TEN THESES ABOUT TRANSPORTATION RESEARCH

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Research is our middle name at TRB. In reality, we do very little hands-on research. We do, however, identify research needs, coordinate research, administer research programs, and generally promote research by disseminating research findings and providing opportunities for researchers to interact with one another. Clearly, the Transportation Research Board is part of the nation's transportation research community, and it is as a member of this community that I have been speaking from time to time about the subject of this essay.

Like any community drawn together by a common purpose and experience, we take for granted some basic aspects of our work, which we know almost instinctively and about which, I believe, we do not often enough remind ourselves. More important, we do not tell others about them. Too often, for a variety of understandable reasons, we let misunderstandings about the nature of research go unchallenged even when they are at odds with fundamental beliefs that we all share.

Provided below is my list of 10 theses about transportation research. Not all are of equal importance, others could be added, and certainly some could be better articulated. Some are related to research generally, not just to transportation research. They are offered in the spirit of promoting greater awareness of the nature of transportation research among those of us in the community and providing a checklist that we should periodically discuss with the sponsors and users of research.

RESEARCH MATTERS

The first and foremost thesis is that research can make and has made a difference—a huge difference—in the availability and affordability of transportation and thereby in our quality of life.

Unfortunately, it is all too easy to overlook the steady stream of new and better technologies that have been developed for transportation. Many of the improvements in technology have been incremental, spread out over many years, with no single improvement responsible by itself for breakthrough gains in performance. Moreover, focusing on the effectiveness of individual research projects and programs can obscure their cumulative and synergistic impacts.

For example, during the past 13 years, *TR News* has been running the "Research Pays Off" series that reports on successful research using hard numbers about benefits and costs. In an era of constrained resources, producing and disseminating such information is important. However, hard numbers are difficult to come by, and the "Research Pays Off" articles have, of necessity, dealt with tightly circumscribed projects for which cost and benefit information has been carefully collected.

Taking a different approach, last year's special issue of *TR News* celebrating TRB's 75th anniversary summarized the remarkable progress since 1921 in 10 areas: bridge design, highway pavements, traffic control, trucking, highway safety, air travel, railroad freight, motor-vehicle fuel efficiency and emissions, public transportation, and intermodal freight transportation. Whether an order-of-magnitude reduction in the motor-vehicle fatal accident rate, the development of longer-lasting pavement materials, the design of more fuel-efficient and less polluting motor vehicles, or the advent of new ways to move freight, the enormity of success through research and technology is unmistakable despite the lack of hard numbers about benefits and costs.

RESEARCH IS A TOUGH SELL

Transportation agencies, especially those in the public sector, will always be pressed to make the case for research and its funding. Most public officials acknowledge the importance of transporta-

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tion research; but when times get tough (and tough budgetary times seem perpetual), activities for which a payoff is years, even decades, away are at a disadvantage. If infrastructure maintenance can be deferred, what can one expect for research? Moreover, even the long-term link between transportation research and public welfare appears less direct than it does for medical research and defense-related research.

The fact that research is a tough sell places a special burden on the transportation community not only to make the case for research but also to ensure that research funds are used wisely.

Goal Is Innovation, Not Research

Tom Larson, a former Federal Highway Administrator and a distinguished researcher, observes that ". . . research costs money, innovation saves money." He is, of course, right. Research does not necessarily lead to the implementation of better, more cost-effective methods and materials. Recognizing this, transportation agencies are increasingly focusing on innovation as a process: one that includes problem identification, research and development, technology transfer, training, testing, and procurement activities.

Innovation Process Is Inherently Messy and Confused

All too often those of us involved in research and research management speak as though innovation is a neat, orderly process that begins with basic research, moves on to applied research, and concludes with demonstration and technology transfer activities. This view greatly misrepresents the complexity of innovation in transportation and promotes unrealistic expectations.

In the real world, innovation is frequently a two-steps forward, one-step backward process fraught with uncertainty and more than occasionally appearing to depend on serendipity for success. Technologies that must work together in systems may be at different stages of development. Paths that appear promising from a technical perspective may not be the ones most feasible on institutional or economic grounds. More often than not, innovation is a process of iteration: the problems remain the same, but we work continually to refine existing solutions and develop new ones.

Transportation Research Programs Appear Fragmented and Disorganized

In comparison to defense research programs, transportation research appears (for good reasons) fragmented and relatively disorganized. Unlike defense, transportation is a highly decentralized industry with tens of thousands of institutional and corporate participants. In the highway field alone, nearly 40,000 local and state agencies own and administer public highways. Although transportation agencies have much in common, they face different challenges and look at research from different standpoints and with different priorities. Thus, it is appropriate, even essential, that to some extent transportation research programs mirror the industry they serve with distinct federal, state, university, and private-sector research programs. In this way, those of us in transportation research can maintain close links with agencies and practitioners at different levels—communication that is necessary to keep the research relevant and maintain the partnerships required for research products to move from the lab into practice.

Transportation Is Neither a Discipline Nor an Area of Science

Transportation is an area of human activity that involves an incredibly diverse array of technologies and systems. Much follows from this fact, including the need for multidisciplinary approaches to transportation challenges. But the human dimension of transportation deserves special emphasis and is particularly important in understanding how transportation facilities and services evolve.

Human-factors issues of all sorts affect transportation, including a host of issues involving operator-vehicle interactions and their consequences for performance and safety. Among these issues are individual preferences about where to travel, when to travel, and how to travel; and the values placed on travel time, safety, comfort, convenience, and so on. Together these preferences and values not only define the demand for transportation but also affect decisions about where people live, work, and recreate.

In looking to the future, how the ongoing revolution in communication and information tech-

nologies will change transportation is likely to be determined more by the behavioral response to the new technologies than by the technologies themselves. Predicting how new technologies will develop is difficult, but often not as difficult as predicting how people will choose to use the technologies and how these choices will affect society at large.

Balance Is Important

No one knows what the optimal portfolio of activities in a research and technology program should be, nor are we ever likely to deduce a process that will tell us. However, we do have some ideas about what research and technology programs should contain. For example, as noted above, it is generally accepted that such programs should be innovation programs and that they should contain a blend of research, development, demonstration, technology transfer, and training activities.

Within the context of research, it makes sense that in a field as broad as transportation the topics studied should reflect that breadth and include both the hard technological issues as well as behavioral, economic, and institutional issues. Research aimed at incremental gains in current technologies and higher-risk research aimed at breakthrough technologies should also be included. Again, no one knows what the ideal mix should be; the actual mix is the result of judgment calls made by research sponsors and agencies throughout the country.

Duplication in Research Is Not Necessarily Bad

The Transportation Research Board was created in part to reduce the number of duplicative research projects under way in the highway field in the years immediately following the passage of the Federal Aid Road Act of 1916. This continues to be an important goal of TRB's staff, committee, conference, and publication activities. But some duplication in research is healthy and necessary to keep the innovation process strong and robust.

Researchers looking independently at the same problem from different perspectives can sometimes find alternative solutions that otherwise might be missed. At other times, it is also appropriate to reexamine old problems and old data sets in light of new information or to take advantage of newer analytical techniques. And, of course, some duplication is warranted simply to ensure that important results can be replicated.

Although this is not a plea for more parallel research projects (researchers should always be prepared to explain how their work relates to previous and ongoing work elsewhere), research projects that appear to duplicate other work should not be rejected out-of-hand.

Innovation in Transportation Is Difficult

Innovation is never easy in any field. The transportation field, however, presents some special challenges to innovation that are not always found elsewhere. As noted above, transportation is highly decentralized; it is not one industry but a collection of industries. In many instances transportation is a joint public-private enterprise in which responsibility for innovation is left ambiguous. And perhaps most important, when the public sector is involved, marketplace incentives that drive innovation in other industries often do not apply, and the desire to safeguard public funds minimizes risk taking. Given these challenges, progress in introducing better, more cost-effective technologies in transportation is all the more remarkable.

Innovation Requires Champions

Because the innovation process entails much more than research, responsibility for innovation is not restricted to researchers. Everyone working in transportation must assume some responsibility for innovation. Of course, the problem with something's being everyone's business is the tendency for it to become nobody's business—not deliberately but simply because there are so many demands on time and energy. Nonetheless, innovation depends on individuals at all levels in both the public and private sectors who will support research, take prudent risks, and champion promising products, methods, and techniques.