

## HIGHWAY RESEARCH REQUIREMENTS IN THE SEVENTIES—A PROJECTION

EDITOR'S NOTE: This article was adapted from a report prepared by the staff of the Highway Research Board in response to an inquiry from the Federal Highway Administration.

The decade of the Seventies will have to be used for planning, research, development, and demonstration if it is expected that the decade of the Eighties will see major innovations in our national transportation picture. The lead time is simply that long. This, of course, is partly due to the tremendous cost of transportation facilities and the great number of people (roughly one-seventh of the population) who are directly involved in providing the nation with highway transportation and who would be affected by any major change. The inertia is great. In addition, it is difficult to make substantial advancement until all of our population receive a more equitable distribution of our current productivity and have an equal voice in the future allocation of resources.

In order to put the needs of the Seventies, as they point toward the Eighties and beyond, into rational focus, the staff of the Highway Research Board has listed ten principal areas of current and potential problems that should be receiving significant attention. Because these problems and their elements interact with each other heavily, there is little point in attempting to ascribe priorities. Thus, the list that follows is not in order of priority.

1. The effective use of highway funds and resources. Because the HRB staff believes that highway needs will continue to be greater than the ability of the states and federal government to generate revenues, there will continue to be a vital obligation to use highway funds and resources most effectively. This concept is retroactive in the sense that something should be done to take better advantage of the millions already spent for research.

2. Improving the quality of the environment through highway design and location. Because there is growing concern that modern technology, including highways and automobiles, is adversely affecting the quality of life and disturbing ecological balances, it is probable that the quality of the environment will receive substantial attention, especially in urban areas.

3. Integrating the different transportation modes into a unified demand-sensitive system. The increasing trend toward state departments of transportation indicates growing interest in the integration of the different transportation modes into unified national, state, and local transportation systems.

4. Increasing the safety of highways for users and for the community. Concern for highway safety is stabilizing after a strong initial thrust. We may expect to see a continuing steady emphasis aimed at making both highways and

vehicles safer. Highways have come a long way in this respect, particularly interstate highways. There is still a great need for improvement in the primary and secondary systems. Much emphasis will be placed on the vehicle as a direct element of the system and as a mechanism for providing the driver with safeguards that he needs in the event of an accident.

5. Increasing capacity and reducing congestion on existing highway facilities. Public resistance to highways in some urban areas emphasizes the need for means to relieve urban traffic congestion other than the construction of new highway systems. Although it seems unlikely that there will be any major new developments in the theory of traffic flow that will dramatically increase the capacity of existing highway systems, there is a great need to apply existing knowledge and technology to urban street systems.

6. Improving durability of pavements and structures and reducing maintenance costs. Improvements in construction, materials, and design to increase the life and performance of pavements and structures are needed in order to protect the large investment in highway facilities. Maintenance costs must be reduced through improved management, equipment, and techniques.

7. Evaluation of the economic and social influences on highways, including demand, costs, and pricing. Since the end of World War II, response to demand was the primary criteria for determining highway programs. Needs were established through a combination of traffic demands, design criteria, and safety improvements. Now, economic and social influences of highways will receive greater consideration.

While social considerations may impede the construction of new highways and freeways, we do not believe that there will be a substantial shift in the use of transportation systems in urban areas to alter highway needs appreciably. Whether the vehicle be bus or automobile, fast, efficient, and safe highway corridors will still be necessary. Use of congestion-pricing techniques would only shift traffic that exceeds the capacity of the system to other points of the urban area, leaving the existing routes saturated to capacity. Because of investment and operating costs and the need for high density along the routes, mass rail transit systems will not offer economically or socially feasible solutions to urban traffic congestion except in a few large, high-density cities. However, the integration of highways into a total transportation planning process will mean that all systems will be more closely evaluated as to responsiveness to demand in comparison to cost for the facilities.

8. Defining governmental, industrial, and consumer responsibility for transportation. One of the primary problems in transportation is defining the governmental relationship and responsibilities for financing, constructing, and operating the different systems. If any sufficient innovations in transportation are to be achieved, the multiplicity of governmental and other agencies responsible for planning and transportation in urban areas will have to be effectively coordinated. Councils of governments, such as are being formed in many urban areas, provide one means for synthesizing the many affected agencies into a single agency. Increased attention will be given in this decade to the sources of funds for transportation systems and the effects that fund structure has on influencing the development of the transportation system.

9. Development of new transportation systems and technology. The urban environment is undergoing rapid social and economic change and it is difficult at the present to predict the kind of transportation systems needed 10 to 20 years from now. It would be naive to expect that new technological hardware by itself could resolve the transportation problems that plague the cities today. However, because of the increasing lead time necessary for development and application of technological innovation, it will be desirable to allocate appreciable funds for design, development, and demonstration of new hardware



systems. Because of the current public concern with safety and pollution, the next 10 years should see substantial efforts by both industry and government toward the development of totally new technological systems. Such systems will require major changes in urban structure, and because of their high costs, their development will be gradual and based on market demand rather than as welfare investment. Since there will be little immediate market, the government will have to underwrite the majority of the costs, as is done with space systems, for example.

10. Data needs and information retrieval systems. The availability of high-capacity electronic data processing systems has permitted the geometric increase in the availability of data for transportation planning and research purposes. The next decade will continue to see further application of computers in planning and research and in design, maintenance, construction, and operation of transportation facilities as well. Much progress needs to be made in computer application, particularly toward integrated processing of management, planning, and design information. Standardization of input, output, and software is badly needed.

Many of the problems described are currently not viewed with substantial concern by some state highway departments, especially those in rural states where the departmental activity is primarily related to construction and operation. Therefore, we anticipate that during the next 10 years in the majority of rural states the emphasis will be on improving management techniques, especially in the areas of maintenance, design, and construction. Even the highly urbanized states have not yet developed planning and research processes competent to deal effectively with all problems relating to urban areas.

The states that are moving toward departments of transportation are putting greater emphasis on planning and research needs. In Connecticut and Wisconsin, separate planning divisions have been developed to serve all the modes. The long-range planning and policy development activities have been placed in an independent unit separated from the operating modes. Physical research and methods and procedures research that relate to the construction, operation, and maintenance of model systems remain with the modes.

There is substantial staff competency in the area of physical research among highway departments, consultants, and universities, but there has been a general lack of staff for planning research activities. It will take time to develop the planning research staffs and for research ideas to mature. Therefore, there will continue to be a lag in developing a comprehensive approach to resolving the transportation problems.

The basic issues as we see them have been described above. In Table A we have broken the basic problem areas down into programs that suggest specific avenues of attack. There is overlap, redundancy, and, as previously mentioned, heavy interaction. However, we believe that this breakdown will make it easier to understand the overall problem areas.

TABLE A  
Breakdown of Problems and Programs  
That Will Receive Attention  
During the 1970's

1. The Effective Use of Highway Funds and Resources
  - A. Better definition of needs, programs, and project selection.
  - B. Reducing disruption to community and to the flow of traffic during construction and maintenance.

- C. Evaluation of true total costs of design alternatives, considering maintenance and interruption of traffic flows for future repairs.
  - D. Analysis of materials characteristics to find replacements for costly and scarce construction and maintenance materials.
  - E. Management analysis and methods and procedures review to reduce costs, especially for maintenance.
  - F. Development of procedures to achieve better cost and quality control in highway construction.
  - G. Increased use of automation and electronic data processing to reduce personnel costs in design, construction, and maintenance.
2. Improving the Quality of the Environment Through Highway Design and Location
- A. Designing highways and structures to enhance the aesthetics to the user and the community.
  - B. Use of transportation corridors in shaping the urban environment through multiple-use and joint development projects.
  - C. Using highways judiciously to influence land use and density of use.
  - D. Reducing environmental pollution caused by highways, including noise, air pollution, pollution from highway materials, etc.
  - E. Greater concern for community values and the effects on the community in route location.
  - F. Greater concern for those dislocated or directly affected by the construction of the highway.
  - G. Evaluation of the relationship of highways to the changing urban structure, including the growth of suburbia, new towns, and urban sprawl.
3. Integrating the Different Transportation Modes Into a Unified Demand-Sensitive System
- A. Establishing criteria for a "balanced transportation system."
  - B. Measuring the costs and benefits and return on investment of alternative transportation modes.
  - C. Effects of pricing, both direct and indirect, on modal split.
  - D. Reducing intermodal interface problems.
  - E. Development of direct intermodal transfer points as part of a balanced system.
  - F. Establishing levels of service for alternative travel modes.
  - G. Locating freight and passenger terminals.
  - H. Needed transportation services for the poor, the infirm, and those who do not have the use of cars.
4. Increasing the Safety of Highways for Users and for the Community
- A. Improving the highway system and the vehicle and providing driver information services to reduce the occurrence of accidents.
  - B. Reducing the severity of accidents through highway design, vehicle design, and their coordinated interaction.
  - C. Protecting the pedestrian and the community from accidents and from the transportation of hazardous commodities.
  - D. Increasing facilities for accident response and treating the injured.
  - E. Preventing accidents through driver services and through automated vehicle guidance and control.
  - F. Improving driver selection, education, and training and preventing drunks and accident-prone persons from driving.



5. Increasing Capacity and Reducing Congestion on Existing Highway Facilities
  - A. Greater application of existing knowledge on capacity and flow.
  - B. Increased use of electronic devices to maintain traffic surveillance and flow.
  - C. Improving communications systems to drivers and from drivers.
  - D. Developing and improving parking facilities.
  - E. Improving the transfer process between automobiles and transit and airports and developing end-of-line parking facilities and intermodal terminals.
  - F. Developing metering devices and other techniques to reduce peak loading of highway systems.
  - G. Resolving problem of delayed accident clean-up and resulting traffic impedance.
  - H. Improving all-weather characteristics of road services and driver information systems.
  - I. Upgrading existing facilities through redesign and construction—adding traffic lanes utilizing existing right-of-way through multi-storied construction.
  - J. Analysis of effect of truck and freight movement on the flow of traffic.
6. Improving Durability of Pavements and Structures and Reducing Maintenance Costs
  - A. The development of specific materials designed for a particular use. In this field the transfer of technology from one government agency to another, such as from NASA or AEC to DOT, should be improved.
  - B. The development of new designs, construction techniques, and equipment.
  - C. Systems building of bridges and structures, including provision for sectional replacement.
  - D. Nondestructive methods of snow and ice control, including applications of energy storage and transformation and systems to eliminate ice adhesion.
7. Evaluation of the Economic and Social Influences on Highways, Including Demand, Costs, and Pricing
  - A. The economic costs of different levels of service compared to benefits.
  - B. Better understanding of the psychological, sociological, and economic factors affecting modal split.
  - C. The economics and costs of subsidy programs for transit systems and comparisons to alternative transportation investments.
  - D. Economic criteria for the modal choice of freight movement and the consequences on highway design.
  - E. Economics and investment costs of changes of size, weight, and horsepower requirements of trucks.
  - F. Analyzing the costs and alternatives of providing transportation services for the handicapped, minorities, and those who do not have access to automobiles.
  - G. Motivational analysis of why people want to drive their cars.
  - H. Developing ways to measure transportation demand and its flexibility to different price structures.
8. Defining Governmental, Industrial, and Consumer Responsibility for Transportation
  - A. Simplifying the legal responsibility for transportation systems, especially in urban areas.

- B. Evaluation of urban transportation systems and the effects of different fund structures.
- C. Sources of funds for financing transportation systems through financial inducements.
- D. Broadening the powers of eminent domain to provide for excess taking and land management.
- E. Reevaluation of criteria for allocating resources among modes and among states and cities.
- F. Developing an intergovernmental structure to permit joint development projects.

9. Development of New Transportation Systems and Technology

- A. Effects of changing urban structure on transportation demands and systems.
- B. Developing guidance systems and guideways for existing automotive vehicles.
- C. New vehicles and power supply systems.
- D. Non-pollution and minimum-pollution transportation systems.
- E. Analysis of investment costs and problems of transition to new transportation systems.
- F. Development of the total logic system for a new transportation system.
- G. Perfection of design and construction techniques to accomplish the upgrading of existing right-of-way with minimum (or no) disturbance to traffic.
- H. Development of extremely rapid construction techniques for new locations either above or below ground and with minimal disturbance to the environment.
- I. Development of a permanent transportation vehicle concept—that is, one built to last specifically for the lifetime of the user. This means the application of energies and money now devoted to styling changes in the development of ultra-safe, high-performing, and non-polluting vehicles.

10. Data Needs and Information Retrieval Systems

- A. Closer analysis of what transportation data are needed and how the data will be used when generated.
- B. Further application of computers to routine engineering and administrative processes.
- C. Reducing costs for acquiring data.
- D. Evaluation of needed data for planning purposes.
- E. Developing comprehensive transportation information retrieval systems, including some way to sort out pertinent new knowledge and findings from the mass of verbiage.