

Toward a Balanced Transportation Research Program

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National interest in transportation research is increasing. The advancement of U.S. transportation technology and expertise is one of the six major themes of the U.S. Department of Transportation policy plan published in February 1990. Research is cited as a strategy for maintaining a competitive economy and for meeting social goals. This belief is becoming widespread at the state level also, as transportation problems such as traffic congestion become more critical. However, there are challenges in developing transportation research programs to meet these needs. First, transportation is a broad field with many constituencies; there is disagreement over what type of research is most urgent. Second, consensus on the value and purpose of research is often lacking, particularly regarding the differences over basic versus applied research. These two challenges to developing transportation research programs are serious, at times causing disunity among parties who should have common interests. In Minnesota, the University of Minnesota Center for Transportation Studies has worked to develop a balanced transportation research program through a strategic planning process that is highly participatory. In this paper, the processes used are described, results are evaluated, and plans for the future are presented. Conclusions from the Minnesota experience that could be applied in the development of a national transportation research program are also presented.

There is a renewed national interest in transportation research. The national transportation policy issued by the U.S. Department of Transportation (DOT) Secretary Samuel Skinner in February 1990 has as one of its six major policy agenda themes "the advancement of U.S. transportation technology and expertise for the 21st century" (1). The U.S. DOT feels that the United States must strengthen its focus on technology and innovation to improve its transportation systems and to maintain technological leadership in the world. Research on several issues is proposed, such as human factors, information technology, financing techniques, environmental protection, high-speed and magnetic levitation rail systems, intelligent vehicle and highway systems, and design safety. Emphasis is also placed on disseminating information and research results and improving transportation education. DOT plans to expand its efforts to ensure that the U.S. transportation community is aware of and has access to emerging technological advances.

This new policy direction was fueled by several previous studies. TRB has long called for increased research, citing a decline in federal research funding for all transportation modes from more than \$1 billion in 1980 to an estimated \$750 million in 1987 (adjusted for inflation) (2). This decline happened during a period when federal research funding for defense

and public health was increasing. Compared with private industry research, transportation research funding also looks weak. High-technology businesses spend 7 percent of sales on research; other firms with research budgets of \$1 million or more spend 3.5 percent of sales. In comparison, federally funded research for transportation accounts for less than 1 percent of total expenses.

At the national level, there is also increased awareness of transportation research underway in Europe and Japan, particularly in the area of intelligent vehicle and highway systems. By failing to keep pace with these research advances, the United States loses an opportunity to develop private-sector leadership in a high-technology field and also falls behind in the implementation of transportation innovations. The research efforts in Europe and Japan are impressive, involving large collaborative efforts among academia, government, and the private sector (3).

This renewal of interest in research is also taking place at the state level. AASHTO has sponsored several studies by its Standing Committee on Research that outline future research directions for state DOTs. A report published in January 1990 presents the results of a detailed questionnaire completed by state transportation agencies, indicating a strong desire for increases in transportation research (4).

CHALLENGES TO DEVELOPING TRANSPORTATION RESEARCH PROGRAMS

Although there seems to be consensus that increased transportation research is needed, agreement regarding the type and purpose of the research is lacking.

Engineering Versus Planning and Policy Research

There is often debate between those who believe more policy-oriented research is needed versus those who desire more technological research. Transportation is a complex field, with many constituencies. As transportation problems grow, so do these constituencies. The problem of urban traffic congestion, for example, has increased the number of citizen groups, planners, and elected officials involved in the transportation debate. These groups believe that engineering solutions alone cannot solve the growing problems. They call for new methods of designing transportation systems that are integrated with land use and environmental planning and that also support social and economic goals. They would like increased policy and planning research to investigate new solutions.

On the other hand, engineering professionals point to the critical stage our infrastructure has reached, with investments in bridges, pavements, and other public works in danger of being lost. They call for increased research in materials, engineering design practices, traffic management, and so on. They see tremendous opportunities in applying technological advances to transportation problems.

This debate is not simple. There are certainly those in the engineering community who want policy research and those in the planning community who value infrastructure research. But in times of scarce resources, it often appears that sides are drawn. One discipline has difficulty understanding the value of another discipline's arguments.

In Minnesota, the largest transportation research efforts have been conducted or funded by the Minnesota DOT (Mn/DOT). These efforts have traditionally focused on what is called the "hard" side of research—materials, pavement, structures, etc. There is growing interest, however, by the state legislature and communities for "soft" research—on alternative transportation systems for congested urban areas and the relationship of transportation to the rural economy. The challenges lie in deciding how to allocate research funds to these various interests.

Basic Versus Applied Research

Another issue that is often debated when choosing research to fund concerns basic research versus applied research. Basic research deals more with discovery and theory, whereas applied research develops new methods (often based on the results of basic research) to address specific problems. Which has more value? How should funding be used for each? What should be the sources of funding for each?

Charles Fairhurst, former head of the Civil and Mineral Engineering Department at the University of Minnesota, has pointed out that university departments of civil engineering today emphasize one of two approaches in their teaching and research (5):

1. A modern approach, emphasizing laboratory experiments and mathematical analysis, and the development of computer and analytical or numerical approaches suitable for future applications (a basic research approach).
2. The traditional empirical approach, emphasizing case histories and collection of field data, heavily oriented towards design and consulting problems (an applied research approach).

Fairhurst states that ideally both approaches should be pursued, as they are in other fields. For example, basic research in a university electrical engineering department is complemented by applied research in private sector R&D laboratories; basic research in a medical school is closely tied with applied research in a university hospital; and basic research in agriculture is tested through applied extension programs.

However, university civil engineering departments have few opportunities to work with an applied research organization. If they choose the modern research approach, their theoretical work is restricted by the lack of adequate physical verification. If they choose the empirical approach, the lack of fundamental

basis for their designs limits the applications. They cannot do both approaches themselves because of limited resources.

Civil engineering faculty are most likely to be judged within their university (in promotion and tenure review, for example) on the basis of their performance in basic research—the primary emphasis of their colleagues in other university disciplines. Officials and practitioners in public agencies, because of limited applied research groups to consult, are more likely to press faculty for quick answers to urgent problems. If the faculty member tries to do both basic and applied research, usually neither group is satisfied.

The situation described earlier for civil engineering also applies to the other disciplines that conduct transportation research—economics, public policy, urban planning, etc. Most transportation research results are applied in the public sector. Few private sector research laboratories are involved, and rarely are special organizations, such as agricultural experimental stations, established to test basic research results before they are implemented.

The result of this situation is a lack of understanding by both academicians and practitioners about the needs and purposes for transportation research. Public sector practitioners are often desperate for help from the university to develop and apply new techniques that solve immediate problems. They may not appreciate the value of the theoretical work the academicians would like funded. The academicians at times think the practitioners are short-sighted in defining their research needs. They have little interest in pursuing the agency's applied projects, because they will not enhance their academic careers.

In Minnesota, these issues arise during transportation research discussions between Mn/DOT and the University of Minnesota. They also arise in other state efforts. In the past year, a study by the Stanford Research Institute (SRI) proposed the creation of a new urban university in the Twin Cities that would be more closely tied to the community through applied research and teaching. Some people hailed this proposal, saying that a new institution could provide services that the University of Minnesota does not. This produced counterarguments, particularly related to the role the University plays (6). Some felt the SRI suggestion implied that the basic scholarship in research universities is less relevant to the community.

The fear often present in these debates, as in transportation research debates, is that resources targeted for one (basic or applied research) will be used for the other.

Risks of Conflict

The debates described earlier can present serious challenges to developing transportation research programs. A certain amount of conflict can be healthy, sharpening the issues and leading towards a constructive consensus. However, conflicts that turn destructive can lead to a situation where neither side wins.

At both the federal and state level, funding decisions encounter growing pressure and competition, as there are many other serious problems to address besides transportation: education, health, economic development, the environment, etc. There is also the growing national deficit, which has caused

some decision makers to look at traditional transportation funding—the gas tax—as a deficit reduction method. Even though interest in transportation research is increasing, it faces serious competition in attracting needed funding.

Most of the transportation research funding will result from decisions by elected officials who are sensitive to disagreements among constituencies. If transportation groups are in conflict over the types of research needed, they risk being ignored in the competition for funding. The elected officials instead may turn to funding requests by interest groups that are united and well coordinated, which are much easier for them to deal with. If a balance can be developed and communicated to decision makers that is satisfactory to all transportation interests—between engineering and policy research and between basic and applied research—efforts to increase state and federal research funds stand a much better chance for success.

CURRENT APPROACHES

AASHTO Survey

The AASHTO report providing the results of research questionnaires (4) reveals how one key constituency views the future needs for transportation research. State DOTs are clearly in favor of engineering and applied research.

In terms of engineering versus policy research, AASHTO members are strongly biased towards engineering. The subject areas preferred were infrastructure, highway safety, new materials, highway congestion, and computer technology. Support for policy research such as long-range strategic research, economic analysis, and regulatory issues was low. When asked how they would use increased funding for research, they said they would increase state research funds by 50 percent, FHWA demonstrations by 26 percent, Strategic Highway Research Program (SHRP) by 17 percent, and National Cooperative Highway Research Program (NCHRP) by 13 percent.

AASHTO favored applied research over basic research by a wide margin. “Applied research on state and regional problems” received the highest rating, and implementation, technology transfer, and contract research were also highly rated. Fundamental research was rated number 15 out of 17 items, while university support ranked number 12. No increase in funding for university research was desired, whereas increases of 20 to 60 percent were desired for the five top-rated research activities.

SHRP, NCHRP, and UTCP Research Programs

Two of the traditional programs that AASHTO wishes to be increased—SHRP and NCHRP—are primarily applied research programs that focus largely on engineering problems. SHRP is “a time-specific, concentrated, short-term, and results-oriented research effort” (7). It focuses on engineering research, with heavy emphasis on pavement, structures, and highway maintenance research. NCHRP is “a unique, applied research program designed to respond to the needs of state highway and transportation departments” (8). The problems

are “specifically defined and limited in scope.” Although these problems include policy, planning, and administrative issues, the majority of the research is directed towards engineering problems.

The processes used for soliciting and selecting SHRP and NCHRP projects somewhat naturally encourage applied research. Problem statements are defined primarily by users. Research plans must follow prescribed methodologies, and proposals are selected using a ballot process conducted by user panels.

Both SHRP and NCHRP emphasize solving a problem, not discovering a theory or new technology that might ultimately be applied to several problems. Academic proposers, unless they have been actively involved on NCHRP panels and in TRB, are omitted from two of the critical research steps that they take most pride in: defining the problem and developing the methodology. In contrast, the National Science Foundation (NSF) is much more supportive of basic research, and does not constrain proposers in what problems they address nor in how they address them. The SHRP IDEA program was established to have some of these characteristics, accepting innovative proposals generated by researchers outside the request-for-proposal process. However, these proposals are still encouraged to address applied rather than basic research problems. One consequence of the applied nature of the SHRP and NCHRP programs is that consultants perform much of the research.

In the last 2 years, a third transportation research program has begun that specifically involves universities, the University Transportation Center Program (UTCP). This program was initiated by universities working with the congressional delegation, with little federal or state DOT involvement. This is reflected in the low ranking the AASHTO report (4) gave the UTCP program; it ranks last in priorities for research funding increases. This program is new and needs time to demonstrate its value. The new U.S. DOT administration has now actively begun to shape the UTCP to serve the goals of the U.S. DOT policy plan (1), and many of the initial uncertainties in the program are being resolved. The original intent of UTCP research—to bring new disciplines into transportation research, with less emphasis on engineering—has been confirmed, and offers promise for new approaches to transportation problems. However, there still appears to be some uncertainty between universities and DOT agencies on what research role the universities should play. DOTs may expect this research to follow the applied research model of NCHRP or SHRP, while universities may see it as an opportunity to do what they do best—basic research.

Effects of Current Approaches

The bias towards engineering and applied research exhibited in these surveys and programs does not mean that this research is not needed. There have been many innovations, for example, developed from NCHRP research, and SHRP projects exhibit great promise. The problem is that the desire to continue research programs along these lines causes concern to the new actors attracted to the growing transportation challenges. Nonengineering and academic researchers feel their innovations can play a larger role in addressing transportation

problems. If programs are not available for their involvement, transportation users do not benefit from the new approaches that might result.

If organizations that fund basic research, such as NSF, had a stronger commitment to transportation, complementary programs could be established with NCHRP, SHRP, and other applied research efforts. However, the lack of commitment to transportation by NSF is most likely influenced by the consistent message from AASHTO and others that transportation organizations place their highest priority on applied research.

C. V. Wootan, director of the Texas Transportation Institute, made a plea for more balance at the 1990 TRB meeting (9), calling for increased fundamental and applied research. He explained the important role university research plays in the education of transportation professionals, as well as in developing innovations.

CENTER FOR TRANSPORTATION STUDIES APPROACH

The University of Minnesota faced these issues in 1987 when the Center for Transportation Studies was established. The governor allocated \$2.7 million of oil overcharge funds to initiate the Center, and the legislature allocated an additional \$2.0 million of oil overcharge funds in 1988 for Center programs. In addition, the Minnesota Department of Transportation (Mn/DOT) and the Regional Transit Board (RTB) contributed administrative and research support. The Center has used these funds to establish ongoing programs of transportation research, education, information, and outreach. The oil overcharge funds must be spent in approximately a 4-year time period. The challenge for the Center is to establish worthwhile programs so that it can attract future funding when these funds are depleted. Because much of the funding is spent on research, the Center placed a high priority on establishing a balanced research program that meets the needs of various transportation interests in Minnesota.

Strategic Planning Process

The Center used a strategic planning process to develop its programs, with strong participation from the various constituencies, or stakeholder groups, that could benefit from these programs. An initial committee, primarily consisting of transportation professionals, developed broad recommendations (10) that outlined the Center's program areas, which allowed initial programs to begin while a longer term planning process was put in place. This planning process began with the formation of the Center's advisory board. This board has been involved in setting directions for education and information programs as well as research programs. Special emphasis has been placed on developing the research program.

Planning retreats were held to identify key stakeholder groups for the Center. These groups were used to select advisory board members and also to develop the Center's mailing list. Invitations were sent to selected leaders in Minnesota, and approximately 60 people volunteered to serve on the board. Ten of these people were also selected by the chair to serve on an executive committee. These leaders represent many

groups, with a balance of government leaders (including 10 state legislators), private sector leaders (shippers, carriers, and vendors), and academic leaders (deans of the university). The board was intentionally designed to have a diverse membership, to reflect the broad interests in transportation.

The full advisory board meets twice a year. The fall meeting discusses current issues and outlines long-term directions for the Center. The spring meeting hears a report on Center results and approves directions for the next year; it is scheduled in conjunction with the annual Center research conference. The executive committee meets an additional four times a year, to refine the advisory board directions into work programs and to select research priorities.

Communication and Participation

The Center has placed a high priority on communication and participation. Because its constituencies are so diverse and because there are, at times, disagreements such as those described previously, an attempt has been made to bring these groups together around their common interest of transportation. The Center's goal is to be a focal point for these groups, raising awareness of transportation issues and offering programs to address them.

The first way of doing this is to communicate to them frequently about the Center's activities. A monthly newsletter is currently sent to over 1,600 people, primarily Minnesotans. This four-page publication includes short items about transportation activities occurring at the university and a calendar of upcoming transportation events. Faculty on the mailing list are asked each month to contribute items that relate to transportation. This newsletter has been an excellent mechanism to help show the breadth of transportation activities occurring at the university. An annual report has also been produced by the Center that has been distributed widely (11).

The second way of becoming a transportation focal point is to give these groups various opportunities to become involved in center activities. In addition to the participation of advisory board members, there is wide participation by others in Center events. An initial success was the establishment of quarterly luncheons, where national experts are invited to speak on various transportation issues. These luncheons regularly draw a diverse crowd of over 100 people. In May of 1990, the Center held its first conference, focusing on transportation research. Over 300 people attended, providing an opportunity for people with diverse interests to interact. A focus of this conference was to allow practitioners to hear about the research being conducted by faculty members. In addition, the Center sponsors regular seminars and periodic forums that focus on specific issues, and is regularly sought as a cosponsor for other events.

A key goal of these communication and participation programs is to generate increased awareness about transportation, which ultimately is translated into input and guidance to Center programs.

Research Goals of the Center

The emphasis on communication and participation was used by the Center's 60-member advisory board and 11-member

executive committee to help define the Center's research program. The executive committee created a mission statement for the Center, which focused on the importance of multi-disciplinary approaches for addressing transportation problems. It also decided to use a request for proposal process to solicit research ideas from university faculty.

The Center used a participatory process with the advisory board to define the research emphases outlined in the request for proposals. The process consisted of the board's hearing experts speak about transportation issues, breaking into small groups to generate issues, discussing these issues in a large group setting, and completing rating sheets that ranked research priorities. This information was collected and analyzed by Center staff and then discussed by the executive committee. Following their direction, the information was incorporated into the request for proposal.

A key decision by the executive committee and Center staff was to cluster the various research issues generated by the advisory board into overarching titles. The end result was that proposals were requested from faculty for research in three broad emphasis areas (12):

- **Strategic Directions for Transportation in the Upper Midwest.** Proposals were requested for research that examines the relationship between the transportation system and the changing economic and social characteristics of the Upper Midwest.

- **Improved Management of the Transportation System.** Proposals were requested for research on how to improve the management of the transportation system, including decision-making processes and roles as well as technical management improvements.

- **Innovations in Transportation Technology.** Proposals were requested for research on transportation technology, including innovations that link vehicle technology to infrastructure design and management.

The request for proposals also listed three or four research questions under each of the three emphases.

Aspects of the Process

There are two important aspects of this process to note, given the challenges in developing a research program that have been discussed previously. First, a variety of nonengineering research topics are proposed in these emphasis areas. This was addressed explicitly by advisory board members in the large group discussion. Initially, a feeling was expressed that others could conduct the technical research (on pavements, bridges, etc.) and that the Center should focus on policy concerns. However, the discussion eventually turned to the importance of technological advances, located in the third emphasis area. The backgrounds of the participants were significant. The executive director of a pavement association spoke strongly on the need for research that developed strategic directions for transportation (first emphasis area), and the chair of a transit authority emphasized the importance of technological research (third emphasis area). These positions would be reversed for people with these backgrounds. The communication and participation broke down traditional bar-

riers and led to a consensus for a balance of engineering and policy-related research.

Secondly, the clustering of the research ideas by the executive committee left quite a bit of freedom for the proposer. This approach contrasts with the bottom-up process used by NCHRP, where several specific problem statements are created, methodologies prescribed, and research projects selected by a ballot approach. The specific issues generated by the Center's advisory board were instead used as indications of broader concerns. The clustering helped identify these concerns by creating overarching titles. The researchers were then asked to propose projects that would address pieces (which they would choose) of these three research emphasis areas and present their own research plans for accomplishing this research. This freedom allowed proposers to choose basic or applied research approaches and design their own research plans, an approach appropriate for academic researchers.

The request for proposals was announced to all university faculty. A peer review team of seven people was established to judge proposals against the criteria listed in the request for proposals. The executive committee reviewed the peer review results and made the final decision on what projects to fund.

RESULTS OF THE CENTER'S PROCESS

First Cycle

The first use of the request for proposals was in April 1989, when it was announced to all University of Minnesota faculty. Before that, the Center had funded some projects in selected areas, primarily in traffic engineering. The request for proposals required all faculty members interested in Center funding to follow the same process.

In response to this request, the Center received 31 proposals. The peer review team rated these proposals against several criteria established by the Center's executive committee. The executive committee made the final decisions on which proposals to fund, evaluating the overall balance of the program as well as the peer review results. Mn/DOT also reviewed all the proposals and selected five for Mn/DOT funding. The projects chosen for funding in July 1989 are summarized below under the three research emphases areas, indicating the university department and project subject:

- **Strategic Directions for Transportation in the Upper Midwest.**
 - Agricultural/Applied Economics: transportation/economy.
 - Forest Resources: transportation/forest planning.
 - Marketing/Logistics: just-in-time impacts.
 - Public Affairs: linkages among rural communities.
- **Improved Management of the Transportation System.**
 - Civil Engineering: ramp metering control.
 - Civil Engineering: intersection control (Mn/DOT).
 - Civil Engineering: network design (Mn/DOT).
 - Economics: airport congestion pricing.
 - Psychology: air traffic controller training.
- **Innovations in Transportation Technology.**
 - Agricultural Engineering: water flow/pavement subgrade.
 - Civil Engineering: pavement deformation (Mn/DOT).

- Civil Engineering: modeling pavement systems.
- Civil Engineering: corrosion of reinforced-steel bridges.
- Civil Engineering: geostatics for pavement (Mn/DOT).
- Civil Engineering: frost heave in pavements.
- Computer Science: pavement simulation software (Mn/DOT).
- Forest Products: prestressed timber bridges.

In evaluating this first cycle, the Center's executive committee felt positive about the variety of disciplines attracted to the process, confirming a wide level of interest in transportation at the university. The process also confirmed the technical strength at the university, particularly in the Civil and Mineral Engineering Department. But there was disappointment that some areas did not attract more projects, particularly in the strategic directions emphasis. There was also disappointment that projects for the most part came from individual disciplines, even though the criteria were designed to rate a proposal higher if it involved multiple disciplines. Changes were made for the second cycle.

Second Cycle

The second request for proposal was announced in January of 1990. This followed another meeting of the advisory board and several revisions to the process by the executive committee. These revisions were as follows:

- The three broad research emphases were refined to five more specific needs.
- A special emphasis was put on one area, transportation and the economy, with an appendix outlining a long-term study and its components.
- The criteria were reduced, from nine items to four, as suggested by the peer review group.
- Financial incentives were established for multidisciplinary teams. A project could receive \$10,000 of additional funds for each additional discipline added.

This request for proposals received a response of 33 proposals. The Center again asked the peer review group to review all proposals based on executive committee criteria. In addition, both Mn/DOT and the Regional Transit Board (RTB) reviewed all proposals, as a result of their interest in funding some of the projects. The executive committee, Mn/DOT, and the RTB chose the following projects for funding beginning in July 1990. The projects were announced under a new categorization that better reflected the Center's research focus.

- Transportation and the Economy.
 - Agricultural/Applied Economics, Sociology: trade patterns.
 - Management Information Systems: telecommunications/transportation.
 - Marketing/Logistics: intermodal transportation.
 - Public Affairs, Agricultural Economics, Economics: local economies.
- Transportation Safety and Traffic Flow.
 - Civil Engineering, Computer Science: traffic simulation (Mn/DOT).

- Civil Engineering, Computer Science: incident detection.
- Civil Engineering: origin-destination model.
- Computer Science, Civil Engineering: parallel processing.
- Human Factors, Computer Science: elderly driving.
- The Transportation Infrastructure.
 - Agricultural Engineering: water/pavements (Mn/DOT).
 - Civil Engineering: pavement test facility design.
 - Civil Engineering: bridge ratings (Mn/DOT).
 - Civil Engineering: crushed tires/pavement (Mn/DOT).
- Transportation and the Environment.
 - Civil Engineering: LRT station design (RTB).
 - Landscape Architecture: bicycle transportation.
 - Mechanical Engineering: alternative fuels (RTB).
 - Mechanical Engineering: methanol in engines (RTB).

Evaluation

The process chosen by the Center to establish a transportation research program in Minnesota has both strengths and weaknesses, as described in the following paragraphs.

Strengths of the Process

- The use of the Center's advisory board has brought a variety of transportation interests together, resulting in a concise articulation of the major transportation challenges facing the state, which has given direction to the Center's research efforts.
- The process has identified a wealth of expertise in university faculty members who are interested in conducting transportation research. The Center and the university are clearly capable of bringing together multiple disciplines to address transportation challenges, which has been called for by both national and state decision makers.
- The Center's process has attracted the interest and financial resources of two major transportation agencies in the state, the Mn/DOT and the RTB. Mn/DOT had previously funded research at the university; it is enthused about the increased access to new disciplines and ideas that the Center's process has generated. The RTB has found that the Center can help it perform its legislative mandate to conduct transit research.
- The iterative nature of the process, with frequent evaluation and discussion by the Center's executive committee, has helped define the Center's strategic strengths. The changing of the category titles reflects increased awareness of what the Center can do best. For example, it does not have a major strength in logistics, as another center (for example, the Massachusetts Institute of Technology) might. Instead, the logistics experts are part of the team that is addressing the relationship of transportation to the economy.
- The research program has a balance of engineering and policy-related projects that appears to meet the needs of the Center's advisory board. The announcement of the first cycle of projects caused concern by some that the Center's program was too dominated by traditional infrastructure research. The second cycle was successful in attracting new disciplines, while still maintaining a strong technical program that receives substantial support from Mn/DOT.

- The focus on whether a project is addressing the research needs has reduced the debate on whether the project is too basic or too applied. It has not mattered in the selection process as long as the proposal is sound and addresses a priority emphasis.

Weaknesses of the Process

- The request for proposal process, even with the adjustments in the second cycle, is still not satisfactory. Some projects that were strongly desired (and stated so in the RFP) were not proposed, even though the Center was aware of qualified principal investigators. Although the incentives for multidisciplinary teams worked in some cases, the results of this too were disappointing.

- There may be the impression, given the advisory board's initial statement of research goals, that the university can address all those issues. It clearly cannot. The critical factor is whether the faculty is interested in addressing these topics, more so than whether it is capable. If a faculty member is found who has the skills to address an urgent issue and funding is made available, that does not mean that he or she will do it. It may not be consistent with his or her long-term research interests. This is not widely known outside academia, sometimes causing expectations that are not met.

- Even though the debate about basic and applied research has been reduced, it remains a challenge as these projects are conducted and the results are disseminated. The Center still needs to demonstrate to many practitioners the value of basic research. This was pointed out at the Center's conference, where the reactions to theoretical presentations by faculty were mixed. The Center needs to be a catalyst to show practitioners long-term benefits of basic research and to focus researchers on potential applications of their theoretical findings.

- The requests for proposals have encouraged matching funds from private industry, but it has only happened in a few cases—even though there is increasing interest by the private sector in the Center's programs. This process provided limited mechanisms for this partnership.

THE CENTER'S FUTURE PLANS

The Center's executive committee has decided not to use the request for proposal process to fund future projects. Its use has been essential in the Center's early stages, to help identify interested faculty and the Center's strengths. These tasks have been accomplished, and now the Center will take a more proactive role in defining projects for funding. It will be guided by the advisory board's original goals—balancing policy, management, and technological research—but it will use the more specific research emphases areas that were announced for the second cycle of funding:

- Transportation and the economy,
- Transportation safety and traffic flow
- Transportation infrastructure, and
- Transportation and the environment.

Core faculty members for each of these four research emphases areas will be designated, drawn from those who have

been funded and those who have shown interest in addressing issues in these areas. The Center will bring these faculty teams together with advisory board members and other interested external parties. Discussions will focus on the critical transportation issues in these areas, with much interaction between faculty and external representatives. The issues defined will be used to develop short proposals by faculty teams, which will be evaluated and expanded by group members. A selective request for proposal may be issued to other faculty if a critical area of expertise is needed. Decisions on funding will still be made by the executive committee, influenced by the recommendations of the groups.

The proposals developed will also be used to pursue additional funding from outside sources. Mn/DOT and the RTB will continue to be heavily involved in the process. The federal government, foundations, the private sector, and others will also be contacted for potential participation. The Center will offer support services in developing research directions, developing proposals that follow these directions, and making contacts with funding organizations.

The Center plans to increase its technology transfer efforts and continue the strong communication and participation efforts that have been started. It will increase its involvement in conferences (for example, supporting the 1991 ASCE International Conference on Advanced Technologies in Transportation) and offer frequent forums for researchers and practitioners to interact. The executive committee believes this is a critical role for the Center, not only leading to the implementation of innovations, but also in generating future funding support. The Center will particularly continue to make a strong case for academic research, which brings innovations and educational benefits to transportation that are needed to complement the current applied research programs.

CONCLUSIONS

The Center for Transportation Studies at the University of Minnesota has learned a great deal in its efforts to establish a transportation research program. A goal of this program is to be balanced, which is a subjective judgment. The Center bases its success in achieving this goal on the feedback of the diverse transportation interests it has assembled on its advisory board and executive committee. It has been successful in balancing engineering and policy-related transportation research. It continues to face challenges in showing why increased basic research is needed to balance the applied research demanded by users.

A balanced transportation research program is needed at the national level also. Some conclusions from the Minnesota experience are offered that may be useful in the development of a national program:

1. All transportation interests must be involved in developing a transportation research program. State DOTs are critical, but they must be joined by other key stakeholder groups to broaden the research agenda. This will result in increased awareness and support for all types of transportation research.

2. Additional disciplines must be brought into the transportation research program. Civil engineering must be strengthened, but must also be complemented by skills from

the social sciences, other technical fields, and public policy disciplines to answer the research questions a broad constituency is raising.

3. There needs to be increased understanding by transportation decision makers of the role universities and basic research play in addressing transportation challenges. Transportation can learn from medicine, agriculture, and defense how to use basic research from academia to develop innovations.

4. Mechanisms need to be established, at both the national and state level, to ensure a balance of basic and applied research. At a national level, an NSF-like program could be established to complement NCHRP and SHRP programs. At the state level, state research programs could result in increased master's and Ph.D. students being hired by state DOTs to apply the concepts and technologies developed in universities.

5. Transportation agencies and other government organizations must become aware of and promote the economic development benefits of both basic and applied research in transportation. The positive spin-offs of the increased knowledge base—in new technologies, better educated students/employees, new expertise for consultants—will help keep the United States competitive. A “let's wait and buy what Europe and Japan develops” attitude is short sighted and ultimately harmful to the U.S. economy.

6. Increased collaboration among government, academia, and the private sector is needed in transportation research, particularly in the development of advanced technologies (13). The DRIVE program in Europe is producing collaboration that goes beyond national boundaries and that will soon produce results that surpass the United States in technological leadership in transportation. The government should be the key instigator in developing these relationships, with strong support from transportation centers. For these relationships to succeed, all parties must understand the different organizational incentives involved—political, academic, and profit—and find ways for all of them to be achieved.

REFERENCES

1. *Moving America—New Directions, New Opportunities. A Statement of National Transportation Policy.* U.S. Department of Transportation, Feb. 1990.
2. T. B. Deen. Focus on New Initiatives in Transportation Research—Introduction. *TR News*, No. 143, July-Aug. 1989, pp. 2–4.
3. K. Russam. Advanced Vehicle and Highway Technology—Presentations on Overseas Programs. Presented at Transportation Research Board 68th Annual Meeting, TRB, National Research Council, Washington, D.C., Jan. 24, 1989.
4. *INNOVATION—A Strategy for Research, Development, and Technology Transfer. Results of AASHTO Member Department Questionnaires.* AASHTO, Washington, D.C., Jan. 1990.
5. C. Fairhurst. *The Role of University Research in Civil Engineering.* Civil and Mineral Engineering Department University of Minnesota, Minneapolis, 1985.
6. T. M. Scott. U of M Said to Meet Tests of an “Urban University.” *Minnesota Journal*, Vol. 7, No. 5, Jan. 30, 1990, pp. 1, 4.
7. *Information and Instructions for Preparing Proposals, 1987–88.* Strategic Highway Research Program, National Research Council, Washington, D.C., p. 1.
8. *The National Cooperative Highway Research Program: Funding Under the 1987 Surface Transportation and Uniform Relocation Assistance Act.* AASHTO, Washington, D.C., Feb. 2, 1988, p. 4.
9. C. V. Wootan. Research Needs of the Future—A University's View. Presented at the Transportation Research Board 69th Annual Meeting, Jan. 7, 1990.
10. *Interim Advisory Committee Recommendations.* Center for Transportation Studies, University of Minnesota, Minneapolis, Feb. 1988.
11. *1988–89 Annual Report.* Center for Transportation Studies, University of Minnesota, Minneapolis, March 1990.
12. *Research Strategies.* Center for Transportation Studies, University of Minnesota, Minneapolis, June 1989.
13. K. C. Sinha, L. F. Cohn, C. T. Hendrickson, and Y. Stephanedes. Role of Advanced Technologies in Transportation Engineering. *Journal of Transportation Engineering, ASCE*, July 1988.

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