

Transportation Research *Current Practice and a Look Forward*

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The waning years of the 20th century have seen major changes in the way we plan, coordinate, and conduct transportation research, primarily as a result of numerous trends in the transportation sector and in society as a whole. There has long been widespread recognition that transportation is the foundation of our economy and our quality of life. More recently, however, transportation agencies have begun to see their role as much more than simply providing infrastructure. The mission statements of today's transportation agencies typically include enabling the movement of people and goods in an efficient, convenient, safe, and environmentally sustainable manner.

In their new roles, transportation providers must interact with—and, at times, compete with—other government departments and quasi-governmental agencies. Transportation agencies have become more focused on making sound investments in transportation solutions that address strategic issues and needs. This change requires an increased emphasis on the careful allocation of funds to achieve the maximum benefits and outcomes of our research programs. It also necessitates that transportation research be expanded beyond traditional infrastructure concerns to include areas such as policy, economics, sustainability, and the environment. Similarly, transportation engineers need to broaden their knowledge bases so that they will be prepared to deal with these new areas of concern. As program and project managers, engineers must expand their arsenal of skills to be effective at planning and delivering their products and meeting their customers' needs.

Responding to an aging highway network and to limits on expansion of new facilities, agencies are shifting their emphasis from building new roads to maintaining existing systems and optimizing capacity. In addition, the construction, maintenance, and operation of transportation facilities, which traditionally was provided by government entities, are increasingly being delivered by private-sector firms and public-private partnerships. The public-sector role has shifted from provider to manager, facilitator, and regulator, putting new and different demands on transportation agencies and the research entities that support them.

The world's trading patterns and economies also have changed, and as communication networks continue to expand, additional change is inevitable. As economies expand from national systems to continental and global systems, our transportation issues and problems evolve in response. New research issues emerge, as does our ability to look beyond traditional borders for information, best practices, and potential partnerships.

As we approach the next millennium in this new environment, we must continue to operate intermodal transportation systems that are efficient, safe, and environmentally sustainable. But we must do so while increasing the emphasis on competent fiscal management, sound business practices, and customer-focused services. Transportation research must be linked to these business goals. Research programs must demonstrate how they support these goals while remaining responsive to the transportation profession's current and future needs. It is this balance between supporting current programs and trends and anticipating the future that allows research programs to best serve their customers, even in times of shrinking budgets.

Tremendous advances in the fields of communication and information technology have had major impacts on research methods. Good research depends on good data. Twenty years ago, it was difficult to find and retrieve information. Today, we have fast and convenient access to vast quantities of information. Electronic communication technologies have made a vast trove of information available to transportation researchers, making the global body of knowledge more readily accessible. Improved communication tools and information resources, together with stronger partnerships with marketing and communications professionals, have contributed greatly to our ability to disseminate and implement the results of our research.

All of these factors have contributed to changes in the conduct of transportation research as we approach the 21st century. The most notable trends and future issues can be grouped into four broad categories:

- Financing transportation research,
- Administration of research,
- Information management, and
- Implementation of research results.

FINANCING TRANSPORTATION RESEARCH

To secure adequate research funding, transportation research organizations must closely reflect and support the strategic goals of their parent organizations. Most government transportation agencies are moving away from their old mission of solely providing and maintaining infrastructure; they are moving toward facilitating and enabling a broad range of integrated services. Research departments play an important role in helping to achieve these new institutional objectives, but they must expand their focus if they are to retain their relevancy and senior management support. Research programs with a strong policy and economic component will more likely be supported by their parent organizations, because they offer the resources and expertise that senior management needs to make wise strategic investment decisions.

Research managers in transportation agencies should thus be regarded as part of the strategic management process. For this to happen, research organizations and the agency's top management must develop a mutual level of trust.

No matter how well a research organization is supported, it is rarely economical for a researcher to work in isolation. Given global changes and increased demand for better use of limited resources, the research organizations that excel in the future will be those that pool their resources to work on common issues and problems. Transportation organizations must find new and innovative ways to finance their research. Cooperative partnerships are

an important strategy for both maximizing the value of the research investment and reducing the duplication of effort. Cooperative research programs in the United States and around the world are strongly supported, and all partners have a solid understanding of the value and benefits that result from sharing resources.

Research collaboration, in various forms, has achieved a high level of prominence in the past decade. Partnerships between public, private, and academic institutions are common and are being used more frequently to leverage available funding for best results. The recently concluded Strategic Highway Research Program (SHRP) and the ongoing SHRP implementation program are excellent examples of successful partnerships among federal and state governments, industry, and academia. By pooling funds and expertise, states were able to leverage their resources to study and develop solutions for a targeted list of problems over a short (5-year) timeframe. In the foreseeable future, these arrangements will become even more common and will more often include multinational public and private sector partners.

The National Cooperative Highway Research Program (NCHRP) is the most significant forum for research collaboration among government agencies in the United States. The NCHRP budget of \$15–20 million per year is provided by the state departments of transportation, which contribute a portion of their state planning and research funds. Projects are selected by the American Association of State Highway and Transportation Officials' Standing Committee on Research and administered by the Transportation Research Board (TRB). The Federal Highway Administration (FHWA) also administers a pooled-fund research program, with participation from federal and state transportation agencies. At the international level, the Road Transport Research Program of the Organization for Economic Cooperation and Development (OECD) administers a research program using pooled voluntary resources contributed by OECD member countries.

ADMINISTRATION OF RESEARCH

To justify their programs, today's research managers must be able to measure and discuss the performance, quality, and value of their programs in terms that support the strategic goals of senior management. Performance measures for research and development programs are currently a high priority among highway agencies.

It is not enough to simply evaluate a program's performance, quality, and value. To develop and sustain support for a strong research program, researchers must proactively promote the value of research both within and outside the agency. To do this, transportation researchers must develop and perfect their skills in marketing their programs and services.

Today, transportation researchers also have better tools and training to carry out their work than their predecessors did. As the primary role of transportation agencies shifts from delivery of infrastructure to management of transportation services, research administrators need a broader set of management skills. Professional capacity building—that is, enhancing the skills and knowledge base of current practitioners—has become a priority for transportation agencies and organizations. Sustaining and improving the skills of the current research community and laying the groundwork for the next generation of highly trained and competent transportation researchers is a critical issue. Much work has been done to develop manuals, primers, and courses that provide guidance and assistance in conducting research. The conduct of research will be treated in an even more systematic

fashion in the future, and the emphasis on the application of superior research practices, scientific methods, networking, partnering, and marketing will likely increase.

INFORMATION MANAGEMENT

Because organizations with sound fiscal management practices do not spend time or money duplicating research that has already been conducted and verified, comprehensive information on the state of the art and practice must be readily available. Information based on published reports and journals, research in progress, and human expertise can be found and retrieved by using a wide variety of manuals and electronic sources, which include bibliographic and statistical databases, library catalogs, and web sites.

The value of information and information services is gaining recognition among transportation researchers. A recent study by FHWA found that the money spent on information services can yield benefit-to-cost ratios in excess of 10:1 (1). The value of information can be measured in terms of

- Reduced costs of agency research, technology development, and operations;
- Quicker implementation of innovations and time savings; and
- More effective decision making at all levels of the agency.

The study report provides information on organizations that have saved millions of dollars by investing in access to accurate, timely, and relevant information.

Transportation professionals are becoming more aware of major transportation research resources such as the Transportation Research Information Service and the International Road Research Documentation database, as well as less focused sources such as the World Wide Web. These resources provide access to the global network of research information and hence improve the quality of research and make more efficient use of resources.

As the amount of information proliferates, the importance of the role of the information professional has become better understood and more prominent. Research librarians and information specialists—trained and skilled in the integration, analysis, and management of information—now are recognized as important members of the research team. Information professionals will play an important role in the organization and retrieval of web-based information systems in the future.

Other information management initiatives have sprung up in recent years. For example, information clearinghouses are being developed that compile, organize, and disseminate information on high-priority topics. Several recently developed clearinghouses are devoted to areas that include intelligent transportation systems, work zone safety, highway metrication, and transportation demand management. Clearinghouses play an important role in the information exchange and research process and probably will become even more prominent.

Concern for the timely reporting of current research is of growing interest. Information databases are only as useful as the information they contain, and research organizations are increasingly motivated to report new projects as they begin. New technologies are being developed and used to facilitate information gathering, making it easier for researchers to contribute information about their work to major international databases.

Clearly, information technology will continue to advance rapidly and significantly affect the way we exchange information, acquire new knowledge, and conduct transportation research. Issues involving the organization, storage, and retrieval of information present some of the greatest challenges that need to be addressed in the coming years. Although the Bureau of Transportation Statistics is creating a National Transportation Library of full-text electronic documents, vast quantities of existing printed material remain inaccessible. Greater efforts will be needed to link library catalogs and improve document-delivery services.

The preservation and archiving of printed transportation research documents (to ensure that documents are not lost as a result of age or deterioration) is another important concern. Finally, serious efforts must be taken to analyze and organize the volume of information being made available through web-based Internet sites, through either better design and integration of the sites as they are developed, or improved sophistication of tools that enable users to search for information across multiple websites.

IMPLEMENTATION OF RESEARCH RESULTS

The benefits of applied research will be realized only after the research products are implemented in the field. The information and communication tools described earlier can be used to help market innovative technologies and strategies for improving our transportation system. However, having the ability to quickly and efficiently access information about the latest research will not guarantee that the research products will be put into practice. Many barriers to the implementation of research results—resistance to change; the complexity of effective communications; and the cost and inconvenience of personal contact, which often is the most effective way to disseminate information about and learn to adopt new technologies—remain to be demolished.

The concepts behind technology transfer and its practice have received considerable attention from the transportation community during the past decade. Technology transfer generally refers to a strategy or process for bringing appropriate practices or technologies to the attention of the transportation practitioners who can benefit from them. Technology transfer has been described as a process that links research and implementation; however, it is more accurately described as an effective communication process that links information with the people who can benefit from it. Technology transfer involves packaging and communicating information in a manner most appropriate for its target audience.

Technology transfer has a tremendous potential to optimize the operation of transportation systems cost-effectively, by reducing or eliminating duplicated effort and by facilitating the implementation of best practices and relevant technologies. The process of technology transfer is becoming better understood and more systematic, and a primer that provides guidelines for the best technology transfer practices has recently been published (2). Technology transfer in transportation will continue to expand, and the most effective practices for technology transfer will become more widely disseminated.

Transportation agencies, seeking ways to hasten the implementation of research results, are increasingly encouraging or requiring researchers to develop implementation plans as part of the research process. In the future, we probably will see even stronger ties between the research and implementation phases of innovation processes.

REFERENCES

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