

Efficient Utilization of Transportation Research and Educational Resources

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In beginning to cope with today's lack of transportation research funding, Wilfred Owen might begin by quoting from Charles Lutwidge Dodgson, the English mathematician and logician (better known as Lewis Carroll) and author of Alice's Adventures in Wonderland. Robert Herman would recite a delightfully appropriate and somewhat irreverent limerick. Paul Roberts would tell a homespun story--probably about a young lad with a frog in his pocket--and poke fun at Henry Bruck's necktie. Others of us would organize a task force or form a committee or write a technical paper or journal article. But in a word, transportation educators, researchers, and practitioners are "concerned" about the level of financial support for transportation topics.

Experience and history tell us that the pendulum will swing. Improved funding, interest levels, and demand for specially trained transportation research personnel will surely return. The challenge in the interim is to make more effective and creative use of existing resources (people, dollars, and services in kind). Services in kind are contributions of data or computer time or other resources that defray project expenses. Such services might be used as matching funds.

The purpose of this paper is to identify and discuss innovative funding sources for transportation research in an era of scarce funding. To assist in this discussion, several distinctions and premises are proposed:

1. Demand for trained personnel should lead supply in order for an adjustment to occur.
2. Fundamental conflicts exist between research objectives and more applied opportunities. These conflicts are more problematical for university faculty and staff but exist within industry and government laboratories as well.
3. Although industry and private venture funding have been required to provide increased support for basic research in the current economic climate, the responsibility for major support for basic transportation research remains with government (primarily at the federal level).
4. There is a distribution of skill levels and motivations among research personnel. The most highly skilled and motivated will almost always have support; the least capable dilute available resources and should be weeded out. The greatest funding challenge is for the larger group of investigators in between the two extremes.
5. Griping and commiserating about the current lack of funding is counterproductive and wasteful. Instead, we need to justify our needs with good

work, solid preparation, a positive outlook, energy, productivity, and recognition that we get what we deserve.

DEMAND AND SUPPLY

There is a general shortage of highly skilled, highly trained people to conduct research. National Science Foundation (NSF) numbers indicate that U.S. universities conferred 3,400 Ph.D.s in engineering in 1970; 2,500 in 1980; 2,644 in 1982; and 2,780 in 1983. Of these, 354 were in civil engineering and 86 were in industrial engineering in 1983.

Personal experience as an employer and a recruiter indicates that the current supply is well below demand. Further, prospects for the future tend to be dim with one large private institution considering dropping the undergraduate civil engineering program because of lack of students. At several other universities, student-to-faculty ratios in transportation programs may necessitate a shift of faculty to other topics. Finally, high demand and good salaries for engineers with B.S. and M.S. degrees have siphoned off potential Ph.D. candidates.

RESEARCH OR CONSULTING?

The prime function of the university is education. The purposes of faculty and graduate student research are to develop new knowledge (which also retains the interests of the capable faculty needed for the basic teaching function) and to train students in how to approach and conduct research. There is often a temptation to blunt these purposes by applying resources for consulting or contract work of a short-term or applied nature. This is particularly true in times of financial shortages and declining markets for longer range research.

It is proposed that contacts made outside the university by faculty and staff members should include prospecting for support for more basic research. Successful applied research, consulting, or training services with a new client build exposure and credibility. As a result they represent opportunities to conduct more fundamental research.

There are the additional advantages in being there first--in frontiers of science or technology, in newly discerned needs, or in anticipated needs. Artificial intelligence and expert systems needs, and applications in logistics, distribution, routing, and scheduling are current transportation-related examples.

SUPPORTING BASIC RESEARCH

Who should support basic research? The responsibility rests with society and with government as the agent of society. Government and society agree that this is the case with science but attitudes regarding engineering vary. On the plus side, the NSF is considering long-term financial support of engineering research centers. NSF describes the purposes of such on-campus centers as "bringing together university and industry people to improve the education of those who will undertake the practice of engineering and expos[ing] a significant number of engineering students to the nature and problems of cross-disciplinary research or engineering systems" (1).

In the meantime, the continued decline in federal support and increased competition have spurred industrial and private venture interest in sponsorship of university research. Such support comes in many forms ranging from unrestricted, philanthropic grants to directed contracts with specialized faculty on specific studies.

One example is the Presidential Young Investigator Awards of the National Science Foundation (2), which are intended to provide research support to the best science and engineering faculty members and include participation of the industrial sector.

The awards are directed to helping universities respond to the demand for specially skilled research personnel in both academia and industry. The awards are for a minimum of \$25,000 (over a 5-year period) but NSF will provide additional matching funds of up to \$37,500 on a dollar-for-dollar basis with funds from industry. Thus potential support is up to \$100,000 over a 5-year period, and prospects are excellent for client involvement and exposure.

About 55 percent of the General Motors and General Motors Foundation contributions in 1983 consisted of aid to education, including support for colleges and universities and scholarship and fellowship programs (3). Another example has been the designation of three universities as Affiliated Laboratories by the Association of American Railroads. The purposes of the financial support and commitment represented by these designations are threefold: (a) to retain competent investigator interest by partially replacing lost or declining federal support, (b) to provide for continuity and stability over a designated period of time, and (c) to make more efficient application of resources through local specialization and coupling through technical advisory committees, which include industry representatives. In some cases, portions of such financial aid from industry, associations, and foundations are available to perceptive, aggressive, and capable researchers.

TIMELY TOPICS

An example of the importance of timely topics both in gaining financial support and in assisting managers to make better use of available resources is the Strategic Transportation Research Study (STRS) (4). This study was initiated by the Transportation Research Board (TRB). Given the continuing decreases in research support, STRS was initiated to (a) identify high-value research topics (beginning with highways), (b) assess the prospective costs and benefits of research on those topics, and (c) recommend alternative approaches to getting the needed work done.

Other examples of timely topics include:

- Better use of existing facilities, for example, highway operations and transit operations;
- Freight operations and logistics;
- Applications of personal computers;
- Data needs; and
- Applications for artificial intelligence and expert systems in transportation.

Some may argue that traffic operations and transit operations (and consulting, as well) are not research. However, these topics need work and given good work and successful results they could lead to more research-oriented efforts when financial prospects improve or other somewhat related research needs arise with the same satisfied clients.

The topics of freight operations and logistics have surfaced as opportunities because of the rise in interest rates, the economic slump, which created pressures to find cost savings, and deregulation. In addition, as productivity improvements provide efficiencies in manufacturing, the proportion of product costs from transportation, material handling, and inventory expenses increase.

Despite significant strides already made in applying personal computers in transportation design, operations, and management, efforts to date only scratch the surface. Innovative applications await discovery and, once the idea is sold, training and software program improvements are follow-on possibilities.

Transportation data needs are of continuing concern (5). Vital to both research and applications, the collection, organization, and provision of transportation data represents opportunities for individuals and organizations.

INSTITUTIONAL ARRANGEMENTS

Joint ventures have many advantages in times of limited resources. Often services in kind can be provided by organizations collaborating on research areas of common interest. Two examples of services in kind are data and computer time. In addition, pooling of personnel can often provide a critical mass where any one of the joint venture partners could not manage sufficient staff alone.

Two subject areas that might afford opportunities for public-private-university joint ventures are (a) management science and (b) human behavior and traffic safety.

Substantial experience in business management by industry and commerce might be applied to government transportation management needs through university analysis and review. Cooperative highway safety research among manufacturers, government agencies, and universities would expedite the development of increased understanding of how people perceive and use safer transportation products. Such understanding could contribute to resolutions of drinking and driving problems and to increasing the level of seat-belt use and acceptance of mandatory seat-belt use laws.

Bootstrapping is another set of opportunities for getting started. Bootstrapping comes in many forms, including seed money grants from foundations or industry, building from support for other work in traditional areas (such as National Cooperative Highway Research Programs), or entering new areas through professional and technical societies such as the National Council of Physical Distribution Management.

Education and Training contracts can often lead to research support as the client and the contractor get to know the subject and one another better. Professional acquaintanceships can also be improved through faculty members consulting with industry and government or through sabbaticals with industry and government. In such arrangements everyone gains. The client gains through the availability of specialized knowledge, training, and capability. The faculty member gains through a broadening of experience and exposure to new, real-world settings. Perhaps most

important of all, the students of the faculty members benefit from the enrichment in the knowledge and experience base of the teacher.

In addition, research work with industry is exciting and stimulating. Such work provides opportunities to prove theory, to demonstrate application potential, and to have the satisfaction of seeing one's efforts in actual, ultimate use. Such work makes demands on the realism of models and on research ingenuity and personal productivity, which are sometimes missing in a more abstract environment. Exposure to the clients also serves as a constant source of new research ideas.

Consulting in mature subject areas and with state and local government sponsors in addition to federal sponsors can often lead to support for research work in newly developing or frontier subject areas. For example, work in management, operations, and planning for transit agencies could lead to future, more basic work in marketing or in spare-parts inventory control for the same organizations. Finally, individual support from government, industry, or a trade association for a particularly deserving graduate student can often lead to continuing interest and support.

SATISFYING THE NEED FOR PERSONNEL AT THE Ph.D. LEVEL

The present shortage of personnel at the Ph.D. level will persist until funding improves. Mere demand for qualified personnel is not sufficient; there will be a lag in the supply. In the interim, sabbaticals (particularly for younger, perhaps untenured faculty and staff), reverse sabbaticals or trades of qualified industry or government personnel, and special scholarship or grant incentives from industry or government to particularly deserving, research-oriented graduate students would help. In addition, technology transfer programs that directly expose graduate students to industry and government needs might encourage pursuit of further graduate work.

Admittedly, persuading harried and worried administrators to dilute their scarce commodity by assigning people to possibly temporary pursuits will be tough to sell. But maybe the merits of the benefits will justify the attempt.

FUNDING SOURCES

With reductions in public agency support for research in transportation and in other important subject areas, private ventures have found it advisable to increase contributions in particular cases. Given the economic climate that has prevailed, support has focused on high-priority or promising topics. Foundations that focus on transportation include the UPS Foundation and the Eno Foundation.

Another time-proven source of seed monies is industrial affiliates. Transportation centers with affiliates who contribute a relatively modest annual membership fee have an assured financial base for helping young faculty members (plus an outside source of advisors for dissertation committees or for evaluating faculty and graduate student research).

As mentioned earlier, consulting and sabbaticals with government and industry represent an underused source of funding. The often-cited specters of patent rights and publication limitations are excuses and not impediments to partners working on important, interesting, and exciting topics.

One university faculty has proposed a variety of alternatives to the provision of critical research and equipment funds. One of the suggestions is for a student surcharge of \$300.00 per term on every engineering junior, senior, and graduate student. The resulting funds would be used to replace or provide needed equipment and to support research within the traditional review and approval procedures.

SUMMARY

The present paucity of funding for transportation research is natural, temporary, and probably deserved. The shaking out of less capable investigators from the transportation research field is healthy. The challenge is largely for deserving investigators to do what is necessary to justify the importance and the value of their proposed work.

REFERENCES

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