered:

- Synthesis of practice for evaluating research;
- Published case studies;
- Checklist for evaluation processes; and
- Manual for evaluating transportation research.

It is also suggested that a TRB annual meeting session on Evaluation of Transportation R, D, & T<sup>2</sup> be presented to show how R, D, & T<sup>2</sup> is related to the overall "business strategy" of the parent organization.

### **Cooperative Efforts with the Private Sector**

Public/private partnerships for research are increasing and have long been recognized as beneficial. However, barriers to successful cooperative efforts still exist and are difficult to overcome. Shrinking economic resources have played a large role in recognizing that cooperative efforts between the public and private sectors are critical for moving the industry forward. Five topics were presented as part of the workshop discussions on this subject.

#### *Models of Successful Public/Private Partnerships*

Successful partnerships have resulted in win/win situations where each partner has recognized and used the other's unique strengths and capabilities. There is a need to identify and disseminate the success stories to serve as models for creating more public/private partnering. Education could help both sectors overcome barriers often experienced in developing cooperative efforts. A showcase of success stories is needed at the federal and state levels, e.g., the Intelligent Transportation System (ITS). Workshops for senior level public and private transportation professionals can be used in conjunction with formal publications to promote the methods and benefits of potential partnerships. It was suggested that the FHWA, Office of Technology Applications, along with the TRB committees, work in a cooperative effort to promote these activities.

#### *Procedures for Developing Partnerships*

Formal procedures need to be developed which identify and provide guidance for addressing the issues and barriers for creating public/private partnerships. The experiences gained in transportation design and construction programs should be considered. Successful procedures need to be identified, their effectiveness evaluated, and an assessment made of their applicability to research partnerships.

It is suggested that a synthesis be developed documenting successful partnerships in the transportation and other related sectors. Resources for this study should include other modes of transportation, public and private sectors, and other operational phases of the transportation industry. Initially the synthesis of the state of the practice

would serve as a starting point for creating a checklist related to specific research and technology transfer partnerships. Other challenging issues of partnering would be identified and addressed.

#### *Barriers to Partnerships*

Current procurement policies and processes often constrain the public sector's ability to use proprietary technology in the public transportation industry. These barriers need to be identified and a method for overcoming them considered. These barriers include restricting policies and processes which must often be addressed at the legislative level. Since many of these barriers cut across multiple organizational boundaries, it is important that all affected agencies be involved.

#### *Private Sector Involvement in Research, Development and Technology Transfer Activities*

The use of private sector professionals on the research team can have beneficial returns to the public agency program. Uses include involvement in program development, study design technical panels, attendance at outreach events, and marketing activities. In addition to performing research activities, private sector professionals can be used in other R, D, & T<sup>2</sup> activities such as technical writing, marketing, and training.

Public sector agencies at all levels should be proactive in inviting private sector professionals to participate in their programs.

#### *Modal Balance in Research, Development, and Technology Transfer Activities*

Research, development, and technology transfer programs and activities at all levels need to reflect the multi-modal nature of transportation. The TRB is currently addressing this issue within the Board, through membership appointments on their committees and presentations at the annual meeting.

### **Marketing the R, D, & T<sup>2</sup> Program**

Marketing efforts and programs should be defined as a form of pro-active technology transfer. Marketing at the program level helps to identify the research program as beneficial to the individual user and, for the administrator, beneficial to the agency.

### *Marketing the R, D, & T<sup>2</sup> Program*

Marketing is important at the levels of top management, mid-level supervisors, working level technicians, legislators, commissioners, and the traveling public -- the ultimate user. The contribution of marketing individual project results must be assessed when considering the marketing of the overall program.

These programs become important when the lack of research program appreciation exists by the agency CEO's and other decision makers. However, engineering professionals often have very limited training in marketing strategies or background on the principles of professional marketing efforts.

The principles of marketing new technologies should be the subject of a research problem statement for consideration by NCHRP. User guidelines and procedures should be developed for application by researchers within all transportation agencies. Marketing of the study findings should be considered as a cooperative effort between TRB, AASHTO, FHWA, and the LTAP centers.

### *Public Affairs Office Involvement*

The professionals found in transportation agencies' public affairs offices should be approached to assist in promoting research programs. Solicitation of their PR services, either on a full-time or as-needed basis, can result in a cost-effective marketing tool. A good working relationship with the PR office staff can help in presenting research program activities and study results in a very informative and newsworthy format. In addition, the PR staff is also familiar with the delivery mechanism for getting the word out to the user and customer.

It was suggested that a synthesis of practice be made of agencies proactive in marketing through public affairs professionals. A model procedure and agreement to cover PR-related marketing activities for use by researchers should then be developed. The FHWA, Office of Technology Applications, could take the lead on this activity in conjunction with an associated TRB committee. A TRB annual meeting session on "Integrating Public Affairs & Research Groups" was also suggested.

This workshop also discussed a *Marketing Model* outlined by the attendees. The model addresses input from the public, policy/law makers, region, and agency levels. A diagram outlining the model can be found in the Appendix A.

### NEXT STEPS

A review of the 1994 and 1996 workshops indicates that the job is not finished. Both workshops identified significant issues that need to be addressed in the area of research administration, the conduct of research, technology transfer, and implementation. It is now essential that research professionals follow up on each of the activities requiring further attention. The TRB Committees on the Conduct of Research (A5001) and Technology Transfer (A5012) will take the lead in advancing many of the recommended actions. It is also envisioned that other transportation agencies will review the recommendations and take the lead in follow-up activities. This *Circular* along with *Transportation Research Circular 448, "Conduct of Research Workshop Proceedings", October 1995*, should be the reference documents for these activities.

As indicated earlier, discussion details from each of the 1996 individual workshops is presented in Appendix A. These recorder notes provide the basis of the discussions and recommendations which are summarized in the previous sections of this *Circular*. Specific action items include the following:

#### **Bridging the Gap Between Research and Implementation**

- *Management of the Implementation of Research Findings and Results* - This topic has been retitled, *Systems Approach to Implementing Research and Changing Current Practices*. An ad hoc task force of TRB Committee A5001 has been established to develop a problem statement on this topic. The emerging problem statement should be considered for funding by the AASHTO Standing Committee on Research as an NCHRP study. If necessary the problem statement would also be submitted to the AASHTO Standing Committee on Highways (NCHRP 20-7).

- *Bridging the Gap Between the State of the Art and the State of the Practice* - A TRB Committee A5012 task force suggests that a primer on the topic be developed. Recommendations from the primer would be the basis for a future NCHRP problem statement.

#### **Measuring the Effectiveness and Benefits of R, D, & T<sup>2</sup>**

Five topics were identified in this workshop for follow-up activities. It is suggested that a joint task force from TRB Committees A5001 and A5012 examine the topics in order to make specific follow-up action recommendations. These include annual meeting session topics.

### Cooperative Efforts with the Private Sector

Each of the five topics identified in this workshop session are interrelated and should be addressed as a comprehensive effort. A cooperative effort such as a joint task force between the TRB Committees A5001 and A5012, as well as other industry experts, should be organized. It is anticipated that an NCHRP 20-7 study could address the topics. The output from this task could include study proposals and synthesis topics.

### Marketing the R, D, & T<sup>2</sup> Program

- *Marketing the R, D, & T<sup>2</sup> Program* - In cooperation with NCHRP, TRB Committee A5012 should develop a scoping study on this topic.

- *Public Affairs Office Involvement* - TRB Committee A5001 should submit an NCHRP Synthesis problem statement on this topic as part of the 1998 solicitation.



## APPENDIX A BREAKOUT SESSION SUMMARIES

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### BRIDGING THE GAP BETWEEN RESEARCH AND IMPLEMENTATION

#### Opening Remarks

A major concern within many research programs is the lack of full acceptance and implementation of research findings by the user. Research findings, in the form of technical reports, often get put on the shelf with little if any follow-up. The lack of implementation is not necessarily a reflection on the extent or quality of the research study, but may reflect a lack of emphasis on the application of the study findings or lack of funds to implement them. This breakout session was organized to address those issues which should be considered in order to establish a natural transition from the state of the art to the state of the practice.

#### Topics Discussed

Eight specific topics were discussed during this workshop session. They included:

- Professional Capacity Building
  - Considerations of Implementation/Practice during R&D
  - Economics of Implementation/Practice during R&D
- Tie Technical Programs to Organizational Strategic Goals
- Marketing
- Team Approach with End Users
- Risk Management
- Taking Off-the-Shelf Research into Practice
- Reward Our Champions

Even though each of the topics discussed were worthy of consideration, it was felt that many were being addressed elsewhere or were beyond the capacity of this workshop. It was therefore decided to address only a few of the issues and develop a clear direction for follow-up activities.

#### *Management in the Implementation of Research Findings and Results*

A systems approach, which explicitly deals with all aspects of a proposed change, including the associated risks, has been applied throughout the United States by both public and private sector organizations. However, the

application of this approach in the construction industry has not been as widespread as some other industries. In addition, its application by state or local transportation agencies has been very limited.

The workshop participants identified as a major shortcoming the lack of a systematic approach in the transportation industry for dealing with changes in products, processes, policies, and equipment. Most other engineering disciplines use systems analysis to define performance using quantitative methods to identify and manage the associated risks. Unfortunately, this is rarely done in highway engineering, perhaps because of a misguided perception that highway engineering is not as complex as some other engineering disciplines. Yet, in the highway industry the service environment is rarely well defined, no easy method exists to predict long-term performance of materials and systems, and the cost of failure is extremely high.

#### Action Needed

A manual is needed on a systems approach to identify and manage the risks associated with the changes in technologies, products, processes, policies, and equipment and their impact on infrastructure performance. The manual should be developed to help identify current issues and introduce applicable techniques for dealing with them. The new manual should help identify the need for formal university training for civil engineers on the systems approach.

It is recommended that the manual be developed within the TRB National Cooperative Highway Research Program. Objectives would include:

- Identify techniques and practices in systems analysis.
- Identify examples of unreported significant failures that could have been prevented and what practices are now in place to deal with these issues.
- Emphasize the systems approach to identifying and managing the risks associated with changes and their impact on performance.
- Describe a training course to provide practitioners with the necessary skills in these areas.

#### Interested Agencies

The manual will have direct application to all civil engineering agencies. Immediate impact should be felt

within state highway and other transportation agencies as part of their infrastructure developmental process. This will include administrators, design, and construction engineers. It is anticipated that researchers will incorporate the manual recommendations into their research study implementation plans.

#### Discussion/Justification

Administrators often do not want to assume risk associated with new technologies which might result in failure and subsequent bad publicity and/or costs associated with repairs. In addition, many administrators are more comfortable to "let the other guy do it" when the associated risks are not well defined nor understood.

#### *Bridging the Gap Between the State of the Art and the State of the Practice*

Many of the other topics identified in this workshop session will be combined and considered as part of this topic assessment.

- Professional Capacity Building—It is essential that personnel be identified who have the capacity to carry out the research studies. Those studies most adapted to the implementation phase must also be identified. The associated tools should also be available and related training be given. Future generations of transportation professionals should be educated on the value of research and how we do business. Academia frequently use "old standards and/or information" in their curriculum. Transportation professors need to be advised on and encouraged to present more state-of-the-art ideas and techniques so that students come out "ready to go" rather than having to start over with more retraining programs. Further, industry needs to partner with academia to foster better education for both the professors and students. Management in private and public sectors must be educated as to the necessity as well as the benefits of research and good implementation. It is also essential that top management be informed on the issues in order to recognize and provide support to the process.

- Considerations of Implementation/Practice during R&D—Assessment of the research process must be comprehensive and well thought out. As part of this assessment, the implementation activity should be given full consideration. The unique requirements for an implementation program should be assessed for each separate research study—one size does not fit all.

- Marketing—The process for distributing and promoting the emerging technologies must be fully

addressed by research administrators. Targeting the right agency and levels within that agency should be considered.

#### Action Needed

A research needs statement should be proposed to the AASHTO Standing Committee on Highways for consideration for funding, probably under NCHRP 20-7. It is suggested that guidelines on this topic be considered as a standalone document or as part of the R & D Procedural Manual. A specific procedure or manual should be developed that would include quality assurance/quality control guidelines along with total quality management principles. The guidelines, to be used by researchers, should address agency strategic goals and receive support by top management.

Manuals, publications, videos and other resources currently exist on the topics identified. These should be identified, possibly through a TRB synthesis, and made available to research administrators. AASHTO, in coordination with TRB committees A5001 and A5012, could create an award for agencies showing leadership in implementation of research findings. In addition, individual agencies should be encouraged to recognize or reward champions.

Federal agencies, such as the FHWA, could take the lead in assembling task forces as necessary to address these issues. In addition, as findings emerge from NCHRP Project 20-33(2), "...Facilitating the Implementation of Research Findings", they should be reviewed and implementation strategies developed. Again, AASHTO and the TRB committees, in cooperation with the FHWA should take the lead in this activity.

Follow-up activities in the form of seminars and training sessions should be conducted to take the findings to the users. Possibly a national summit conference on Professional Capacity Building should also be considered with academia in full participation with the public and private sector professionals.

#### Interested Agencies

Principal user agencies should include TRB committees (A5001 and A5012), FHWA, Office of Technology Applications, the AASHTO Research Advisory Committee, Local Technical Assistance Program T<sup>2</sup> Centers, and others.

#### Discussion/Justification

No additional discussion.



## MEASURING THE EFFECTIVENESS AND BENEFITS OF R, D, & T<sup>2</sup>

### Opening Remarks

A major component of the administration effort within a research program is the assessment and reporting of its effectiveness and benefits. These features are often used to justify the program's overall worthiness to top management, funding organizations, and users. It is also important that specific information is available on "what we can do for you" and/or cost savings as a result of research studies. This information must be readily available and reflect recent accomplishments. These examples, when presented to top management and funding agencies will help in the justification for research program resources in order to help the program be continuous and effective.

The objective of this breakout session was to explore methods of measuring research program effectiveness and identifying methods of documenting its benefits.

### Topics Discussed

Five topics were discussed during this workshop session. They included:

- Program Benefits vs. Effectiveness
- The Value of "Failures"
- Complexity of Research Evaluation
- What are the Value Expectations? What measures are Convincing?
- Canada Study Example

### *Benefits vs. Effectiveness*

An important issue is whether or not benefits and effectiveness are the same and whether they should be measured in the same way. The differences between research, development, and technology transfer must also be recognized; they are three different things. Often research may cost \$1, development \$10, and implementation \$100. But many managers are in charge of all three, and they need a measure of each. Perhaps the management of research, development, and technology transfer is a fourth category requiring separate measures.

The use of existing knowledge as well as the search for new knowledge is essential. Effectiveness must extend to multiple audiences, including ourselves, our organizations, the public, and legislatures; not only for research and development but for the entire transportation

industry. New technologies often require new technology transfer methods.

Prior research findings must also be recognized. A common mistake in research is failure to access older information that is available in what is largely a mature set of transportation technologies. "One stop shopping" for data bases or literature searches would be useful, as would indexing of expertise in various fields. Informal networks of experts could be applied to solve problems cooperatively.

A simple flow chart can illustrate the sequence of input → process → output → consequences (outcomes). Researchers cannot completely control consequences (e.g. increased safety), only their own output. Even if researchers cannot control consequences, they tend to be judged by them. It is advantageous to tie consequences to actions.

It is important to integrate the different functions of research, development, and technology transfer into a total systems approach if research programs are to be effective. Cross-functional teamwork may be needed, requiring ways to assess team effectiveness.

### *Measuring the Value of "Failures"*

Value can be gained by proving what doesn't work, but how does one measure this? Are failures minimized when reporting, despite the fact that they may provide the most valuable information? Most agencies work in applied research, not basic. In addition, most programs have limited funding and work for organizations with tight budgets. All of these factors apply pressure to produce "successes" and avoid "failure". It must be recognized that failure often is more effective in initiating change than success. Furthermore, learning which mistakes should be avoided has value in itself.

How does one define "failure"—by lack of results or by performance less than expected? It is better to measure failure or success of research performance, not of the concept studied or evaluated. It is important to distinguish between failure in an individual project and failure of an entire research program.

### *The Complexity of Research Evaluation*

Many factors complicate the evaluation of research. It can be difficult, but important, to predict the potential benefits of research. Overall effectiveness may not be the same as direct benefits.

The value added by research is often incremental, building upon earlier work by other researchers and depending upon implementation by operational units.

Many external factors affect final outcomes. How can the effectiveness of the small piece of a single discrete project be measured?

Benefits are often long term and intangible. For example, building and maintaining expertise within an organization and knowing where outside expertise exists becomes a valued asset for research professionals. Maintaining a staff who possess these qualities and transmit their knowledge to organizations can have lasting value. The value of this short-term assistance can be difficult to assess. Thus, program evaluation and project evaluation are distinct and separate processes.

*What are the Value Expectations?  
What Measures are Convincing?*

Diverse measures—such as benefit/cost ratios, scaled ratings, number of lives saved, numbers of research needs addressed, and response time for short-term assistance—may be appropriate. Although quantitative measures are more easily discussed, qualitative measures are often necessary also. To obtain funding for research, quantitative measures are needed and must be convincing. It is usually easier to forecast the benefits of future efforts than to quantify benefits of past efforts. Unfortunately, the data to make a quantitative assessment of research effectiveness is often unavailable. Since value engineering shares many features of research evaluation, it is possible that value engineering techniques can be used to quantify research techniques.

Goals need to be defined first in order to have something to measure against and help decide where to invest effort and resources. Measures then may force researchers to modify their goals. Is the goal to do research or to solve problems? The original purpose of the research must be kept in mind.

The term "technology" should be used generically, to include plans and policies as well as widgets.

General concerns (for example, saving lives) must be translated into statements of specific transportation problems. Their significance must be assessed, and the availability of resources to address the topic must be determined.

Feedback mechanisms are also needed to track applications and benefits.

#### *Canada Study Example*

A recent Canadian study, "Performance Evaluation Mechanisms for Transportation Research Programs" found most organizations had means of evaluating proposals but not results. Evaluations fell into five major categories:

- Peer review,
- Client review,
- Cost-benefit (best for projects where results can be quantified),
- Case study (best method for projects where results are known but not quantifiable), and
- Performance indicators.

The study produced a matrix of purposes for each method but did not target audiences for each. It proposed development of a manual for research evaluation.

#### Interested Agencies

The audience for evaluation information includes many: budget authorities, legislatures, peers, research managers, highway users, and transportation industries. Some politically influential industries might prefer that funding go into construction projects rather than research. Each customer may use different "measures" of success. The type of measure needed may depend on the audience being addressed.

#### Action Needed

Several tools may be useful to those evaluating research:

- Synthesis of Practice for evaluating research;
- Published case studies;
- Checklists for evaluation processes; and
- A manual for evaluating transportation research.

Parts of these tools may already exist, for example, in the Canada study. The state research program peer review process may develop a synthesis of best practice. Material from other disciplines should be applied when appropriate. Methods for evaluating venture capital efforts in the private sector could possibly be translated for use in evaluating research in the public sector.

A manual/guidelines for evaluating research, development and technology transfer activities could contain:

- Concepts,
- Case studies,
- Best practices,
- Applications from industry and other disciplines,
- Checklist, and
- Formats and tools for communicating measures and relationships between them.

It is also suggested that a TRB session on Evaluation of Transportation RD&T be presented to show that research, development and technology is related to the overall "business strategy" of the parent organization.

- Who are stakeholders?
- What are the expectations?
- What are the measures of effectiveness?
- What are data requirements?
- What is the feedback link of results to expectations?
- Was the right thing done well?

Finally, an *Annotated Bibliography* on the subject of research evaluation and assessment could be developed. It should include transportation research and present examples from other disciplines and industries.

(Reference Note: *Performance Evaluation Mechanisms for Transportation Research Programs* by Doug Williams, ARA Consulting Group, Transportation Association of Canada (2323 St. Laurent Boulevard, Ottawa, K1G 4K6, (613) 736-1350, FAX (613) 736-1395) Report #4, 1995)

## COOPERATIVE EFFORTS WITH THE PRIVATE SECTOR

### Opening Remarks

Transportation professionals involved in research, development, and technology transfer have long acknowledged the potential benefits of cooperative efforts between the public and private sectors. The number of examples of successful cooperation is growing, but barriers are still difficult to overcome. In many cases, barriers are so great that public/private partnership opportunities are not even considered. However, challenged by solving today's transportation problems with shrinking economic resources, transportation professionals recognize that cooperative efforts between the public and private sectors are a critical factor for moving the industry forward.

### Topics Discussed

Discussion focussed on five central topics in this breakout session:

- Models of successful public/private partnerships
- Procedures for developing partnerships
- Barriers to partnerships
- Private sector involvement in research, development and technology transfer activities

- Modal balance in research, development and technology transfer activities

### *Models of Successful Public/Private Partnerships*

Successful partnerships result when all partners recognize the value of the other partners' contributions. The agreement is mutually beneficial; all partners are giving and gaining. This is no small feat due, in part, to the traditional public/private model of customer/client relationships. But successful partnerships are possible and there is a need to educate both the public sector and private sector about success stories involving cooperation and partnering. Education could help both sides overcome the tension and apprehension inherent in some partnerships. There are a variety of examples of successful public/private cooperation which could serve as good models for partnering, ranging from private sector participation on research project technical panels to formal public/private partnership agreements.

### Action Needed

There is a need to develop a showcase of success stories of public/private partnering at the federal and state levels. The showcase will be created by identifying success stories and having someone familiar with the effort write an article and/or create a display. Partnering efforts currently underway through the Intelligent Transportation Systems program should be considered as one resource for success stories. These stories can then be published in various professional journals and presented at national conferences and workshops where the intended audience is senior level public and private sector transportation professionals.

### Interested Agencies

FHWA's Office of Technology Applications could lead the effort of creating and disseminating the showcase stories with input and assistance from the TRB Committees on Conduct of Research and Technology Transfer. Input should be collected from other modal administrations, also.

### Discussion/Justification

There is a need to identify and disseminate success stories to serve as models for creating more public/private partnering. Education could help both sectors overcome

some of the barriers often experienced in developing cooperative efforts.

#### *Procedures for Developing Partnerships*

Partnerships need to address a variety of issues in order to be successful. They need to include a balance of public and private efforts, a combination of donated time and payment for service, and an agreement on intellectual property, product and patent rights to name a few. There is a need to develop formal procedures for partnering which identify and provide guidance for addressing the issues and barriers associated with partnering. Some procedures have been developed and utilized for creating partnerships, particularly in the design and construction industries. There is a need to identify these procedures, evaluate their effectiveness, and assess their applicability to research and technology transfer partnerships.

#### Action Needed

A synthesis of existing procedures for creating partnership agreements in all modes is needed. This document could provide guidance in developing partnering "checklists" for use by both public and private sectors when entering into cooperative agreements, with emphasis on issues associated with research and technology transfer partnerships.

#### Interested Agencies

A synthesis could be developed by TRB with guidance from state departments of transportation, transportation industry associations, and the National Quality Initiative.

#### Discussion/Justification

A synthesis of state-of-the-practice could be developed which illustrates the basic procedures for creating partnerships. This would serve as a starting point to creating "checklists" related specifically to research and technology transfer partnerships. In addition, current procedures would likely need to be enhanced to address some of the more challenging issues of partnering which have not yet been addressed.

#### *Barriers to Partnerships*

There are some barriers in place which limit the types of partnerships that can be created and the benefits that can

be achieved. One example is the restricting nature of current procurement policies and processes which constrain the public sector's ability to use proprietary technology in a research and development environment. Procurement policies can also limit the use of technology developed outside the U.S. A second example is the absence of a policy and process that would enable the public sector to patent products resulting from research and license their use to the private sector. A third barrier is the donation clause which limits the public sector's ability to learn about new technologies if it involves accepting something of value from a private company.

#### Action Needed

There is a need to reexamine the policies and processes designed to engage the private sector in partnerships with the public sector. In some cases legislative changes may be needed to remove existing barriers and further promote and facilitate these partnerships. By highlighting these issues in this publication, the goal is to raise the awareness level that these barriers exist and that change is needed.

#### Interested Agencies

A variety of agencies and groups across all modes would be interested in reexamining policies and processes in order to facilitate partnerships. These include the federal modal administrations, states, MPOs, local jurisdictions, TRB, NHTSA, universities, private firms, and others.

#### Discussion/Justification

The transportation industry will not be able to achieve the maximum benefit from partnerships until some of the key barriers are examined and addressed. These key barriers include some restricting policies and processes which must often be addressed at the legislative level.

#### *Private Sector Involvement in Research, Development and Technology Transfer Activities*

There is a need, particularly at the state and local levels, to include more private sector involvement in a range of research and technology transfer activities. This involvement can include participation in a brainstorming session where research topics are identified, membership on a technical panel for monitoring a research project, and attendance at outreach events. In addition, private sector professionals can be used as instructors for workshops,

writers for newsletters, and for other technology transfer mechanisms.

#### Action Needed

Invite more private sector participation in research and technology transfer activities at the state and local levels.

#### Interested Agencies

The states, T<sup>2</sup> centers, and university transportation centers would be in the best position to identify potential private sector participants in their geographic areas and determine ways to expand their involvement in research and technology transfer activities.

#### Discussion/Justification

No additional discussion.

#### *Modal Balance in Research, Development and Technology Transfer Activities*

Research, development, and technology transfer programs and activities at all levels need to reflect the multi-modal nature of transportation. To that end, the TRB Committees on Conduct of Research and Technology Transfer need to reflect a balance of the transportation modes in their memberships and activities.

#### Action Needed

Identify and invite representatives from non-highway modes to attend the January 1997 Conduct of Research and Technology Transfer committee meetings at the TRB Annual Meeting. Involve these representatives in committee assignments. Also, include presentations from all modes at future annual meeting sessions developed by these two committees.

#### Interested Agencies

The chairpersons of the TRB Conduct of Research and Technology Transfer Committees should identify and invite modal representatives to the January 1997 committee meeting. Committee members responsible for planning annual meeting sessions should include all related modes when selecting presentations.

#### Discussion/Justification

No additional discussion.

## MARKETING THE R, D, & T<sup>2</sup> PROGRAM

### Opening Remarks

The general theme of the workshop discussion was whether or not advanced-level marketing efforts or programs would enhance the state research, T<sup>2</sup>, and LTAP units' survival or betterment. The propriety and/or legality of marketing efforts under state and Federal law was brought forth as a concern. The benefits of such programs or efforts might include higher visibility, greater management or agency "buy-in", a higher level of implementation or use of products, and a more central role in the activity of the overall agency.

### Topics Discussed

The discussion focused on two primary topics surrounding marketing as it relates to research programs. They include:

- Opportunistic Marketing Plan, marketing models at all levels
- Public Affairs Office Involvement

#### *Marketing the R, D, & T<sup>2</sup> Program*

By definition, marketing is the process or technique of promoting, selling, and distributing a product or service. The workshop included a brief discussion as to where or to whom marketing efforts by research agencies should be directed. A number of possibilities were suggested, such as marketing to state DOT top management, mid-level managers, working level technicians, state governors, legislators, Congress, etc. The question was also initially raised, do we want to market the overall research program, or project results, or both?

#### Action Needed

The workshop recommended that a modest scoping study be performed to initially investigate the need for and the potential benefits of marketing at the research program level. In addition, a plan for a second larger effort should be developed to identify and refine methods, materials, and training to market research and T<sup>2</sup> programs. Such



marketing efforts would be used by state research units or university LTAP centers. Marketing programs might be directed towards top management of state DOTs, universities, other transportation-related agencies, including state legislators. (See Marketing Model example below) The recommended study should target the marketing effort to all involved in the research program and its technologies.

#### Interested Agencies

The initiation of this effort should be of interest to AASHTO through RAC meetings, the AASHTO-VAN, TRB, and FHWA especially within the National Highway Institute (NHI).

The AASHTO Standing Committee on Highways or the Standing Committee on Research should be presented with this problem statement. The topic might be complementary to the subject matter of the NCHRP 20-24 project series dealing with special projects related to management issues.

#### Discussion/Justification

Research and T<sup>2</sup> programs are often not well understood or appreciated by transportation agency CEOs since they frequently come out of diverse, non-transportation, non-research backgrounds. Through a marketing effort, there is a need to justify these programs and convince managers as to their need. On the other hand, engineering professionals often have only very limited training in marketing strategies within engineering schools' research/T<sup>2</sup> based curricula—a need or deficiency that was explored in another session of this conference.

Another deficiency is that most state research/T<sup>2</sup> personnel often have either little or no background in the principles or knowledge of the capabilities/potential of professional-level marketing efforts. Thus, there is a need for materials and/or training opportunities in marketing for transportation research/T<sup>2</sup> personnel.

#### *Public Affairs Office Involvement*

Any marketing program needs to be customer-driven and proactive. There is a need for clear and effective channels of communication between customers of research and the research staff to ensure an effective program.

Some states with large research programs have significant writing/editing/marketing functions. Other

alternatives include training researchers or, more cost effectively, getting public affairs office staff involved in research marketing. Interaction with state public relations (PR) office staff can be used to develop working relationships with the press for marketing to the public in addition to marketing within the transportation agency. A good working relationship with PR office can help in presenting research program activities and study results in a very informative and newsworthy format.

#### Action Needed

A synthesis of practice within research agencies proactive in marketing through public affairs professionals should be made. The synthesis would explore marketing programs within agencies who have hired professional public relations staff, those who have trained researchers in PR techniques, those who have working relationships with agency public affairs offices, and other marketing strategies. A model agreement to cover PR-related marketing activities for use by researchers should then be developed.

#### Interested Agencies

The FHWA, Office of Technology Applications has the capability to set contracts for marketing efforts. Working with a variety of research agencies, the FHWA, OTA could play a leadership role in this activity. All research agencies would be direct users of the final product. Following this study, the findings and information obtained should be presented in a TRB annual meeting session, "Integrating Public Affairs & Research Groups."

#### Discussion/Justification

A good product or program deserves a very good promotional/implementation effort. The involvement of public relations professionals, either within the research agency or on an as-needed basis, can provide a cost-effective marketing tool. Benefits will include distribution of technologies to the users as well as recognition of the agency's research program.

(Note: The following Marketing Model was presented)

## MARKETING MODEL

## PUBLIC

Customer Input (NQI Survey) + Our Expertise + Insight/Inspiration—*Vision*

## NATIONAL POLICY/LAW MAKERS (CONGRESSIONAL)

Vision + Research Priorities to Achieve Vision + Quantified Benefits & Examples  
—*Programs & Funding*

## REGIONAL - NGA, AASHTO, INDUSTRY

Funding & Programs + Regional Priorities + Quantified Benefits & Examples  
—*Top Management Support & Resources*

## AGENCY

Top Management Support & Resources + Agency Priorities  
+ Responsiveness (Benefits & Examples)  
—*Projects & Programs That Support Vision & Create More Insight, Expertise, Etc.*

## APPENDIX B AGENDA AND ATTENDEES

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**Joint Mid-Year Meeting & Workshop**  
 TRB Committee A5001, "Conduct of Research"  
 and  
 TRB Committee A5012, "Technology Transfer"  
 Princeton, New Jersey  
 July 31 and August 1, 1996

### Agenda

*Wednesday, July 31*

**Research Implementation** (Held in conjunction with RAC Session 8)

- 9:00 a.m. Establishing a Climate of Research Acceptance and Use - *Andy Lemer*
- 9:20 a.m. Facilitating the Implementation of Research Findings - *Barbara Harder*
- 9:40 a.m. BREAK
- 10:00 a.m. Transferring Research Knowledge and Promoting Acceptance - *Norman R. Scott*
- 10:20 a.m. Technology Screening: How to Know Which Basket to Put your Eggs In - *Henry Honeywell*
- 10:40 a.m. Assessing Research & Technology Programs - *David Huft*
- 11:00 a.m. Breakouts on Implementation Issues - Mixed by Region
  - A. Measuring and Targeting Research Effectiveness
  - B. Improving the Bridge Between Research and Application
  - C. Advancing Technology Development with the Private Sector

Noon LUNCH

**Perspective on Future Funding & Legislative Issues** (Held in conjunction with RAC Session 9)

- 1:00 p.m. National Perspective on Funding & Legislative Issues - *Robert Betsold*
- 1:30 p.m. Discussion
- 2:00 p.m. BREAK

**TRB Committees Meeting Session**

- 2:15 p.m. Introduction and Opening Remarks - *Lynne Irwin/Denis Donnelly*
- 2:30 p.m. Overview of RAC National Meeting Activities - *Denis Donnelly*
- 2:50 p.m. Short Term Barriers/Long Term Plans for SHRP - *Neil Hawks*
- 3:15 p.m. A Cooperative Effort - TRB Committees A5001 & A5012 - *Lynne Irwin*  
 Round Table Discussion
- 4:00 p.m. Conduct of Research Workshop, follow-up to 1994 meeting  
 Program Development - *Richard Stewart*  
 Research Methodology - *Robert Perry*  
 Dissemination of Information/Information Exchange - *Ray Griffith*  
 Research, Development & Technology Transfer Coordination - *Chris Hedges*
- 5:00 p.m. Adjourn Meeting
- 6:00 p.m. **Reception** (Cash Bar)



**Joint Mid-Year Meeting & Workshop**  
 TRB Committee A5001, "Conduct of Research"  
 and  
 TRB Committee A5012, "Technology Transfer"  
 Princeton, New Jersey  
 July 31 and August 1, 1996

**Agenda (Cont.)**

*Thursday, August 1*

***Workshop Session***

- 8:00 a.m. Welcome To TRB & RAC Attendees - *Robert Spicher*  
 8:15 a.m. Workshop Objectives - *Denis Donnelly & Lynne Irwin*  
 8:30 a.m. Workshop Assignments and Logistics - *William Carr*  
 9:00 a.m. Breakout Session A - *Bridging the Gap Between Research and Implementation*  
 Facilitator - *Bill Evans*  
 Recorder - *Maria Ardilla-Coulson*  
 9:00 a.m. Breakout Session B - *Measuring the Research Program Effectiveness*  
 Facilitator - *David Huft*  
 Recorder - *Matthew Reckard*  
 Noon LUNCH  
 1:00 p.m. Breakout Session C - *Cooperative Efforts with the Private Sector*  
 Facilitator - *J. Peter Kissinger*  
 Recorder - *Laurie McGinnis*  
 1:00 p.m. Breakout Session D - *Marketing the R, D, & T<sup>2</sup> Program*  
 Facilitator - *Carolyn Goodman*  
 Recorder - *Robert Garber*  
 4:00 p.m. Wrap-Up/Discussion - *Denis Donnelly*  
 4:30 p.m. Adjourn Workshop

(Note: Breaks will be held during the morning and afternoon breakout sessions)

**Attendance List**

Joint Mid-Year Meeting & Workshop  
 TRB Committees A5001 & A5012  
 July 31, 1996 thru August 1, 1996

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