

Value of Transportation Research: Federal Perspective

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The value of transportation research may often be quantified in terms of direct savings associated with the construction, maintenance, and operating costs for transportation facilities. Such an approach can serve as a useful device in determining the cost-effectiveness of the research effort and as a means of supporting a feasible level of research funding. However, value must also be considered from the perspective of the basic objectives of specific research projects and the scale of the problems being addressed. As the magnitude of the problem increases, a more substantial research effort is justified, even though the probability of solving the problem successfully may be relatively low. Although there frequently are significant transportation research developments to which high values may be attached, research must be viewed as a systematic cumulative procedure wherein individual studies contribute to the final objective as the nature and the multiple facets of the transportation problem become more precisely defined and understood.

In an assessment of the value of investments in research activities, recognize that the research objectives of an agency may dictate differing measurements of value. For example, if the primary mission of an agency is of a regulatory nature, a different value yardstick should be used than that associated with much of the research in the private sector, where the development of marketable products is usually given top priority.

In the broadest sense, transportation research is conducted by the U.S. Department of Transportation for the purpose of bringing about a desirable change in the nation's transportation system. This may be viewed in terms of a desirable change of a near-term nature and, at the other end of the spectrum, as a possible long-term change that, at the extreme, could conceivably involve the deployment of an entirely new surface transportation concept. Because of the basic differences in research targeted at near-term problems as compared with longer-range research, the value yardstick must also reflect these differences. It seems appropriate, therefore, to consider the value question separately, as it relates to the short-term problem-solving research effort and research of a more fundamental nature that has a more futuristic perspective.

By far the largest slice of the federal highway research and development program is of an applied nature allocated to specifically identified problem areas. These problems are either nationwide in scope or at least applicable to a significant segment of highway mileage included as a part of the federal-aid highway system.

Recognize at the outset that any research and development conducted under the auspices of the public sector, whether at the local, state, or federal level, should only be undertaken after determination has been made that it is either not desirable or not feasible for the private sector to undertake the specific research and development being considered. We have been fortunate in the highway industry that the private sector has historically played an active lead role in the development of new highway products and construction and maintenance equipment whenever the projected market can stimulate the needed level of investment to support the research and development activity. However, in those instances where the market is either very limited or no marketable product exists, where there is a vested interest to be served by maintaining the status quo, where the research may support regulatory action, or where the required level of funding exceeds the financial resources of the private sector, the case for involvement of the public sector is supportable.

In addition to determining whether a research and development effort is more appropriate for public in lieu of private-sector financing, it is also essential to evaluate objectively the appropriate public-sector level to undertake the research and development activity. The types of problems addressed by the highway research program vary from those of a local nature, such as the determination of the durability characteristics of a specific local-aggregate source to problems of national scope. It goes without saying that, ideally, the highway agency for the local level of government should be the logical choice to perform the necessary evaluation to determine the suitability of the locally available aggregate since the research results are primarily of only local value. By the application of this same logic, a strong case can also be made that highway research that addresses problems that are statewide in scope be conducted by state highway agencies and problems of national significance be addressed at the federal level. This type of structure obviously enhances the actual adoption and timely implementation of the research output and the resulting societal benefits.

In considering the societal values that accrue from an applied research program targeted at specifically identified problem areas, the most simplistic value assessment is to record direct savings in construction, maintenance, and operating costs attributable to the implementation of a research output. This is a straightforward approach that can serve as a useful device in determining the cost-effectiveness of the research effort. It may also serve as an effective means of quantifying the benefits of research for the purpose of supporting a feasible level of research funding. However, as we move into areas where the research results may be targeted at protecting or enhancing environmental features, for example, it becomes more difficult to quantify the value of the research output. Even though the value yardstick cannot be calibrated in terms of cost savings, the research results may, nevertheless, contribute significantly to the overall benefit and well-being of society as a whole. We must, therefore, recognize that other measures of value must be considered and, in many instances, there are no commonly accepted standards for measuring worth or value.

This is particularly true as we move from the area of applied research, which generally equates to research targeted at short-term problem solving, to longer-term research, where more emphasis is placed on basic research. Basic research is generally undertaken to gain fuller knowledge or understanding of the fundamental aspects of phenomena and of observable facts, without specific applications toward processes or products in mind. Therefore, the probability of developing basic research results that have a high short-term payoff is far less than that associated with most applied research undertakings. Because of a general tendency to at least attempt to identify an estimated near-term savings for all types of research, whether applied or basic, it is extremely difficult to defend requests for basic research in the budget arena. Earmarked funding included in most public agency budgets for basic research is either nonexistent or at best minimal, even though the scientific community recognizes that basic research should be undertaken because of po-

tential long-term societal values. Nevertheless, a decision to fund basic research is extremely difficult to defend, particularly under restricted budget conditions.

Closely related to the value concept of research is the risk factor. In our desire to quantify value, we often overlook that any research undertaking has a certain degree of risk. As well-known scientist A.B. Thomas, president of the Batelle Memorial Institute, once said, "If success is certain, there is no point in the experiment. Success often means the end of thought; failure may represent a fair beginning." If the problem being addressed by the research effort has a significant societal or economic impact, a more substantial research investment is justified, even though the probability of successfully solving the problem is relatively low. This is well illustrated by the large investment in cancer research, where a significant part of the total research effort is of a high-risk nature but, because of the potentially large benefit to society, the base of financial support is broad. In a similar vein, the potential impact of the world's dwindling petroleum supply on our nation's transportation system is beginning to be recognized by policymakers in both the public and private sectors and has resulted in substantial increases in energy-related research activities.

In summation, research is generally recognized as a valuable asset to federally funded programs administered by the U.S. Department of Transportation. However, since an applied research program can be more-effectively equated to near-term benefits, it is much easier to defend in the budget review and approval process. The result is that long-term research of a more basic nature generally receives only limited support and is usually the first item to be eliminated from an agency's research and development program.

Value is a many-faceted quantity that must be considered from the perspective of the basic objectives of individual research projects and the scale of the problem being addressed in terms of economic and societal impacts. As the magnitude of the problem increases, there is generally sufficient support for a larger research effort, even though the probability of success may be somewhat limited. Although the value of research is irrefutably accepted as a fact of life in the scientific community, this is not the case in the decision-making arena, where limited financial resources must be allocated on a priority basis. To ensure continued financial support for transportation-related research, we must continue to recognize the importance of quantifying its potential value, even though it may not be feasible to do so in absolute terms.

Value of Research to the Researcher, Economy, and Society as Viewed at the Academic Level

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The great value of research to the individual and to society as viewed by academia is presented as obvious. Further support is provided by factual data on the benefits that result to the Indiana State Highway Commission from 40 years of cooperative research with the Joint Highway Research Project at Purdue University. One of the most significant benefits noted is the production of the leaders and educators of the future from a university research program. The significant contributions of the Indiana experience in this area are reported and the challenge made that the opportunity, really the responsibility, for similar research-education programs exists for all transportation agencies and universities.

The basic question posed by the assigned topic is one that should never have to be asked, Is there value in research? Of course there is value, tremendous value. Research has given us almost everything we have. As an example, consider the next physical items you touch or use and think about how each of them came to be. If all people did that each time they used something, we would no longer take so much of what we enjoy for granted; we would know the value of research. There is great value in research. If there were not, we would not be spending \$51 billion/year on research and development in this country.

Another question about research that has been voiced often also bothers me. That question concerns the risk in research and especially that basic research has a higher risk. The fact is that there is no risk in research. Any research done competently produces new knowledge, even if it is not what was desired. That, too, is new knowledge, and

any knowledge has value. Since the real purpose of research is to produce new knowledge, research will always be successful. Risk only occurs if from a particular research project one wants a specific result and nothing else.

In the early years of this nation, Thomas Jefferson noted, "An enlightened citizenry is the only safe repository of control over the ultimate processes of society." Americans then, and for many years after, looked to science as the way to progress and strength. In the recent two decades or so, however, our fellow citizens have become skeptical of science, as they have of many other things. They appear to have forgotten that science and technology play an increasing role throughout our society. In business, in government, in the military, and in the professions, science is clearly an important key to success. The computer has revolutionized activity everywhere. Modern communications govern much of what we do. Travel and transportation find clearly that their futures, although heavily affected by resources available and environmental concerns, lie primarily with what we can do through science and technology.

Economists estimate that advances in knowledge have accounted for perhaps three-quarters of the economic growth of this country. But the economic impact is probably not as important as the impact on society, although I find it difficult to separate the two. Albert Einstein once said, "Concern for man himself and his fate must always form the chief