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Elements in the Transportation Planning and Programming Process in the Public Forum

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Transportation Research Record 617
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page 71, column 2, line 39
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page 71, column 2, line 41
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Discussions
Anthony James Catanese 15
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page 30, authors of Abridgment
Add **Kunwar Rajendra, Planning Department, City of Lansing, Michigan**
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NCHRP Synthesis of Highway Practice 42
page 65, Equation A-1
Change $(+ \sin\phi)$ to $(1 + \sin\phi)$
page 67, footnote to table
Change $\underline{N}_\sigma{}^*$ to $\underline{N}_c{}^*$ and $\underline{N}_c$ to $\underline{N}_\sigma$

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Figure shown as B-3 is B-4; figure shown as B-4 is B-3.

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Evaluation of the Planning and Programming Process

Henry L. Peyrebrune, New York State Department of Transportation, Albany, New York
C. William Ockert, Columbia Region Association of Governments, Portland, Oregon

This report summarizes a conference session dealing with an evaluation of the transportation planning and programming process. Experiences in implementing new regulations and new directions for the metropolitan planning process are discussed.

Recent federal planning and programming regulations have prompted federal, state, and regional agencies to conduct a significant review of the current structure and emphasis of the planning process. Therefore, the Transportation Research Board Committee on Planning, Programming, and Evaluation conducted a conference session at the 1977 Annual Meeting of the TRB to hear reports and discuss issues relating to these regulations. This report summarizes those papers and discussions. Our intent is to present the results and conclusions of various studies on the effectiveness of the planning and programming process, share new procedures with others, and point out areas for improvements.

URBAN SYSTEM STUDY

Richard D. Morgan, Federal Highway Administration

The Urban System Study, commissioned by the Federal-Aid Highway Act of 1976, assessed the role of the Metropolitan Planning Organization (MPO) in filling the joint planning requirements of the Federal Highway Administration (FHWA) and Urban Mass Transportation Administration (UMTA). It analyzed the types of organizational arrangements for fulfilling the planning process, the status of the jurisdiction of the Federal-Aid Urban System Program responsibilities for programming transportation improvements, and the capabilities of MPOs in exercising their responsibilities under the joint guidelines. Researchers consulted several national liaison groups, who prepared position papers for the study. Several of the major conclusions of the Urban System Study are presented below.

1. The various planning liaison organizations held diverse opinions concerning the role of the MPO in fulfilling the joint planning regulations. The views varied from strong support of to strong opposition to the planning regulations, but groups that represented the states expressed particular concern for the role of the MPO. The responsibilities for programming were the most controversial aspect of the urban system program.
2. The program is becoming much more successful; obligations of federal urban system funds are increasing under the guidelines and the program is gaining momentum. However, the controversy over respective roles continues to present some problems. The local governments, acting through the policy committee (the MPO), have assumed the responsibility for setting priorities. At the same time, the states maintain a strong role in policy direction. The process of selecting projects varies according to the jurisdiction of the project in question. Allocations of funds are proceeding well; the agency that has jurisdiction over the project is providing matching funds. Transit flexibility is being used in projects worth about $77 million.
3. Although their capabilities vary, most units of governments are processing urban system projects.

The primary conclusions of the Urban System Study were that obligations for urban systems projects are increasing. Federal requirements should be simplified. Planning and programming emphasis is changing from long-range to short-range issues and planners are taking advantage of the flexibility built into the regulations. The roles of the MPO continue to be controversial. The study concluded that transportation improvements can be implemented to serve state and local needs. The concerns for responsibilities should not overshadow transportation objectives.

STATE-OF-THE-ART SYNTHESIS ON PRIORITY PROGRAMMING AND PROJECT SELECTION

Bruce Campbell, Fay, Spofford and Thorndike

National Cooperative Highway Research Project (NCHRP) 20-5 provides a description of the actual state of priority programming today: (a) how programming is managed and what are its key elements; (b) how decisions on why, where, and when are made; (c) at what level improvements should be made and how decisions are later modified; (d) what the balance is between technical and political factors; and (e) what impact technical priorities have on the allocation of resources. The information was obtained from interviews with officials of a dozen states, two transit agencies, two large counties, and several large cities. The basic conclusions of the study are listed below.

1. A structure for establishing improvement program needs to be defined.
2. The programming process has to involve matching available funds with available projects to accomplish specific objectives. If programming is not concerned with the achievement of objectives, it becomes a scheduling process.
3. A set of common definitions should be established for the programming process.
4. Similar programming processes are used in the areas under study. The major concern is the lack of understanding as to who makes the final decisions on projects.
5. A technical analysis is needed to guide decision makers in setting priorities. Decision makers need a framework and an orderly process for reaching agreement on priorities.
6. The total appropriation available for transportation improvements is the most important factor. Although considerable concern was voiced about the inequity of establishing allocation formulas, often this is the

only practical way to initiate the programming process. Some effort must be made to fund the most critical projects. Concern was expressed about establishing credibility and avoiding overprogramming.

7. Programming is not separate from planning but is part of the planning function.
8. Politics has not been significant in many of the programming exercises, partly because producing a project takes a long time.
9. A policy-planning unit is needed. A technical evaluation of competing projects is necessary to understand the trade-offs in establishing priorities.
10. Planning and programming staff need to communicate with design staff to ensure that the original concept of a project is maintained in the final design.

FEDERAL PERSPECTIVES ON TRANSPORTATION SYSTEM MANAGEMENT

C. Kenneth Orski, Urban Mass Transportation Administration

This paper describes the institutional roles in transportation system management (TSM) planning. The two models of institutional decision making presented are the top-down model, which is the typical long-range planning process whereby the MPO establishes an overall TSM plan and then orchestrates the implementation of that plan, and the bottom-up model, which is a project-by-project incremental approach whereby TSM projects are initiated by the various operating agencies. The role of the MPO is to resolve conflicts and ensure consistency between the various proposals. Although the top-down model is useful in some applications, the bottom-up model is closest to the reality of metropolitan decision making because of the close involvement of implementing agencies most familiar with real-world problems. Several conclusions were presented:

1. The MPO must work closely with the operating agencies. Planning funds should often be passed through to the implementing agencies.
2. The MPOs should develop capabilities for analyzing the short-range implications of TSM proposals.
3. The private sector should become involved in the process to develop the TSM.
4. Those public ordinances that hinder the development of prospective TSM proposals should be eliminated.
5. Funds should be earmarked for TSM improvements in order to avoid competition with other improvements.
6. The process of developing the TSM plan should be on a shared-power basis.
7. The TSM plan should provide a balance in the transportation system.

EVALUATION OF THE REGULATIONS FOR TRANSPORTATION SYSTEM MANAGEMENT AND FOR TRANSPORTATION IMPROVEMENT PROGRAM: THE FIRST YEAR'S EXPERIENCE

Frederick Gottemoeller, Maryland State Highway Administration

This paper presents the findings of a task force of the Transportation Programming, Planning, and Evaluation Committee on the first year's experience with the joint planning regulations. The task force interviewed people from seven state transportation agencies, two transit operators, and two local governments to obtain opinions from people in all levels of government on how practitioners were dealing with the regulations.

In general, the task force found that the regulations have not produced major changes in transportation programming but that the programming process has worked better under the new regulations. A more comprehensive picture for decision making is available and more TSM projects are being implemented. Initially, the task force concentrated on the regulations that attempt to involve regional bodies of local governments in programming decisions. Although many of the respondents are disturbed by the newly defined roles of the MPO, in most areas the regulations are being implemented. The task force reached several specific conclusions.

1. FHWA and UMTA have implemented the joint regulations in a consistent and positive manner.
2. The staffs available to the MPOs are adequate to meet the requirements.
3. The local staffs are adequate to meet technical requirements with two exceptions; the first is the need for increased expertise in evaluating the effectiveness of TSM projects, and the second is the ability of local governments to meet federal requirements for environmental review.
4. Almost all of the respondents opposed the establishment of a regional authority responsible for maintaining all highway and transit facilities.

Nearly two-thirds of the respondents to the task force questionnaire indicated that the regulations should be changed. In spite of the controversy, few of the respondents suggested changes in the role of the MPO. Instead, changes were recommended in the flexibility of the programming process required by the regulations. It was suggested that the annual element requirement should be discarded in order to allow flexibility in selecting projects during a 3-year transportation improvement plan; that the need for documentation of projects should be reduced; and finally, that there be stricter analysis of fiscal resources, demonstrations of project effectiveness, and stronger backing for TSM projects.

DISCUSSION

The primary concern voiced during the discussion was the integration of long-range system planning in a traditional sense with pragmatic short-range decision making on transportation priorities. The long-range traditional system planning effort needs to be overhauled in order to focus on short-term concerns. Several people suggested that, although long-range plans should be somewhat optimistic and may call for projects that cannot be funded with existing revenues, many long-range plans need to be made more consistent with available resources.

The MPO should use a short-range evaluation process to ensure that transportation improvements are cost effective and consistent with long-range plans. To accomplish this, project design standards often need to be relaxed. Large projects can often be reduced in scope. In many cases, the planning process should identify less expensive projects that respond to transportation needs at relatively low levels of transportation service. All projects should be subjected to an analysis of their costs and benefits, both for the long term (perhaps 20 years) and for the short term. The process of establishing priorities is a local, metropolitan, and state effort. The planning process should be interrelated with the programming process.

The planning process needs to examine how important the existing transportation system will be for the next

6 years and how cost effective the various projects are in supplying mobility needs. The process must move from a long-range system plan to a pragmatic bottom-up approach of fitting together the most cost-effective projects. The transportation program should involve three major components: (a) maintain the existing transportation system, (b) improve the existing system, and (c) expand the system. The planning process must reflect concern for financial constraints and acceptable levels of service. In many cases, additional financing needs to be found once the level of service at low financing has been shown to be unacceptable.

A current problem is that transit investment programs are not financially constrained. The planning process must guard against losing credibility if, for example, plans are too expensive to be implemented. Care must be taken not to overpromise. A system-level cost-effectiveness approach can estimate the costs and benefits of various projects. The planning process can then be used to advocate specific projects and to assist in finding the needed resources. The implications of projects, including low-cost TSM alternatives, should be assessed.

The MPO is a forum for achieving agreement on the transportation investments to be made in metropolitan areas. A balance must be reached between a plan that only allocates existing resources and an overall optimistic plan based on an unrealistic estimate of possible funding sources. A major concern must be increasing the efficiency of the transportation system, particularly the public transportation system. Excess capacity provided in the off-peak hours is a great waste.

If a consensus is not reached on all plan elements, contingency plans should suggest alternative solutions for allocating money, including their costs and benefits. A transportation planning and programming effort must demonstrate the benefits of proposals and suggest and implement alternatives that are both cost effective and feasible.

Publication of this paper sponsored by Committee on Transportation Programming, Planning, and Evaluation.

The Secretary of Transportation's Innovative Public Hearings

Diane Chrzanowski Roberts, Office of the Secretary, U.S. Department of Transportation

On June 21, 1975, former Secretary of Transportation William T. Coleman, Jr., presided at a public hearing concerning an important transportation project, Interstate 66. This was the first time that a cabinet officer presided at a public hearing. Mr. Coleman subsequently held hearings on the Concorde, another segment of I-66, the St. Louis Airport, and air bags. This paper examines what this action means in terms of the hearing officer, the hearing participant, the public hearing technique, and the transportation planning process. Coleman's decision-making process consisted of examining the issues, writing a position paper, conducting staff briefings, holding a public hearing, receiving written evidence, reviewing testimony, making a decision, and writing an explanation. The written explanation of the decision became a unique document for reviewing the decision-making process. It provided both a tool for congressional and judicial review and a report card on the performance of the administration. The Coleman hearing was designed to restore public confidence in government following the Watergate debacle. In this it was successful; most of the participants interviewed were pleased to have direct access to the decision maker, to have a chance to influence the decision, and to counteract those vested interests that have easier access to decision makers. The Coleman hearing has set a precedent that is being followed by the new administration. It will have a significant impact on both the citizen participation process and transportation planning.

The public hearing concept changed on June 21, 1975, when a cabinet officer, former Secretary of Transportation William T. Coleman, Jr., held a public hearing. This hearing concerned the controversial Interstate 66 (I-66). Other hearings followed on Concorde, a second segment of I-66, the St. Louis Airport, and air bags.

The following question is addressed in this paper: What does this action really mean in terms of the hearing officer (in this case the Secretary of Transportation), the hearing participant, and the public hearing technique and the transportation planning process? Before addressing this question, the main objectives of the transportation planning process need to be enumerated:

1. Determining mobility needs of individuals and their community and the requirements for transferring goods;
2. Developing a strategy to meet these needs;
3. Determining the socioeconomic impacts of the various strategies on the community, the region, and the society in general; and
4. Devising means of fulfilling sound transportation projects.

Citizen input is an effective way to achieve these objectives, and the most popular way to collect direct citizen input is by means of the public hearing.

PUBLIC HEARINGS AND THE TRANSPORTATION PLANNING PROCESS

Historically, transportation planning decisions were based on the mobility of people and goods. In the last 10 years, transportation planners attempted to assess other objectives, especially those of a social or economic nature (1). One of the most popular and effective means of determining and evaluating these objectives has been the citizen participation process, and the public hearing is the most popular of the techniques used. The Federal Highway Administration (FHWA) mandated public hearings in 1968.

These hearings were generally held at the conceptual planning stage when the facility design was firm. They

were conducted by state highway departments close to the time of a final decision on all aspects of the transportation project and only after an engineering recommendation was firm. These engineering decisions primarily used a cost/benefit formula that equated construction dollars to travel time saved. A hearing officer, generally a representative of the state highway department, presided over the hearing and reported the results to the decision maker, who rarely attended the hearing. Increasing protests to highway construction prompted the FHWA to set up the two-hearing (location and design) process in 1969 and to suggest that community values be considered in the decision-making process (2). The next few years were spent researching objective means to measure community values and ways to include them in the cost/benefit formula. Citizen participation was soon recognized as the best way to include community values in the planning process.

In response to controversy surrounding I-66, the final decision maker in transportation matters, the Secretary of Transportation, presided at a public hearing on the segment of I-66 that was intended to provide improved access to Dulles International Airport and that included right-of-way for extension of the Washington-area subway in Virginia. Thus, this route was truly multimodal in its impact; planning on the project proceeded inexorably. The groups of citizens who opposed it attracted national attention by publicizing their views on television, radio, and nationally circulated newspapers. Federal involvement in this project soon exceeded that in normal highway projects.

The cacaphony of protest peaked during the first year of the former secretary's tenure. Local government had little impact on the decision, and the emotional involvement of the opponents intensified. Citizens demanded preparation of an environmental impact statement (EIS). Proponents of I-66 asserted that the project was exempt from that process because the EIS was only mandated by the 1969 National Environmental Policy Act (NEPA) and the I-66 issue clearly predated this legislation. At this time, then-Secretary Coleman, announced that he would hold a public hearing to listen to all views and make a final decision on the future of I-66. For the first time in the transportation planning process, citizens were provided a public forum at which the final decision maker presided. Essentially, a local decision was transformed into a national one. To give a better picture of the kind of activity involved in public hearings, two hearings will be analyzed: the first hearing that was held on I-66 and the Concorde hearing.

Hearing Officer

Former Secretary Coleman decided to put on public record everything said about major transportation issues. As part of the background for this paper, I interviewed Mr. Coleman on October 15, 1976. He stated that he believes that the individual who has primary responsibility for an issue should actually make the decisions himself. If a public hearing is necessary, that individual should personally conduct the hearing. According to Mr. Coleman, the secretarial hearing serves the following functions:

1. It makes all related material part of a public record,
2. It helps people understand why a decision is made,
3. It helps Congress review the action,
4. It helps courts review the action, and
5. It helps citizens evaluate whether the administration is acting fairly.

Mr. Coleman thinks that a secretarial hearing is necessary if the issue involved is complicated, is of major importance, and involves a number of competing forces. The Concorde situation, for example, involved numerous forces, especially environmental forces (noise and air pollution), as well as international and political factors.

Mr. Coleman believes that hearings should be structured to get to the issue; therefore, he first wrote a position paper indicating the problems several weeks before the hearing. At the hearing, the interaction between questioner and respondent was exceptionally important to Mr. Coleman. The live evidence increases understanding of the issue. Despite the extensive work done by the staff of the U.S. Department of Transportation (DOT) on a transportation project prior to the hearing, the secretary can uncover certain new details from hearing testimony, particularly when testimony is presented by the individual who is affected by the issue.

Coleman's model for decision making might be set up as follows:

1. Examine the issue; decide whether it calls for a public hearing according to issue criteria (indicated earlier). If it does, then proceed.
2. Write a position paper and announce the structure of the public hearing.
3. Conduct staff briefings and study issue materials prior to the hearing.
4. Preside at the public hearing.
5. Receive written evidence into the docket.
6. Review the hearing testimony and the written docket.
7. Make the decision and write the explanation.

The steps in this model are reasonable and logical. The only possible problem flows from activity between steps 6 and 7. The criteria used to make the decision, especially the weights of the various factors, are not spelled out. It may not be possible to develop a formula to weigh each function involved; the final decision will be based on the decision maker's insight, sensitivity, and judgment. A written explanation—a decision document—is offered after the decision is made. Through the mechanism of the public hearing, former Secretary Coleman made clear who made the final decision. Decision making was centralized.

Hearing Participants

The public hearing technique as practiced by former Secretary Coleman lets the citizen feel he has increased access to the top decision maker; this is why his hearings are described as innovative. This holds true both for the producer and for the consumer involved in the various issues. This may be more important for the consumers, since they have often felt less powerful and less able to reach a decision maker to make their views known. Consumers can now feel part of the process. For the first time foreign dignitaries participated in a U.S. public hearing. Representatives of the government of Canada, for example, presented their experiences on the seat belt issue and made recommendations as to its continuance in their country. The Concorde hearing attracted representatives of France and the United Kingdom.

Citizens seem to feel that a cabinet officer would be more objective in such hearings than an administrator of the FHWA would be, for example, in deciding the I-66 issue or than an administrator of the National Highway Traffic Safety Administration would be in deciding the air bag issue. Because of their titles, people appear to be-

lieve such administrators' decisions would be colored by the interests of the concerned agency.

Hearing participants think that, even if a decision is not to their liking, their views have been considered. The process thus seems open and democratic. Citizens believe that their views are important enough to be heard by the top decision maker. At the hearing, the consumer hears the views of the producers and the cabinet officer's questioning of the producer and of other consumers. Any other process would give the consumer more limited access to the top decision maker than the producer would have. The producer generally carries more weight because the producer is responsible for many activities important to a healthy economy, such as jobs.

THE PUBLIC HEARINGS

The first I-66 hearing on June 21, 1975, was limited to 4 h. The participants were elected officials and representatives of civic groups. A time limit was placed on all public statements so that all speakers could be heard, and only then-Secretary Coleman questioned speakers. The table below shows the composition of the persons who testified.

Category	In Favor	Opposed	Total
Congressmen	2	1	3
State officials	3	3	6
Local officials	10	7	17
Civic groups	16	14	30
Total	31	25	56

Although the proponents and opponents were fairly evenly represented, as was intended by the DOT committee that selected the participants, then-Secretary Coleman thought that the weight of evidence favored termination of planning for the route, and he decided against construction of the 24.86-km (9.6-mile) segment of I-66. However, the decision following a second hearing on I-66 called for a modified version of the original I-66 plan. When the issue was brought to the attention of the new Secretary of Transportation, Brock Adams, he let the Coleman decision stand.

The Concorde hearing on January 5, 1976, involved similar issues: Citizens wanted to maintain the status quo, their neighborhood, and their way of life against advanced technology. The Environmental Protection Agency, the Counsel on Environmental Quality, and the Federal Energy Administration opposed the Concorde for environmental and energy reasons. The U.S. Department of State and the National Aeronautics and Space Administration favored the Concorde for reasons of international cooperation, technological progress, and aviation policy.

The hearing was not as formally structured as that on I-66; proponents and opponents were more mixed and elected officials appeared at times convenient for them during the day-long sessions. The preponderance of testimony by civic groups, local officials, and congressmen opposed landing rights for the Concorde in the United States; in fact, as shown below, more than half of the speakers opposed the Concorde.

Category	In Favor	Opposed	Total
Representatives of Great Britain	4	0	4
Representatives of France	4	0	4
Congressmen	2	8	10
Civic groups	5	18	23
Experts	3	0	3
British groups	2	3	5
Local officials	3	7	10
U.S. officials	1	2	3
State officials	1	2	3
Business interests	3	0	3
Total	28	40	68

Most of the support for Concorde came from U.S. industry, representatives of the British and French governments, and civic boosters who anticipated economic growth as a result of the Concorde. While supporting groups presented only 25 percent of the testimony, former Secretary Coleman concluded that the Concorde should be allowed landing rights in the United States for a 16-month test period.

To return to Mr. Coleman's model of decision making, here again question is directed to the activity between steps 6 and 7, from reviewing the testimony to actually making the decision. Clearly, an examination of these two hearings shows that the numbers of people who testify for or against are not decisive, nor are grassroots sources a guarantee of secretarial favor. The exact basis for a decision might be difficult to isolate, but certainly the content, quality, and nature of the testimony presented and the influence of the speakers and their constitutency, among other factors, play a proportionate role.

CONCLUSION

The Carter administration apparently endorses the public hearing concept with some enthusiasm. President Carter himself holds town meetings, as does Secretary of Transportation Brock Adams. Mr. Coleman apparently perceived a fundamental need to validate government and the decision-making process in the public forum and to this extent set the pattern for the new administration.

In terms of the transportation planning process, the public hearing makes the decision maker completely visible. The ambiguity surrounding the identity of the decision maker was a major complaint of the various groups and individuals I interviewed. If the transportation planning process were as responsive as it should be to consumer interests, these issues would not have reached the cabinet level. The consumer had great difficulty learning who the final decision maker was when an anonymous public hearing officer conducted the hearing; the citizen never found out whether his or her testimony was heard by the decision maker.

When experts—that is, transportation and community planners, transportation managers, highway and traffic engineers, social scientists involved in the work of transportation—look at Coleman's model of decision making and its emphasis on the public hearing, the most significant point for them is the issuance of the decision document. This is actually the first time such a comprehensive analysis of a transportation issue was made available to the public.

Mr. Coleman's public hearings transformed a local decision into a federal one. The transportation planning process will have to accommodate this transformation in its normal functioning. Generally all participants in the hearings felt they had increased access to decision makers. Their expectations, however, were raised for future controversial issues. This activity set a precedent; the Carter administration is actively attempting to involve citizens in decision making through the town meeting concept. The decision maker also can see the public hearing technique as a protection against negative reaction from citizens. By holding this open forum and by preparing a written explanation of the decision, the decision maker is able to quell any posthearing protest.

Now, where do we go from here? Just how important is direct citizen input before a top decision maker? Does this testimony matter, or has it all been collected, analyzed, and synthesized beforehand, accompanied by recommendations? Is the public hearing just a tool for giving the citizen a taste of power? Does it really matter?

The situation should be examined from two points of view—that of the transportation planning process itself and that of the input of the citizen. Certainly the transportation planning process has been transformed when the hearing officer is the top decision maker. The implications of this action will have to be studied over time. And what about the citizen, particularly the consumer—the individual who has had restricted access to decision makers? All of the citizens interviewed who had participated in the public hearing process had very positive feelings about it and felt that their views were heard and would be considered. Whether this is a good way of handling citizen input in the decision-making process is difficult to determine at this point. Time will provide answers to some of the issues raised, especially that of the institutionalization of the secretarial public hearing.

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Organization for Regional Community Participation: the Boston Approach

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Federal process requirements for community involvement in transportation planning have elicited many responses from state, regional, and local planning agencies. One of the most interesting responses has been in the Boston region, where an institutionalized regional participation approach has evolved over the past several years. This paper examines the current structure for citizen participation activities in Boston: (a) a Metropolitan Planning Organization formed as a joint body of six agencies; (b) a Joint Regional Transportation Committee, which serves as a citizens' advisory group to the MPO; and (c) the Central Transportation Planning Staff, a staff group under the policy direction of the MPO that is responsible for maintaining a coordinated, participatory process for system planning and project development in the Boston region. The paper highlights the special antecedents of these mechanisms, most notably the Boston Transportation Planning Review, which influenced participation procedures in the region. Finally, the paper discusses the strengths and weaknesses of this approach and identifies aspects that might be transferable to other locations.

Attempts to solicit citizen participation in transportation planning were often launched in response to facility-related controversies. Such efforts have usually involved easily defined geographic areas and clear positive and negative impacts. Even for individual projects, the effectiveness of various approaches to community participation is under debate; methods are unclear and poorly understood. Few well documented mechanisms exist for achieving successful and productive citizen involvement in regional transportation planning. Mechanisms are needed to use citizen expertise to respond to broad regional priorities and major transportation resource allocation decisions. Several reasons for organizing a regional process for community participation follow.

1. Legal and administrative reasons involve the requirements for citizen participation in developing regional transportation plans, including the requirements specified by the federal urban transportation planning process, such as unified work programs, transportation system management plans, or transportation improvement programs for long-range, high-capital improvements.
2. Planning process reasons include the development of regional priorities and programs in order to bring about a greater understanding of trade-offs between regional and local concerns. The diminished importance of the complete system plan has meant an explicit recognition of the need for short-term planning. Citizen involvement allows citizens to make inputs to incremental investment decisions that, over the long run, may profoundly influence the shape and functional performances of the region.
3. Political reasons involve allowing citizens a frequent and meaningful voice in regional decisions on priorities, thereby reducing chances of future confrontations over individual project decisions. Such involvement could help avoid the holdups due to citizen opposition in the 1960s and provide an important bridge between regional planning and local project development.

Citizen involvement at the regional level ensures that individual projects are derived from a common framework for transportation. A structure for regional participation may, therefore, be an important prerequisite to successful community involvement activities on the project scale. Also, when the citizen involvement process is administered at the regional level, standard procedures for participation can be applied to each individual project.

EXPERIENCE IN BOSTON

The Boston community has strong intellectual and activist traditions. However, local involvement in transportation planning has become significant only in the last decade. Early regional planning efforts in the 1960s of the Boston Regional Planning Project (BRPP) and the Eastern Massachusetts Regional Planning Project (EMRPP) involved officials of cities and towns in a dialogue on growth and development. Much of the effort was directed to developing technical procedures for land use and travel forecasting; there was little citizen interaction. However, in the period from 1969 to 1972 a major questioning of the region's transportation plans and the assumptions on which they were based led to the following sequence of events:

1. In 1969, local public controversies over the Interstate program prompted the governor to establish an advisory task force to review state and regional transportation policy.
2. In 1970, the governor ordered a moratorium on highway construction in the Boston region until more data on alternatives were available.
3. From 1971 to 1972 the Boston Transportation Planning Review (BTPR) conducted an 18-month restudy of controversial highway and transit projects in the region.
4. In November 1972, the governor decided to drop most major highways within Boston's Route 128 in favor of an expanded regional transit system.

These events were greatly influenced by the activities of an energetic cadre of citizen participants who were concerned with regional decisions and who represented every conceivable ideology. State officials were receptive to the involvement of these participants in the restudy. This led to a high level of regional expectations for community involvement in transportation policy and to the creation between 1973 and 1975 of several closely related institutional mechanisms for regional planning and participation:

1. A Metropolitan Planning Organization (MPO) was formed to be responsible for the federal transportation planning process. The MPO is composed of six state and regional signatory agencies acting jointly through a memorandum of understanding.
2. A Joint Regional Transportation Committee (JRTC) was created to serve as an advisory forum for citizen participation in the planning process. The JRTC has a diverse membership of approximately 50 people.
3. The Central Transportation Planning Staff (CTPS) was created to be a multidisciplinary group supported by the signatory agencies to assist in administration of the planning process and related interagency planning activities.

Evolution and Significance of the Participatory Process

The history of heated political action in Boston that led to a deemphasis in highway construction has been well documented (1). Before 1969, an extremely vocal constituency for regional transportation planning combined with an executive leadership that was sympathetic to an open planning process. During the 1960s, sophisticated transportation planning studies predicted continued heavy use of automobiles and a need for completion of the planned Interstate highway system. In several areas of Boston within the 16-km (10-mile) Route 128 circumferential highway, neighborhood groups, advocate planners, and environmental groups banded together to oppose those links that were not yet completed. In other regions, such opposition was confined to individual segments of the system, but in Boston a regional coalition developed to question the technical validity and social worth of the proposed transportation plan for the region. The proposed inner belt was the project that unified the highway opposition. The inner belt was a circumferential highway around Boston intended to link the proposed Interstate system at the heart of the region.

During the controversy about the inner belt, the antihighway forces formed a united front for antihighway efforts across the region and broadened their position to advocate major new public transportation improvements in the region. These moves raised the issues to a regional level. The shift toward a regional focus for the antihighway protest led to creation of other regional groups that took the prohighway position (formed most notably by labor groups, contractors, and some suburbanites). The development of diverse regional constituencies turned the public agenda to questions of resource allocation and balance of transportation. This, in turn, raised expectations for citizen involvement in transportation planning in the Boston region and influenced the structures that evolved to formally integrate it into the agency processes.

Executive Response (1969 to 1971)

The political turmoil regarding the future of the inner belt and the related Interstate system highlighted the lack of ability, at the state or regional level, to deal with intermodal questions of potential regional significance. In the period from 1969 to 1971, Governor Sargent created a blue ribbon task force. This group recommended a restudy of the controversial facilities and suggested the need for balance in the regional transportation system. The governor also called a moratorium on new highway construction within Route 128 until decisions could be made on the basis of the restudy.

During this period, consultation with diverse groups set an initial tone and level of expectation for community involvement in the restudy process. The restudy (BTPR) (2) was to follow these general principles in citizen involvement:

1. The process was to be participatory but decisive;
2. The study was to have a multivalue orientation;
3. Equity was to be a guiding principle;
4. Public contact was to be encouraged, both in formal steering groups and in ad hoc workshops; and
5. Ten percent of the study funds were set aside for community liaison and technical assistance activities (3).

By the middle of 1971, powerful forces were in motion that placed significant planning resources under the close control of the governor and created a mandate for an open, responsive process. At the same time, the state Executive Office of Transportation and Construction (EOTC) was created. This placed, for the first time, a cabinet officer in a position to oversee the existing state and regional agencies. These trends centralized multimodal decision making while widening the range of inputs to transportation decisions. In order to enable politically and technically knowledgeable executive decision making, it was necessary to have credible mechanisms for discussing, if not resolving, conflicts in transportation preferences and policies among a diverse group of official and ad hoc participants in the region.

Innovations During the BTPR (1971 to 1972)

The BTPR had an important influence on the development of current mechanisms for citizen participation in metropolitan Boston. The mandate for the technical work stressed consideration of alternatives that would be multimodal and broadly defined. The staff was not to make recommendations because decision making would fall ultimately to the governor. The governor's willingness to take direct responsibility for the decision made the decision-making process consciously political and encouraged the full participation of diverse groups.

At the regional level, a working committee was created that included representatives from a wide range of interest groups—suburbs, city, environmental groups, labor, contractors' groups, and chambers of commerce. The working committee was designed to advise on policy matters by using a consensus approach to decision making. Opposing points of view were aired, and the restudy management and staff gave appropriate technical responses. The working committee was a place for disagreements to be discussed in public and for participants to influence the technical work of the restudy. Reviewers of the BTPR have noted that "the working committee served as a microcosm of the full public of the study, offering nearly the full span of views that would eventually be addressed to the proposals" (4) and that "the working committee as a whole was committed to an open participatory process, but this was about the only committment they held in common" (5). The activities of the working committee ensured the perpetuation of a knowledgeable group of regional participants. The transportation agencies grudgingly accepted the inevitability of continued citizen involvement at the regional level.

The mechanism of the BTPR for citizen participation was an independent community liaison and technical assistance staff, to which was allocated 10 percent of the study's $3.5 million budget. This group worked in parallel with the technical staff and used a broad variety of techniques to solicit and maintain involvement. Their efforts went well beyond the usual agency practices of the time. The special mission of BTPR and the governor's interest in the process fostered a spirit of innovation and disrupted the normal flow of work at the transit and highway agencies.

The work of the BTPR was undertaken on a multimodal basis; transit and highway options were studied in each corridor. When the first decisions were made to drop the major highways in favor of expanded transit plans and the BTPR effort was disbanded, federal, state, and regional officials sought to retain the most successful aspects of the process, including closely linked project and system planning; a high level of coordination among modal agencies; and active, closely monitored citizen participation at the project level and at the regional level.

Institutionalization of a Participatory Mechanism (1973 to Present)

Boston's participatory process draws on many of the innovative features of the BTPR experience modified and refined to meet current needs. Three principal concepts create a strong, centralized responsibility for planning and participation in the region: a multiagency MPO, an advisory process for citizen involvement, and a central support staff for community involvement and technical work of regional scope. These concepts are summarized in Figure 1 and explained below.

The MPO

Both the principles and the structure for the current approach flow from the MPO. Boston's MPO is composed of six agencies—the secretariat of transportation, the state highway agency, the regional planning agency, the port authority, the transit authority, and the municipalities' advisory board to the transit authority. These agencies are signatories to an agreement that sets forth their objectives for the transportation planning process in the region. The MPO represents the institutionalization of the multimodal planning approach that was initiated during BTPR.

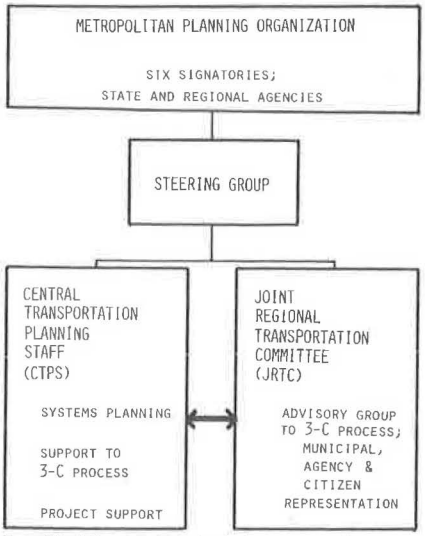


Figure 1. Boston urban transportation planning process.

Note: The 3-C process is a federal urban transportation planning process.

The CTPS

In their memorandum of understanding, the signatory agencies agree to support a CTPS. This is an interagency, interdisciplinary staff of 50 that provides continuing support for transportation planning in the Boston region. The CTPS receives approximately equal portions of highway and transit planning funds for its work; its current annual budget is $1.2 million. The staff works under the policy control of the MPO and the administrative guidance of its agency steering group. This planning staff is charged with three chief functions: systems planning, support of the planning process, and assistance to agencies in project planning. The CTPS develops and maintains a regional data base and travel forecasts to provide all the agencies with consistent, comprehensive information for their planning efforts. It prepares the unified work program and other certification documents for the region. The staff gives liaison and technical assistance services to support citizen participation programs at the regional, corridor, and project levels. Further, the CTPS provides engineering, design, planning, and environmental analyses to agencies for specific transportation planning projects. CTPS aids the agencies in centralizing and coordinating planning for the region and in filling recognized gaps within or between the agencies' functions.

The JRTC

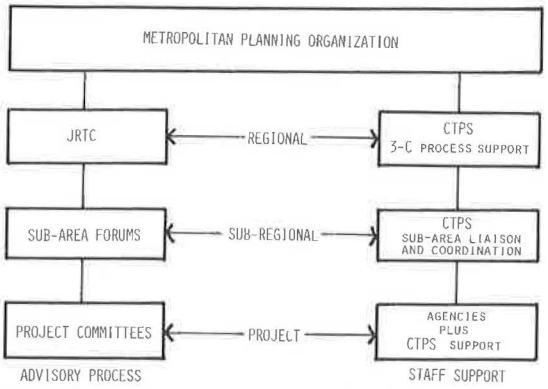
The MPO agencies agreed to provide for a regional advisory process by forming a JRTC. In many critical respects, the JRTC is the descendant of the working committee of the BTPR, both in concept and structure. The JRTC is the policy advisory group to the agencies on transportation planning for the Boston region. It is the MPO's formal means for ensuring that the objectives of the federal transportation planning process are carried

out at the regional level and that community participants have input into regional planning. The JRTC is currently composed of 54 members, all of whom are appointed by the MPO. They include the 14 agency representatives, of whom 6 are the signatory agencies; 20 representatives of municipalities; and 20 citizens from private organizations concerned with transportation planning. Staff support and the advisory process have been structured around regional, subregional, and project elements; there are strong relations between participation and planning at each of these levels.

CURRENT APPROACH TO REGIONAL PARTICIPATION

Both the advisory process and staff support in Boston's regional participation model are specified in the MPO's agreement. As is illustrated in Figure 2, the advisory process and staff support have been structured around regional, subregional, and project elements. The advisory process has different organizational structures for participation at each level, but these levels are closely linked.

Figure 2. Regional participation model.



Note: The 3-C process is a federal urban transportation planning process.

The JRTC was organized in late 1972. Its members represent a broad range of viewpoints. The JRTC's focus is regional, although it relies on information filtered up from corridor and project planning. The committee is an advisory body that works closely with the MPO agencies and whose goal is developing consensus among participants. Its functions are set forth in the MPO agreement as follows:

1. To advise the agencies on matters of policy affecting the conduct of the transportation planning process for the region;
2. To advise the agencies on regional transportation documents, such as the unified work program, that are required by state or federal laws and regulations; and
3. To provide maximum participation in the transportation planning process by creating a forum for bringing the MPO agencies together with other public agencies, municipal representatives, and citizens concerned with the transportation planning process.

This participation is intended to facilitate the consistency of transportation plans with the policies, priorities, and plans of other agencies, communities, private groups, and individuals in the region. The JRTC has monthly meetings, which are open to the general public. In addition, a series of subcommittees on operations policies, intermodal development, port issues, and citizen participation meet more frequently. Ten of the JRTC citizen designees sit on a panel to select other citizens to review proposals for planning projects.

The Boston region has been divided into seven subareas: the Boston core and six broad radial corridors, which each include 15 to 20 municipalities. For each of these parts of the region, subarea forums have been established as the principal means for this level of participation. The forums address planning issues and community concerns in each subarea on a broader basis than purely local or project issues. The work of the forums provides input to JRTC in its consideration of regional issues and provides an overview to guide planning in each subarea.

The forums are not organized groups of designated members, although JRTC members have been appointed as chairpersons. Typically, 100 to 200 municipal officials, agency representatives, and citizen groups are notified of forum meetings, which are open to the public. Forums meet two to four times a year. Meetings are devoted almost exclusively to reviews and comments on aspects of regional planning certification documents that pertain to the subarea.

Project working committees are the principal means by which large numbers of citizens are actively involved in transportation planning in the region. The strong role of working committees in the overall participatory process is a direct inheritance from the BTPR, which has been maintained and supported by the agencies and the CTPS. Other activities and techniques are also used in projects to involve additional citizens in different ways.

Working committees are established by the agency responsible for a particular project, with advice and assistance from the CTPS staff. Committees serve for the duration of the project planning stage. They are usually composed of 25 or more participants from project area municipalities, a diversity of private citizen interest groups, and a number of public agencies.

Working committees are more formally structured than subarea forums and less formally structured than the JRTC. As are all other participatory groups in the regional planning process, working committees are advisory. The success of the project working committees relates to the immediacy of specific planning issues, the strong interest of citizens in active involvement in local projects, and the frequency of meetings. Project working committees identify pressing local issues and generate information that is filtered up to subarea forums and to the JRTC.

STAFF SUPPORT: THE CTPS

The CTPS is organized into five major divisions: systems analysis, design and environmental planning, policy and programming, community liaison, and area coordination. The systems analysis, policy and programming, and community liaison divisions play major roles at the regional level in supporting the planning process.

The systems analysis division is responsible for developing and maintaining the regional transportation data base and for conducting systems analyses and travel forecasts. Its work supports the ongoing regional planning efforts of the agencies, is used in the refinement of regional plans and certification documents, and is also used for individual facility planning.

The policy and programming division prepares and updates the regional planning certification documents. The division provides staff support to the MPO by assisting its agency steering group. The steering group reviews virtually all of the advance work that precedes

MPO decisions, and the CTPS policy and programming staff plays a key role in providing input to these deliberations. It also gives staff assistance to the JRTC by providing information to help JRTC develop its advisory positions.

The community liaison division gives staff support to the participatory process. Its staff of five, about 10 percent of the CTPS, plays three major roles at the regional level: (a) staff support to the JRTC and its subcommittees, (b) information and advice on questions of community involvement policy and process to the agencies and to the JRTC, and (c) encouragement of two-way communication between agency personnel and citizens.

The liaison division and the area coordinators provide staff support for subregional planning. Both divisions have ongoing responsibility to monitor subarea transportation issues, projects, and needs and to relate these to regional plans and certification documents. They are also responsible for developing and maintaining contact with local officials, citizens, and agency personnel in each subarea. Liaison staff and area coordinators work as partners; liaison planners concentrate on the participatory process and community liaison and area coordinators concentrate on technical planning and agency liaison. The separate identity of the community liaison function is a direct inheritance from the BTPR experience. However, because liaison staff and area coordinators work as partners, integration of the related technical and participatory aspects of the planning process is encouraged.

All CTPS divisions take part in project-level activities at various stages of the project's development. At the environmental impact statement and project development stage, one or more agencies assume major responsibility for a project; consultants are typically hired to perform planning, environmental, and design studies. In these instances, the role of CTPS is one of secondary staff support to the lead agency. For studies at the corridor planning and preproject stage, CTPS plays a more direct role, serving as the planning team.

For project work, the area coordinator and liaison staff members keep contact with the community, provide information to agency and consultant staffs, attend workshops, and review work products. In some instances, other CTPS divisions provide specific planning services, such as systems analysis for a project.

STRENGTHS AND WEAKNESSES OF THE APPROACH

The multiagency approach combines the several key agencies that contribute to transportation policy in the Boston region. It has the major advantage of centralizing decision-making authority, while enabling the diverse inputs and concerns of each agency to influence the process. This type of approach to the MPO is one of the ways in which the cooperative facet of the federal transportation planning process is ensured organizationally in a way that responds to the bureaucratic concerns of individual participating agencies. Such a cooperative relation is not necessarily served by designating a single regional planning agency as the MPO, which may also have the effect of bypassing state statutory authorities vested in several transportation agencies. The multiagency approach entails the risk of centralizing a large measure of decision making latitude in the hands of a small steering group, although this group is, in theory, responsive to diverse agency policies and priorities. Because the agencies have such strong control over the process, the decisions regarding participation programs may be slanted to resemble those of a passive advisory group, rather than of a diverse group whose inputs can contribute to a healthy regional dialogue. This type of organization for an MPO is clearly dependent on a relatively amicable interagency relationship; in Boston the role of the EOTC as primus inter pares provides a mediating influence and an extremely strong voice within the MPO. Without such clear direction, such a formula might be a prescription for internecine conflict.

The establishment of the advisory JRTC and the designation of the CTPS to monitor and facilitate the planning process provides a system for participation within which several levels of planning and involvement are closely linked. This system provides for significant mobility of people and ideas between the local and regional levels of concern. The creation of the JRTC explicitly recognizes the existence of legitimate differences of opinion, providing a place and a process for their resolution. The system's multilevel structure provides a means of entry for new participants to become involved at the project level and have the opportunity to participate in activities at either the subregional or the regional level. This also provides a frequent means for communities to represent legitimate concerns that go beyond their own borders and to make these known to others in their immediate subregion. The system requires that the sponsors retain enthusiasm for bringing new faces and concerns into the process. Without such new blood, the system and the participants within it can become stale.

The sponsorship of the CTPS by the composite agencies of the MPO has created a professional staff that is not bound to the outlook of any individual agency. The staff, therefore, has the potential to contribute new perspectives and solutions, which might not be likely to emanate from the agencies. Also, in Massachusetts, where most project development work is done by outside consultants, CTPS provides a flexible means to respond quickly to technical problems with a built- in capacity to deal with the affected community in ways consistent with the federal planning process. The organization provides a locus for contributed staff from the individual agencies and offers a potential training environment for the participating agency staff. Most importantly, CTPS serves as a bridging device between the agencies and the participants and between local and regional concerns. This bridging function is of paramount importance in developing a regional process that does not lose sight of real problems and people. The major opportunity for conflict in such a model is between the rather abstract and idealized needs and concerns of the regional process versus the potential project and implementation-related demands of the signatory agencies that comprise the MPO.

GENERAL CONCLUSIONS

The general form that has evolved for the participatory process in Boston has been strongly influenced by the previous experience in the BTPR. The JRTC is similar, though not identical, to the BTPR working committee. The CTPS is similar in some respects to the BTPR staff; however, the new institutional structure represents a union of the strengths of the several key agencies in ways consistent with current realities, statutory responsibilities of the agencies, and federal process requirements. Although the particular mechanisms have been strongly influenced by the past experience, there is no reason why this model might not be used elsewhere if it is adapted to take account of local agencies'

abilities and authorities and has a regional participatory mechanism that is tuned to the locality.

These observations highlight a more general need for disseminating information and sharing experiences regarding the role of and mechanisms for regional participation in transportation planning among various regions. Such exchanges could result in wider application of innovative organizational and methodological techniques to structure the participation process to assist in formulating, endorsing, and implementing sensible regional transportation systems to reflect local priorities and needs.

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Selecting Effective Citizen Participation Techniques

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Selection of effective citizen participation techniques for use in transportation planning is described as a three-part process: (a) identify on the basis of function those techniques that are suitable to the stage in the planning process, (b) eliminate any techniques that require the use of resources beyond those available to the agency, and (c) select the most appropriate remaining technique on the basis of the sociopolitical situation in the community. Each part of the selection process is discussed and applied to 37 participation techniques, including advocacy planning, charrettes, hotlines, and surveys. The 37 techniques are classified as performing the functions of information dissemination, information collection, initiative planning, reactive planning, decision making, and participation process support and are related to appropriate steps in a 19-step analysis of the planning process. Several other functional classifications and analyses of the planning process are briefly discussed. The resources necessary for implementation of techniques are money, time, staff from the agency, expertise, and equipment. Estimates for each type of resource have been gathered from the literature for the 37 techniques. Sociopolitical factors are not easily quantified. Factors planners should consider in matching a potential technique to a given community are local interest level, attitude, cohesion, expectations of the community's role in planning, past experience with participation, and median educational level.

Much of the recent discussion on citizen participation has focused on individual techniques. Previous efforts to collect and synthesize this material have been in the area of transportation planning and were usually encyclopedic in nature. Typically these works suggested selecting techniques by means of elaborate interactive processes that use classification schemes of up to nine dimensions (1, 2, 3, 4, 5). This paper summarizes and provides a simple framework for using that information. Transportation planning is used as a specific example, but the framework can be applied as well to other types of planning.

Citizen participation techniques are the elementary components of a citizen participation program. In some situations a certain technique (such as a citizens' advisory committee) will be very effective; in other situations the same technique will be totally ineffective. Through systematic consideration, effective techniques can be selected for different stages of a citizen participation program. An orderly three-step process for selecting effective techniques would (a) identify by function techniques that are suitable to the stage in the planning process being considered, (b) eliminate any technique that requires the use of resources beyond those available to the agency, and (c) select the most appropriate remaining technique on the basis of the sociopolitical situation in the community.

The first step in selecting an effective citizen participation technique for a specific stage of the planning process is to determine the function of citizen participation at that stage. There are six functions that citizen participation techniques perform in planning:

1. To disseminate to the public information about the planning process;
2. To collect information, either factual or perceptual, as input to the plans that are being developed;
3. To initiate plans by citizens with assistance from the agency;
4. To collect public reaction to alternative plans developed by the agency;
5. To make decisions that reflect a consensus within the community on the correct action to be taken; and
6. To support other elements of the participation process to operate more effectively (4, p. 18).

Most stages of the planning process require more than one citizen participation function and thus may need more than one citizen participation technique. For example, when a decision is made on whether to build a facility, decision-making techniques are needed, but also needed

are techniques that disseminate information to inform the public of the opportunity to participate.

TECHNIQUES CLASSIFIED BY FUNCTION

Some techniques can serve more than one function; for example, surveys, which primarily collect information, can also disseminate information by letting people know that a planning project is under way. The 37 techniques described by Rosener (6) and the Federal Highway Administration (FHWA) (4) are outlined below. They are classified on the basis of their primary functions (4, p. 19; 6, pp. 60-64).

Information Dissemination

1. Public information program: Information is provided to the public on a particular plan or proposal, usually over a long period of time.
2. Drop-in centers: Information distribution points permit a citizen to ask questions, review literature, or look at displays concerning a project affecting the area in which the center is located.
3. Hot lines: Telephone answering services connected with a planning process are publicized and used to answer citizens directly, to record questions to be answered with a later return call, or to provide a recorded message.
4. Open information meetings: Assemblies are held voluntarily by the agency to present to the public detailed information on a particular plan or project at any time during the process.

Information Collection

5. Surveys: Structured questioning is conducted of a sample of citizens who statistically represent the whole population.
6. Focused group discussion: Small meetings (8 to 10) are guided by a trained moderator who uses a prepared outline; it is based on the assumption that the group collectively has more information and insight than the individual members (synergy).
7. Delphi: This method is designed to systematically develop and express the views of a panel of individuals on a particular subject. First, written views are solicited on a subject; successive rounds present the arguments and counterarguments from the preceding round for panelists to respond to as they work toward a consensus of opinion or clearly established positions and supporting arguments.
8. Community-sponsored meetings: Assemblies organized by a community group focus on a particular plan or project in order to provide a forum for discussion of various interest group perspectives.
9. Public hearings: This method is usually required by law when some major governmental program is about to be implemented or before legislation is passed. It is characterized by procedural formalities, an official transcript or record of the meeting, and is open to participation by an individual or representative of a group to present views.
10. Ombudsman: An independent, impartial official mediates between citizen and government to seek redress for complaints, to further understanding of each other's position, or to expedite requests.

Initiative Planning

11. Advocacy planning: Affected groups employ professional assistance with private funds and consequently have a client-professional relationship.
12. Charrettes: Interest groups (governmental and nongovernmental) convene in intensive interactive meetings lasting from several days to several weeks.
13. Community planning centers: Ongoing local bodies independently plan for their community by using technical assistance employed by and responsible to a community-based citizens group.
14. Computer-based techniques: Experimental techniques that use computer technology to enhance citizen participation.
15. Design-in and color mapping: Citizens work with maps, scale representations, and photographs to provide a better idea of the effect on their community of proposed plans and projects.
16. Plural planning: Each interest group has its own planner (or group of planners) develop a proposed plan based on the group's goals and objectives.
17. Task force: An ad hoc citizen committee is sponsored by an agency and involved in a clearly defined task in the planning process. Its typical characteristics are small size (8 to 20), vigorous interaction between task force and agency, weak accountability to the general public, and specific time for accomplishment of its tasks.
18. Workshops: Working sessions provide a structure for parties to discuss thoroughly a specific technical issue or idea and try to reach an understanding about its role, nature, and importance in the planning process.

Reactive Planning

19. Citizens' advisory committees: A panel of citizens is called together by the agency to represent the ideas and attitudes of their groups or communities.
20. Citizen representatives on policy-making boards: Citizens participate as either appointed or elected members of public policy-making boards.
21. Fishbowl planning: This process involves citizens in restructuring a proposed plan before its adoption; it uses public meetings, brochures (which provide continuity between successive public meetings), workshops, and a citizens' committee.
22. Interactive cable-television-based participation: This experimental tool uses two-way coaxial cable television to solicit immediate citizen reaction; it is now in the initial stages of experimentation on a community level.
23. Neighborhood meetings: Meetings are held for residents of a neighborhood affected by a project or plan (usually these meetings are held either very early in the planning process or when plans have been developed and response is needed).
24. Neighborhood planning councils: Councils for specific geographic areas serve as advisory bodies to the public agency in identifying neighborhood problems, formulating goals and priorities, and evaluating and reacting to the agency's proposed plans.
25. Policy capturing: This highly sophisticated, experimental method involves mathematical models of policy positions of interested parties and attempts to make explicit the weight and trade-off patterns of an individual or group.
26. Value analysis: Various interest groups subjectively rank the consequences of proposals and alternatives to articulate community goals against which alternative plans can be evaluated and consensus for one alternative developed.

Decision Making

27. Arbitrative and mediative planning: Labor-management mediation and arbitration techniques are used to settle disputes between interest groups in the planning process.
28. Citizen referendum: Citizens choose between proposed measures via balloting; it may be an official statutory technique or unofficial.
29. Citizen review board: Decision-making authority is delegated to citizen representatives who are either elected or appointed to sit on a board and have the authority to review alternative plans and decide which plan should be implemented.
30. Media-based issue balloting: Citizens are informed through public media, such as newspapers or television, of the existence and scope of a public problem, alternatives are described, and then citizens are asked to indicate their views and opinions in a ballot to be returned for counting.

Participation Process Support

31. Citizen employment: The direct employment of client representatives results in continuous input of clients' values and interests to the policy and planning process.
32. Citizen honoraria: Payments may be used as an incentive for participation of low-income citizens; honoraria differ from reimbursements for expenses in that they dignify the status of the citizen and place a value on his or her participation.
33. Citizen training: Participants are instructed in technical issues, planning, or leadership.
34. Community technical assistance: Professional staff and technical information and explanations are provided to interest groups so they may develop alternative plans or articulate objections to plans and policies proposed by the agency.
35. Coordinators or catalysts: An individual takes responsibility for providing a focal point for citizen participation in a project, is in contact with all parties, and channels feedback from citizens into the planning process.
36. Game simulations: Citizens experiment in a risk-free setting with various alternatives (policies, programs, plans) to determine their impacts in a simulated, competitive environment where no actual capital investment or real consequences are at stake.
37. Group dynamics: Interpersonal techniques and exercises are used to facilitate group interaction, or problem-solving techniques may be designed to highlight substantive issues.

Information dissemination is more than public relations; it includes techniques to let the public know what steps the agency is taking, what opportunities citizens have to make an input, what plans have been proposed, and what decisions have been made. Information dissemination techniques are needed at almost every stage of the planning process; information dissemination is a secondary function of most citizen participation techniques.

One type of information collection technique cannot collect all the information needed. For instance, identifying the major issues in a community may require communications with a limited number of people on an intense basis through a technique such as focused group discussions, but determining the attitudes of the community on an issue may require communications with a large number of people in a more limited manner through a technique such as a survey.

The public hearing is an information collection technique often required by law. Public hearings are characterized by procedural formalities. These formalities often prevent two-way communication but, when they are properly used with other techniques, they assure citizens of the opportunity to be heard and provide an official record that can be useful in decision making. Public hearings are such a traditional part of the American system that their very use often makes a decision-making process appear legitimate.

The use of an ombudsman is another information collection technique that has a special nature. The ombudsman receives and acts on complaints from citizens when the regular citizen participation process has broken down in some way. The ombudsman is usually not used as part of a single planning project but rather is used in relation to the city or state government in general.

Most interaction between citizens and the agency takes place through initiative planning techniques or reactive planning techniques. The former permit citizens to produce proposals and structure options while the agency provides information and technical assistance to the citizens. Initiative techniques require an active and interested public and a cooperative and skilled agency. In reactive planning techniques, citizens react to proposals and options developed by the agency so that the agency's proposals may be modified. Less public energy is used in reactive planning than in initiative planning.

Decision-making techniques help a community develop a consensus on an issue. These techniques do not replace the legal responsibilities of elected and appointed public officials. Some decision-making techniques, such as arbitration and mediation, develop compromises and resolve conflict while other techniques, such as citizen referendums, simply identify the majority position.

Participation process support techniques make the rest of the participation program run smoothly. They include techniques like citizen training that provide a greater understanding of the planning issues and thus allow more effective participation. They also include techniques such as community technical assistance, which provides citizens with resources that they could not develop on their own. Citizens sometimes view participation process support techniques as diversions; if they are not used appropriately, they may be.

Other classification schemes based on the functions of techniques have been developed. One of them, sponsored by the Pennsylvania Department of Transportation, uses these categories (3, pp. 3-18): (a) notification, (b) citizen feedback, (c) presentation, (d) dialogue, (e) advice, (f) community staff, (g) task force, (h) negotiation, and (i) monitor. Included in this list of functional categories are two techniques, task force and community staff.

Another classification scheme based on technique function by Smith and others was developed for FHWA (2, p. 101). It has these functional purposes: (a) to inventory groups and define key publics affected by a project, (b) to identify key community issues, (c) to identify community priorities and values, (d) to inform publics of meetings and events, (e) to motivate the public to participate in community involvement planning, (f) to predict social and physical project impacts on a community, (g) to promote direct public interaction in planning and design, (h) to resolve conflicts, (i) to monitor actual project impacts of recently built highways, and (j) to evaluate the effectiveness of the community involvement program. These are essentially subdivisions of the categories used in this paper.

Schuster and others, in a report sponsored by the U.S. Department of Transportation, use function as one dimen-

sion of a nine-dimensional classification scheme (1, p. 125). They list these five functions: (a) clarification, (b) communication, (c) communication with feedback, (d) interaction, and (e) problem solving. This scheme focuses on the type of communication that is involved rather than on the result of the communication.

STEPS IN TRANSPORTATION PLANNING

Any planning process can be broken down into several steps. The FHWA's 19-step representation of the transportation planning process is an example of how this can be done (4, p. 25). The full descriptions of the steps, in order, follow; the cycle can be repeated if necessary.

1. Inventory and analyze current conditions, trends, and problems.
2. Generate preliminary definitions of development issues and policies.
3. Forecast population and employment on the basis of policies.
4. Forecast travel demand on the basis of forecast employment and population.
5. Define transportation needs and objectives.
6. Develop alternative transportation plans and programs.
7. Make preliminary evaluation of alternatives.
8. Establish regional or subarea priorities.
9. Select a program package.
10. Make level-of-action decisions.
11. Establish annual (or biennial) action program.
12. Refine location and design alternatives.
13. Analyze in detail environmental impacts and engineering feasibility.
14. Write draft environmental impact statement.
15. Write final environmental impact statement.
16. Make decision on whether to build facility.
17. Prepare final design plans, engineering plans, and cost estimates.
18. Implement and construct.
19. Operate and evaluate.

As an aid to identifying techniques that are functionally suited to the various steps, a matrix can be generated by arraying these steps down one side of a chart and the process-linked techniques across the chart. An example of how this can be done is shown in Figure 1, which was derived from the FHWA manual (4, p. 25). When a group of techniques suitable for a particular stage of planning has been identified, the next step is to eliminate techniques that require more resources than the agency has available. Resources may be grouped under five headings:

1. Money—the funds needed for purchasing supplies, hiring consultants, paying honoraria, and so on;
2. Time—the calendar time required to prepare and put into operation a given technique;
3. Staff of the agency as contrasted to consultants;
4. Expertise needed to put a technique into operation; and
5. Equipment required for a technique.

Possible limitations of resources can be reduced if provision is made for citizen participation at the very beginning of the project. This will give the longest period of time for planning and the greatest opportunity to locate funding, obtain allocations of staff, locate or train experts, and acquire special equipment.

Table 1 synthesizes estimates of the resources required for the 37 techniques (2, 3, 4, 5). Specific dollar amounts are given under the money heading whenever possible; the prices are as of 1975. For some techniques only subjective estimates of expensive or not too costly were available. These were used although they come from

Figure 1. Citizen participation in the transportation planning process.

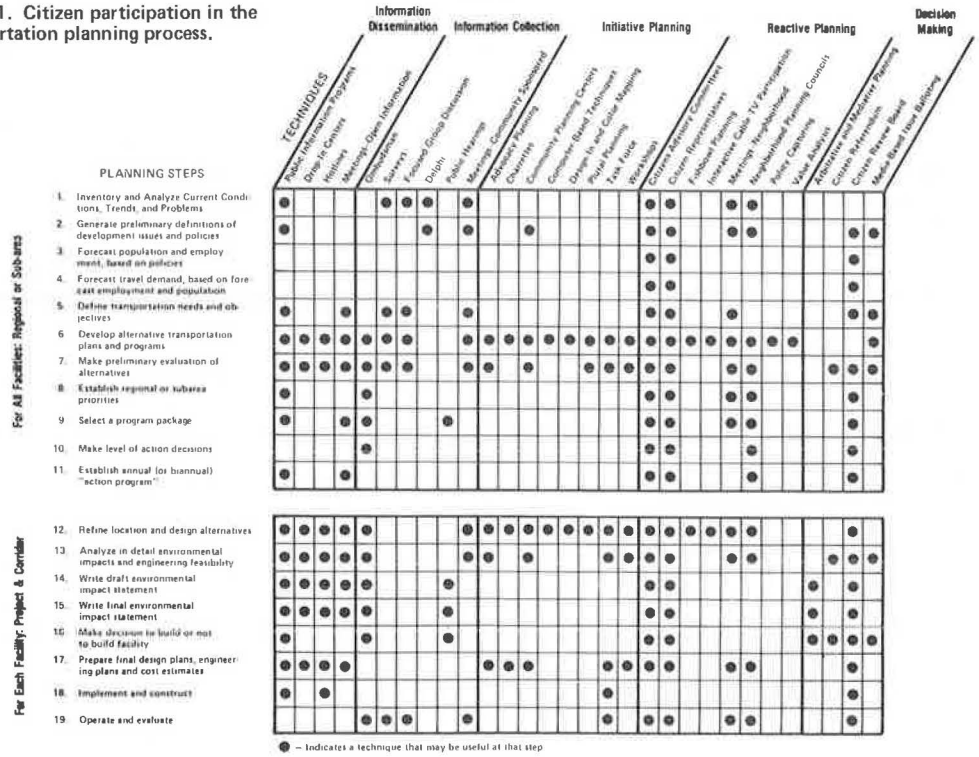

Table 1. Resources and techniques.

Technique	Money	Time	Staff	Expertise	Equipment
1. Public information program	$5 000 to 50 000	Medium to high	Medium to high	No	No
2. Drop-in center	Can be costly	Medium	High	No	Yes (mobile center)
3. Hot line	$2 000/week for recording equipment 24 h/d, $40 installation fee	Low	Low	No	Yes
4. Open information meeting	Varies widely	Low	Medium	No	No
5. Survey	$3 to 5/mailed questionnaire, $10 to 15/telephone interview, $15 to 30/personal interview with basic analysis of data	Medium to high	Medium	Yes	Yes
6. Focused group discussion	Varies	Medium to high	Medium	Yes	No
7. Delphi	Can be costly	High	Low	Yes	No
8. Community-sponsored meeting	Relatively little	Low	Low	No	No
9. Public hearing	$500 to 25 000	High	Medium	Yes	Yes
10. Ombudsman	$18 000 to 40 000 annual salary	Low to medium	High	Yes	No
11. Advocacy planning	$20 000 to 100 000/year	Low to medium	Low	Yes	No
12. Charrette	$15 000 to 250 000	High	Medium	Yes	Yes (overnight facility)
13. Community planning center	$60 000 to 200 000/year	Medium to high	Low	Yes	No
14. Community-based technology	Varies widely	Low to high	Low	Yes	Yes
15. Design-in and color mapping	Less than $100 to 5 000	Low to medium	Medium	No	Yes (models)
16. Plural planning	$50 000 to 100 000/community group	High	High	No	No
17. Task force	Relatively little	Low to medium	Medium	No	No
18. Workshop	$500 to 2 000	Low to medium	Medium	Yes	No
19. Citizens' advisory committee	$20 000 to 60 000	High	Medium	No	No
20. Citizen representative	Very little	Low	Low	No	No
21. Fishbowl planning	Relatively costly	Medium to high	High	No	No
22. Interactive cable TV	Costly	Not available	Not available	Yes	Yes
23. Neighborhood meeting	Relatively little	Medium	Medium	No	No
24. Neighborhood planning council	$20 000 to 100 000/year	Medium	High	No	No
25. Policy capturing	$10 to 20/computer regression analysis; $40 000 for interactive computer graphics program	Medium to high	Medium	Yes	Yes
26. Value analysis	Many cost factors	High	High	Yes	Yes
27. Arbitration and mediation	$200 to 250/d for arbitrator or mediator	High	Medium	Yes	No
28. Citizen referendum	$5 000 to 40 000	Medium to high	Low to medium	No	Yes
29. Citizen review board	Depends on amount needed for honoraria and citizen training	High	High	No	No
30. Media-based issue balloting	$17 500 to 1.5 million	High	Medium	Yes	Yes
31. Citizen employment	$5 000 to 10 000/employee	Low to medium	Low	No	No
32. Citizen honoraria	For each person: at least $10/meeting or $25 to 50/d; higher if repaying at actual payscale	Low	Low	No	No
33. Citizen training	Varies widely	Low to high	Medium	Yes	Yes
34. Community technical assistance	Varies	Medium to high	Low to high	No	No
35. Coordinator or catalyst	$20 000 to 30 000 annual salary	High	Low	No	No
36. Game simulation	$100 to 500/d for existing game; $10 000 to 2 million to develop new game	Medium to high	Medium	Yes	Yes
37. Group dynamics	$150 to 1 000/d for leaders; $1 600 for purchase of videotape equipment; $16 for 30 min of tape	Medium	Low to medium	Yes	Yes (videotaping)

various sources and have no standard scale. Time required to institute a technique is estimated on a three-point scale (2, p. 71): (a) low = less than 1 month, (b) medium = between 1 and 2 months, and (c) high = more than 2 months.

Qualitative estimates of the staffing required for many participation techniques used the following scale (5, pp. 20-21): (a) low = no significant commitment of staff time or skills after a possibly substantial initial effort to institute a technique; (b) medium = short term, intensive effort for each occurrence; and (c) high = significant commitment of some staff members for more than 1 month. Expertise is rated on a two-point scale according to whether a technique requires skills and knowledge beyond that usually possessed by transportation planners (2, pp. 72-95). These ratings have been freely combined with those from other references to the need for special skills. Similarly, the column for equipment indicates whether a technique requires specialized equipment beyond the usual clerical supplies the agency is assumed to have available.

After determining which techniques are functionally suitable and eliminating those that require resources unavailable to the agency, the techniques most applicable to the sociopolitical situation of the community should be selected. At least six factors should be considered:

1. The community's interest in the topic,
2. The community's attitude toward the topic,
3. The community's cohesion,
4. The community's expectations of the role it should play in the planning process,
5. The community's past experience with citizen participation, and
6. The community's median level of education.

Selections must be made subjectively, but they should be based on the objective information obtained from these factors. This is where the judgment and the experience of the individual who is running the community participation program come into play. These six factors do not lend themselves to being arranged in a matrix or to quantitative analysis.

In communities where the level of interest is high, different techniques are necessary and more appropriate than in communities where the level of interest is low. For example, the information dissemination technique of hotlines will not work if there is not enough interest in the community for people to make the telephone calls that start that process. The level of community interest in the topic can be determined by reviewing local newspapers, talking with community leaders, and using such community participation techniques as focused group discussions, delphi, or surveys.

When a community has already developed an opinion, all alternatives may not receive fair consideration. The process may benefit from the use of special techniques. Game simulations, for example, may help by making the participants more sensitive to issues that they have not considered. The community's attitude toward the topic

can be identified in ways similar to those used to determine the level of community interest.

The cohesiveness of the community determines the ease with which consensus can be developed on a proper course of action. If opposing interests exist in the community, conflict resolution techniques such as mediation may be needed. The level of community cohesion is less easily measured than are some of the other sociopolitical factors. It is influenced by such factors as the community's mobility, ethnicity, and range of income levels. Some of these factors can be found in statistical publications and others by talking with people in the community.

The community's expectations are important because they can determine which techniques the community will consider legitimate. Past experiences affect the community's expectations. The community's expectation of the role the public should play in the planning process can be determined by talking with community leaders or by using surveys and other information collection techniques.

The community's past experience will affect the community's opinion of planners. It may cause the community to expect certain levels of power in decision making. It may also have generated the development of certain interaction and leadership skills in the community. These factors should be considered when selecting appropriate techniques. The community's past experience can be learned from interviews with knowledgeable people in the community and in local planning organizations. Records can be found in back issues of the local newspapers and sometimes in the files of the planning agency itself.

The median educational level of a community is an important indication of the expected success of certain techniques. For example, fishbowl planning relies heavily on the reading and writing skills of the participants; it will probably fail in a community where the educational level is low. The median educational level of a community can usually be determined from census data.

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Fiscal Planning and Highway Programming: The Pennsylvania Response to a Changing Environment

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Many states face a changed era of highway programming and administration, an era characterized by a highly uncertain and pessimistic outlook for fiscal resources, escalating costs, and mounting environmental and other operational constraints. This paper discusses this changing environment in Pennsylvania and consequent developments in the state's highway program and programming process and relates them to trends in other states. Major issues described include the forecasting of fiscal resources, development and delineation of program alternatives, recognition and resolution of trade-offs among highway program elements (for example, capital versus maintenance efforts), and programmatic allocation and administration of capital investments.

Many state highway programs are experiencing severe

financial difficulties. National economic problems are the most immediate causes of the fiscal crises. Greatly increased gasoline prices have caused fuel-dependent revenues to level off, and construction costs are beset by tremendous rates of inflation. These recent fiscal problems are also caused by long-standing trends in highway financing and programming. Specifically, very generous federal assistance for highway construction has encouraged large-scale construction programs without adequate consideration of the maintenance requirements of these new facilities, for which federal aid has not been available. Also, the attempt to capture all available federal aid for construction has encouraged construction programs at the expense of maintenance programs. The practice of financing construction through bond issues can produce escalating debt service requirements, which eat up revenues that might otherwise be used for maintenance.

Large decreases in their real purchasing power and their inability to adequately fund operating activities have spurred several state highway and transportation agencies to immediate action. Many have adopted austerity measures that only a few years ago would have been drastic, if not unthinkable. This paper discusses the changing environment of highway financing in Pennsylvania and consequent developments in the state's highway program and programming process and relates them to trends in other states.

In this paper, we draw on our work in continuing policy analysis for the Pennsylvania Department of Transportation (PennDOT) regarding its highway program. Two projects in particular—one involving the allocation of construction funds and the other involving a broader fiscal review of the whole highway program—illustrate the recognition of this changing environment and the development of responses to it. The issues involved represent the kinds of problems that face many states at present and the constraints that must be met in what appears to be a new era in state highway programming and administration (1,2,3).

ALLOCATION FORMULA STUDY

Pennsylvania selects projects for inclusion in its capital program according to an allocation formula adopted by the Pennsylvania Transportation Commission. Traditionally, this formula has involved some weighted combination of factors designed to indicate needs and thereby produce an acceptable distribution of resources. However, in 1974, dissatisfaction with the prevailing formula led the commission to request that its advisory body, the State Transportation Advisory Committee, review the entire allocation procedure. The study focused on the allocation of highway funds because (a) they accounted for most of the state spending, (b) highway improvement throughout the state was urgently needed, and (c) this subject had long been in the public eye (4).

The commission was the arbiter of the allocation procedure, and the allocation occurred only for capital expenditures on state-administered highways. At the time of the study, all federal aid and bond funds available for capital improvements were subject to allocation with one major exception: federal aid for the Interstate and Appalachian highway systems. The prevailing allocation formula for the remaining federal aid and the bond funds consisted of an equal weighting scheme for each county's share of motor vehicle registrations, kilometers of state-administered road, and daily vehicle kilometers of travel. In the budgeting process, sufficient lead time was provided for preliminary, engineering, and other studies on an ad hoc basis. Local units, therefore, often demanded increased funding so that a sufficient backlog of projects could be maintained and used when any of the active projects ran into delays. Finally, the allocation procedure permitted contract awards on a first come, first served basis, with no ceiling on the amount expended in a county. This procedure failed to compensate those regions, particularly urban areas, that encountered difficulty in bringing projects to the contract award stage (for example, because of environmental opposition). This often resulted in large imbalances between allocations and contract awards; no accounting system existed to guarantee that all counties would ultimately get their allocations.

The foregoing characterizes the prevailing situation at the time of the advisory committee's study. The initial problem confronting the committee was one of immediately developing an allocation procedure to permit preparation of the biennial 12-year improvement program as mandated by state law. The interim measure sought, then, was one for resolving the multiple problems of

1. Intense competition for the capital improvement funds by counties in a situation that is exacerbated by inflation, cost escalations, and mounting debt service obligations;
2. Intense rivalry between urban and rural areas that is aggravated by constraints on the use of certain federal aid funds and alleged differences in the manner in which needs had been estimated between urban and rural regions; and
3. Charges that the prevailing allocation formula, which used a weighted combination of socioeconomic parameters, did not adequately reflect needs and was therefore inequitable.

In order to resolve these problems, the committee broke the allocation issue down into a number of elements and analyzed options for each separately at first, and then analyzed them together in terms of composite effects. Its short-term recommendations addressed (a) the treatment of federal aid funds, (b) the establishment of a discretionary fund and guidelines for its use, (c) allocation procedures for bond funds, (d) the relationship between the award schedule and allocation, and (e) the structure of the capital program. In what follows, the actions described are those that were recommended by the committee's study report and were then adopted by the commission (exceptions are noted).

Federal Aid Funds

The different way of treating federal aid funds arose because some of these funds were designated for specific uses (e.g., Interstate, Appalachian, and urban system funds), while others (e.g., primary and secondary funds) were not so constrained. The urban system funds, for example, were earmarked for urban areas that have populations of 5000 or more, and they were to be apportioned according to a formula developed by the state. However, urban areas that have populations of 200 000 or more were entitled to the funds "attributable" to them. In addition to these provisions, other complexities were introduced by (a) consideration of different federal, state, and local matching proportions; (b) ability to reallocate limited funds among eligible systems; and (c) ability to reallocate urban (but not rural) highway funds for transit.

Clearly, weaving these diverse federal fiscal policies into the state's allocation process was a complicated task. According to the committee's report, congressional intentions would be best served and equitably applied if each federal fund was separated and individ-

ually allocated according to its own appropriate criterion. Therefore, the primary, secondary, and urban extension funds were allocated to all counties on the basis of the relative proportion of kilometers of each system in each county. The urban system funds were allocated to the urban areas on the basis of relative population within these areas.

To maintain some flexibility in the allocation process, the committee recommended that the commission establish a discretionary fund to be allocated outside of the formula. This recommendation was accepted by the commission, and the fund amounted to 15 percent of the state bond revenues for highway capital improvements. The committee suggested (although the commission has not yet formally accepted) that the first call on this fund be given to emergency road and bridge improvements. Projects to rectify major system gaps would have the second call. Next, this fund could be used for contingency projects in areas that encounter difficulty in awarding contracts to start projects. Any balance remaining in the fund would revert to the counties in accordance with a formula described below.

State Bond Funds

The interim procedure used to allocate the state bond funds weights the relative urban and rural needs in each county by a policy variable referred to as the urban-rural split. The relative urban and rural needs were estimated by performing correlation and regression analyses on selected socioeconomic variables compared with the results from the Pennsylvania portion of the 1972 National Transportation Needs Study. The urban-rural split adopted by the commission was 55-45.

If a county awards contracts in excess of its allocation over a given time period, a number of actions could be taken in the next period to restore the balance. One possibility proposed by the committee (and eventually adopted by the commission) was to use a period of 2 to 4 years as a model for awarding contracts during the next 2- to 4-year period. Another option would be to reduce the number of projects budgeted, an action that eventually affects contract awards because there will be fewer projects available to award.

During the committee's study, modification of the structure of the 12-year improvement program was suggested to give local planners greater flexibility in developing candidate projects. The inflexibility in the current program structure arises from two characteristics of our transportation scene: (a) the greater concern with environmental factors and community values, which frequently delays or halts budgeted projects, and (b) the long lead time generally required to bring projects to fruition.

For these reasons, local planners should be allowed to develop contingency plans. The structure of the improvement program has to be modified so that it will consist of three classes, each of which would possess different planning and budgeting actions. Class 1 would include projects for which corridor location studies and environmental impact statements had been completed. Class 2 would include projects 3 to 6 years away from contract award. Class 3 would include projects more than 6 years away from contract award. The first two classes would be fiscally constrained; the third would be fiscally unconstrained but would have its projects ranked in priority order. Due to constraints on its time and resources, the committee stopped short of full endorsement for this proposed alternative structure but noted that the proposal clearly merited further consideration.

Programming Implications

Several of the recommendations have important implications for highway fund programs within the new context of scarce resources. First, the recommendation that actual contract awards be tied more directly to the dollar amounts allocated to the counties reflects a recognition of the changing environment of state highway finance. The past policy of open-ended award of contracts in a county, constrained by the total resources available statewide but not by county ceilings, facilitated the (unstated) objective of building as many kilometers of highway as possible in any single year and making use of all available federal funds. Apparently, if almost unlimited resources are available, imbalances between a county's allocation and the amount of contracts awarded are not really a problem because there will be sufficient funds for all projects that counties have under construction. When funds are limited, however, counties that lose projects on environmental or other grounds would be penalized if they could not be assured that their allocated amounts would be available for replacement projects.

Second, the proposed three-tier program structure attempts to impose fiscal restraint on the programming process while providing the flexibility for contingency planning. Although local officials may feel a need to consider alternative projects, the purpose of this proposal is to ensure that the number of projects moving into the advanced stages of the programming process are scaled down to a level that can actually be accommodated by the anticipated available financial resources.

Third and most important, the recommendation of a discretionary fund that would not be subject to the allocation formula is a significant move toward the concept of statewide allocation of highway funds. The possibility of abandoning the county allocation altogether was not seriously considered by the advisory committee, but the committee did recognize that, given a shortage of available funds, some provision was necessary to ensure that emergency improvements and projects that might have a high priority from a statewide perspective could be given special consideration apart from individual county programs.

The traditional procedure of allocating highway funds first to county areas and then to particular projects is based primarily on the concept of geographic equity; that is, every county should be assured of its fair share of projects. In the prevailing allocation formula, motor vehicle registrations and vehicle kilometers of travel might be considered as rough indicators of highway-related revenue generation and could thus serve to return funds to their geographical source. State-administered road kilometers, on the other hand, might be considered a rough surrogate for needs; the adopted urban-rural split was intended to further temper the allocation for the greater needs of urban areas.

Each proposed project is, of course, subjected to economic analysis and some benefit/cost criterion, and within counties the priority ranking of projects might be based on economic efficiency. The point is that the statewide allocation is based primarily on equity criteria and secondarily on needs criteria. Such a policy can result in discrepancies between the composite program of county projects and the priorities that would be established on the criterion of maximum benefits from a statewide perspective. If financial resources are abundant, this may have little or no practical significance but, if resources are scarce, the issue may be critical.

PENNDOT FISCAL REVIEW

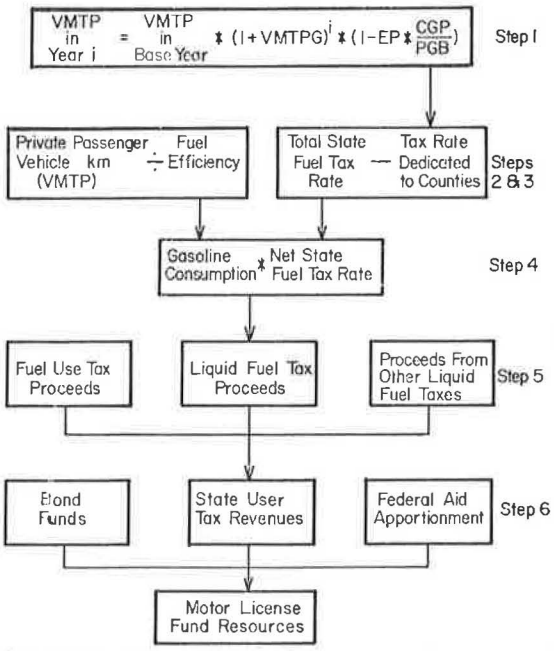
In response to a number of developments in the highway program (including difficulties in implementing the construction program, increasing deficiencies in the maintenance program, and tremendously increasing costs in both areas), the Pennsylvania Secretary of Transportation and the transportation commission established a top-level task force to look into PennDOT's financial problems. The task force's work clearly demonstrated the connection between fiscal planning, systems planning, and programming, and it is instructive for the analytical approach employed.

Because the highway program accounts for about 90 percent of the department's budget, the fiscal review task force concentrated on the broad policy issues involved in the funding, allocation, development, and implementation of highway programs; particular attention was paid to the fiscal management process. It evaluated the problem in dollar terms, identified the critical factors contributing to the problem and the control points for dealing with it, analyzed the implications of alternative program strategies, and made recommendations regarding financial, programmatic, and managerial policies (5,6).

The task force's approach was to compare forecasts of the revenues available to the department based on varying assumptions with projections of resource requirements based on alternative program strategies. A systems approach was used to highlight the constraints imposed on program size and content by revenues and other factors, as well as the interactions among certain program decisions.

Much of the analytical work concerned the development of adequate forecasts of revenues, based on the functional relations modeled in Figure 1 (6,7). Briefly, the motor license fund is credited with revenues from three sources: state user tax revenues, federal aid apportionments, and new bond issues. The state user tax revenues include those generated by fuel taxes, whose proceeds are determined by tax rates and fuel consumption, which is itself determined by such factors as vehicle kilometers, fuel efficiency, fuel prices, and the elasticity of travel demand with respect to fuel price. Federal aid apportionments are determined by the same factors and, in addition, by the interest rate for highway trust fund income and the apportionment factor for Pennsylvania (sequence not shown). Bond funds were not forecast as such because they are set exogenously rather than being determined endogenously.

Figure 1. Flow chart for computing liquid fuel tax proceeds.



VMTPG = Annual growth in private passenger-vehicle kilometer of travel (VMTP)

EP = Elasticity of demand for VMTP with respect to fuel price

CGP = Change in price of gasoline from base year

PGB = Price of gasoline in base year (fiscal year 1974-1975)

Sensitivity analysis was conducted using this model to develop separate forecasts of motor license fund revenues for the next several years based on differing assumptions about the values of the input parameters. These assumptions regarding factors such as growth in vehicle kilometers traveled and fuel price were varied to represent alternative income scenarios, including a null case that reflected existing trends, as well as more optimistic and pessimistic scenarios. The optimistic scenario included provision for a 0.5 cent/L (2 cents/gal) tax increase in the liquid fuels tax—from 2.4 to 2.9 cents/L (9 to 11 cents/gal). Taken together, the resulting set of forecasts represented the likely range of revenues for the next several years.

Program Alternatives

In order to evaluate the implications of the revenue forecasts for PennDOT's highway programs, various levels of construction programs were specified in dollar terms and the costs were determined for alternative levels of maintenance activities. The levels of construction programs were defined as C1—those with only enough new bond issues to meet past commitments for contract awards, C2—new project starts made possible by $100 million in annual bond issues, and C3—new project starts permitted by $200 million in annual bond issues. Average bond issues for highway construction from fiscal year 1970 to fiscal year 1976 were more than $200 million annually.

Five levels of maintenance activities were described and their costs determined; they ranged from a complete and highly desirable maintenance program (M1) through a no-frills program (M2) to a minimal, largely unacceptable program (M5).

M1—Maintain all roads, shoulders, bridges, guardrails, and so on at normal recommended standards. Do catch-up work at a rate that would eliminate backlogs on resurfacing, bridge upgrading, and widening narrow roads in 12 years. Replace substandard guardrail over 25 years. Keep all roadways generally free of ice and snow 95 percent of the time and have limited-access roads bare within 2 h after a storm. Maintain sign and line painting and vegetation control at normal standards.

M2—Maintain roads, bridges, and the like at M1 level on limited-access and primary highways, but reduce maintenance on secondary and rural roads. Eliminate work that affects aesthetics only. Do catch-up work to eliminate backlog of resurfacing, bridge upgrading, guardrail replacement, and road widening over 25 years. Permit snow accumulations of 7.6 cm (3 in) on secondary roads and 12.7 cm (5 in) on rural roads. Remove half of picnic tables from roadside rest areas. Do cleanup services only for safety reasons.

M3—Do only 3200 km (2000 miles) of resurfacing and surface treatment. This will increase backlog by 800 km/year (500 miles/year). Otherwise keep maintenance at M2 level. Do catch-up work in guardrail replacement and road widening on 30-year schedule. Reduce

snow removal during nonpeak hours from 9:00 p.m. to 4:00 a.m. Reduce grading, restabilization, and dust control work on unpaved roads by 10 percent and on shoulders by 25 percent. Do only 50 percent of required public service facility work.

M4—Keep highways in M3 condition, but permit deterioration that will significantly affect capital investment. Put major emphasis on roadway maintenance and little or none on shoulders, service facilities, and so on. Reduce preventive maintenance by 85 percent. Upgrade serious bridge deficiencies on 50-year schedule. Do not replace guardrails. Eliminate snow removal from 9:00 p.m. to 4:00 a.m. Discontinue maintenance of route markers and other signs, and do only 80 percent of required line painting. Reduce mechanized patching by 50 percent. Clean drainages only when completely clogged.

M5—Keep highways open but in a very poor state. Deficiencies will affect highway safety. Patch and surface-treat roads only on priority basis with emphasis on alleviating structural damage. Do 25 percent of required bridge maintenance, and repair structural damage to bridges. Put up no snow fences, and do all snow removal with department forces. Paint center line only on Interstate, primary, and secondary roads; paint no rural roads. Do not maintain warning signs and regulatory signs for night visibility. Do cleanup and vegetation control work only for safety. Replace guardrail only in hazardous situations.

In addition to basic differences in the level of preventive maintenance these programs would provide, they differ substantially in how they deal with the backlog of deficiencies, which are estimated to represent a total cost of $860 million. The M1 program would complete this catch-up effort in 12 years, while M2 would do so in 25 years; the 3 lower levels would never completely eliminate these deficiencies.

Trade-offs between the construction and maintenance components of the highway program were analyzed by examining the linkage from bond issues to future debt service and maintenance funds. Since bond revenues and federal funds can be used only for construction, maintenance must be funded solely out of the state user tax revenues. The maintenance function actually has last call on these funds after fixed obligations to counties and municipalities have been covered, mandated payments to other departments such as the state police have been made, debt service has been paid, and such PennDOT activities as general administration and safety and licensing have been accounted for. Thus, given an amount of state user tax revenues and the amounts set aside for fixed obligations, mandated payments, and general administration, the use of funds for debt service and maintenance is unlikely.

The critical issue, caused by a shortage of funds, then, is the trade-off between present expenditures on construction and future maintenance budgets. The most important aspect of this relation is that, if bonds are issued to finance construction projects, a greater share of the state user tax revenues will be required in future years for debt service; thus, less money will be available for maintenance. Furthermore, within the constraint of the allocated federal apportionment, the amount of federal aid actually used by PennDOT is determined by the amount of matching funds made available through bond issues. Thus, the decision to use, postpone, or forfeit federal funds directly affects the resources available for maintenance. In addition, a ceiling imposed on the proportion of state revenue that can be used for debt service can constrain the amount of new bonds that are issued.

Assuming that the costs of general administration will continue to consume roughly 30 percent of the state-generated revenues made available to PennDOT, the trade-off between construction and maintenance can be shown by the following equation:

$$M = Z - W - Y^* - Y^1/1.43 \quad (1)$$

where

M = maintenance expenditures in a given year,
Z = total state-generated revenue,
W = fixed obligations and mandated payments,
Y^* = debt service on past bonds, and
Y^1 = debt service on new bonds.

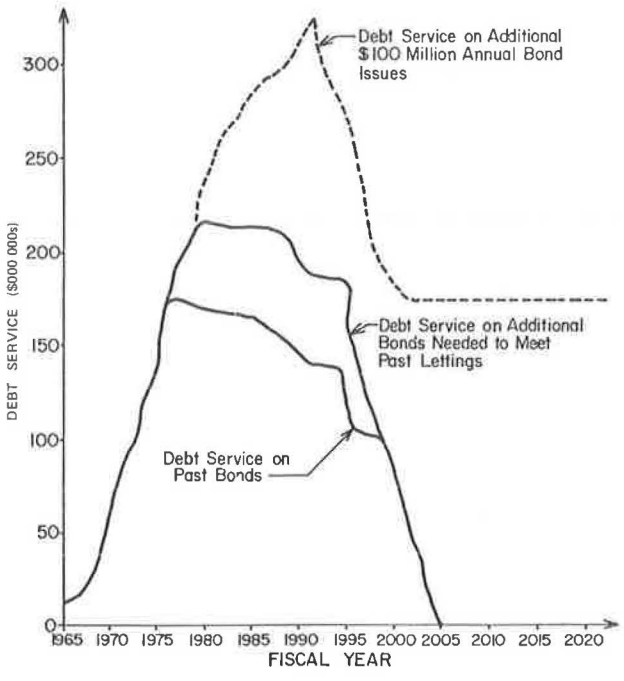
This relation would be expected to hold as long as the policy of financing construction projects with revenue bonds continues (6).

Findings

Revenue forecasts using the three scenarios showed substantial variation by fiscal year 1980-1981. The scenario based on continuation of past trends yielded a forecast of $819 million for fiscal year 1977 in state user tax revenues, the pessimistic scenario yielded $790 million, and the optimisitc scenario yielded $940 million. By fiscal year 1981 this spread will widen to roughly $900 million for the null scenario, $760 million for the pessimistic scenario, and $1123 million for the optimistic scenario. Comparisons between estimated program costs and projected revenues were based on the null scenario forecasts as the best point estimates of revenues, given no change in tax rates.

Debt service has escalated rapidly in the past decade from roughly $12 million in fiscal year 1965 to $179 million in fiscal year 1976-1977, as shown in Figure 2. The debt service on bonds that were issued in the past and on those additional bonds that will be issued to meet past contract commitments will peak in fiscal year 1980

Figure 2. Estimated debt service on past bonds and additional bond issues.



at roughly $210 million. This amounts to 31 percent of the forecast state-generated revenue that will be available to PennDOT. If additional bonds are issued at a level of $100 million annually (the C2 construction program), the debt service would peak in fiscal year 1995 at more than $325 million. After fiscal year 2005 it would level off at roughly $176 million/year.

The estimated costs for the five levels of maintenance programs for fiscal year 1976-1977 ranged from $447 million for M1 down to $252 million for M5. These estimates were then projected for subsequent years by assuming a 5 percent inflation factor. Table 1 shows a comparison of these projected costs and the revenues expected to be available for maintenance, assuming that state user tax revenues in the future are those forecast under scenario 1, the null case, and assuming that the only additional bonds to be issued will be those required to meet past contract commitments (C1).

Given the impact of past bond issues, not to mention future bonds, on the current maintenance program, we decided to examine the revenue deficiencies for the minimum adequate maintenance program, M2, along with various levels of construction financed on a pay-as-you-go basis. The results are shown in Table 2. For maintenance only, the deficiencies would require tax increase of 0.5 cent/L (2 cents/gal), while still more funds would be required to undertake additional construction projects. A modest construction program ($50 million state share) would require only marginally increased funds in the first year due to the lag time in implementation, but the full $50 million would be required annually by fiscal year 1979-1980.

RECOMMENDATIONS AND CONCLUSIONS

The fiscal review produced several recommendations.

Table 1. Effect of bond program C1 on maintenance in scenario 1.

Item	Costs ($000 000s) for Fiscal Year				
	1976-1977	1977-1978	1978-1979	1979-1980	1980-1981
State revenue	819.2	838.4	858.3	879.0	900.5
Expenditures					
Payments to municipalities	85.3	86.9	88.5	90.1	91.9
Payments to other departments	108.4	113.8	118.2	123.3	128.5
Debt service (program C1)	179.5	192.9	206.6	211.6	209.3
Nonmaintenance activities[a]	133.8	133.4	133.5	136.2	141.2
Total	507.0	527.0	546.8	561.2	570.9
State revenues available for maintenance	312.2	311.4	311.5	317.8	329.6
Cost of maintenance programs[b]					
M1	447.4	469.8	493.3	518.0	543.8
M2	388.3	407.7	428.1	449.5	472.0
M3	346.0	363.3	381.5	400.6	420.6
M4	293.9	308.6	324.0	340.2	357.2
M5	252.5	265.1	278.4	292.3	306.9

[a]Taken as 30 percent of the three preceding items subtracted from state revenue.
[b]Using an inflation factor of 5 percent.

The table shows that maintenance resources will increase in fiscal year 1979-1980 and fiscal year 1980-1981, but they will not increase as fast as maintenance costs will. The results of these comparisons are quite stark: Given revenues that are expected on the basis of past trends, no increase in state user tax rates, and no new construction beyond projects whose contracts have already been awarded, the only maintenance levels that can be afforded are M4 through fiscal year 1978 and M5 after that. This is clearly inadequate. Thus, if there are no new funds, PennDOT cannot afford to maintain its present highway system, even if the construction program is halted altogether. A similar analysis was made assuming that PennDOT continues a large-scale construction program that requires $200 million in bond issues annually (C3). The results showed that, because of the interrelationships among the highway programs, the resources available for maintenance would decrease substantially; by fiscal year 1980-1981 the budget would not even support the M5 level of maintenance.

If implemented, they would make dramatic changes in the programming and financing of PennDOT's highway activities. First, the task force recognized that the present balance between construction and maintenance is untenable and urged that priorities be reversed to ensure that maintenance needs are met before new construction projects are authorized. It recommended that top priority be placed on the M2 maintenance program—the no-frills preventive maintenance effort and the reduction of deficiencies over the next 25 years. A fuel tax increase of 0.5 cent/L (2 cents/gal) was recommended to finance the maintenance effort.

As the second priority, the task force recommended a limited construction program to enhance the maintenance, but only if new funds are made available. Perhaps most significantly, it urged that all future construction projects be financed by current revenues and federal aid to avoid increasing debt-service obligations. The task force advocated a further increase in revenue to pay the state's share of a limited construction pro-

Table 2. Estimated new revenue requirements for maintenance and for pay-as-you-go alternative construction programs.

Item	Costs ($000 000s) for Fiscal Year					Five-Year Total ($000 000s)
	1976-1977	1977-1978	1978-1979	1979-1980	1980-1981	
Maintenance only for program M2	76	96	117	132	142	563
Maintenance plus $50 million in state-supported annual project starts	101	134	164	182	192	773
Maintenance plus $100 million in state-supported annual project starts	127	173	210	232	242	984
Maintenance plus $200 million in state-supported annual project starts	177	250	304	332	342	1405

gram and recommended that a moratorium be placed on all new construction until funds are available to finance construction on a pay-as-you-go basis without infringing on the M2 maintenance program.

The recommendations of the task force also had significant implications for the development of PennDOT's capital program. The first recommendation was that the formula allocation of construction funds on a county-by-county basis be replaced by a statewide allocation to ensure that the limited resources available are used to address the most pressing problems. From this statewide perspective, then, development of a construction program based on the following three criteria was recommended: (a) make safety improvements, (b) correct structural deficiencies, and (c) develop a complete, modern core system of vital highways. A further recommendation, in keeping with the policy of programming from a statewide perspective, was that PennDOT seriously consider reducing the state network by returning roads whose function is only of local significance to local jurisdictions (8).

PennDOT has not adopted all of the recommendations. An abrupt and complete shutdown of the construction program, for example, would have a severe impact on the state's construction and related industries (an estimated 18 000 jobs) and is therefore not politically feasible. Nonetheless, the fiscal review and its recommendations have set an agenda for coming to grips with the changing environment in Pennsylvania, and PennDOT is moving in many of the directions suggested by the study. Additional studies are now being undertaken to more fully develop the core system concept for Pennsylvania and to develop implementation procedures for reducing the state network.

Many states are now or will soon need to redefine their highway policies in the face of changing fiscal constraints. The difficulties states have encountered in funding highway programs in recent years reflect a major long-term change in the fiscal environment of these programs rather than short-term problems. This is shown by the following probable trends:

1. Inflation will continue.
2. Fuel prices will rise, reducing earlier anticipated growth rates in distance traveled and liters of fuel consumed; this will subsequently reduce the anticipated growth in fuel tax revenues.
3. Motor vehicles will become more fuel efficient, which will cut gasoline consumption still further.
4. Competition for tax dollars for nontransportation sections will increase.
5. Nonhighway options for transportation will increase.

The states will respond in various ways to this changing environment, depending on their needs, past and present policies, and particular financial circumstances (9,10,11). However, many states will face the common problem of continuing their highway programs within a context of reduced resources and therefore may find the following kinds of policy directions necessary or appropriate.

1. Reverse the traditional priorities to put maintenance of existing systems ahead of new construction.
2. Decrease the reliance on bond issues to finance the state's share of construction programs.
3. Reduce the size of state highway networks to include only roads of greater than local significance.
4. Consider more carefully priorities and alternative service levels for different types of highways within the state network, for both maintenance and construction, by using either existing functional classifications or the core system approach.
5. Allocate funds statewide, rather than by region or county, primarily on the basis of efficiency criteria; some alternative allocation strategies are described by Pecknold and others (12).

Finally, given a changing environment for highway programs, many state departments of transportation and highway departments will have to improve their fiscal planning and programming capabilities. They will need to develop more sensitive forecasting procedures for both short-term and long-term revenues and ways of adjusting programs to conform with realistic revenue estimates. Methods should also be developed for predicting the consequences of current decisions, particularly the effect of construction programs on future maintenance needs and resources. In addition, state transportation agencies should develop more sophisticated performance-monitoring systems to measure the efficiency of operations and impacts in terms of service levels, both for purposes of internal management uses and for the articulation of product to state legislatures and the public.

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The Changing California Highway Program

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The era of limited financial resources has caused California to change the emphasis of its highway programs from long-range expansion programs toward short-range maintenance and rehabilitation programs. This change has created the need to reorganize, reduce staff, abandon planned freeway routes, sell surplus rights-of-way, scale down project designs, and develop a new study of needs. A 6-year highway program based on short-range, cost-effective solutions to current highway problems was recently developed. The federal government provides nearly half of the money in California's highway program. Federal dominance of capital improvement programs has reduced the states' ability to address priority needs; California, therefore, continues to press for greater program flexibility and reduced federal involvement. The purpose of this paper is to describe the impacts on California's highway program of changing financial support and changing federal program emphasis, as well as the effect of environmental concerns.

California's state highway program in the 1950s and early 1960s enjoyed public support for the expansion of the highway transportation system. Few questioned the wisdom of constructing new freeways and expressways to increase urban and rural mobility. The enthusiasm was sustained by adequate federal and state support in the form of trust fund dollars. Cost escalations were moderate because good competition among construction contractors fostered progressive improvements in work methods and productivity.

This is not to imply that all new highway facilities were well received and that some planned routes and designs were not hotly contested. In the early 1960s, some mitigation measures, including aesthetic treatments, that were instituted to gain continued public acceptance began to noticeably increase the costs of new facilities. Subsequently, environmental concerns accelerated the trend toward increases in facility costs and substantially lengthened the development time of projects.

Environmental impacts on the program include (a) redirection from expansion programs to maintenance and operations programs, and (b) project delays because of requirements for documentation of environmental impacts. Increasingly, emphasis is placed on noise abatement, aesthetic treatments, high-occupancy vehicle facilities, and car-pool matching programs.

The California Department of Transportation (Caltrans) completed a cost-effectiveness study of highway system improvements and designs in July 1974. The result was a concentrated effort to redesign projects to obtain the greatest value for the money.

A new equilibrium between program and resources was emerging when the Arab oil embargo created new problems. The costs of construction and materials soared. At the same time, lower gasoline consumption meant decreased revenues. The historic revenue growth trend of about 4 to 5 percent compounded annually suddenly nose-dived in 1973 to -1 percent, and the outlook indicated no substantial recovery to past trends. The state's immediate reaction was to impose a moratorium on advertising new state-funded (without federal-aid) construction projects. In 1975, the federal government released an additional $2 billion worth of obligational authority, which accelerated the advertisement of federally aided projects for a short period and further strained the state's resources. The moratorium was therefore extended to all projects except those of an emergency reconstruction nature.

The California highway program was nearly broke; we forecast deficit spending within a year's time unless drastic action was taken to not overcommit future resources. We were concerned about excess staff and were trying to stretch the funds by expanding the application of cost-effectiveness to more projects in the design stage as well as to those under construction.

"Downscope" design became a department byword, and "lowered expectations" were imposed by the new administration of Governor Brown in 1974. An attempt by the state legislature to raise gasoline taxes eventually died in committee.

At the same time, Congress voiced greater concern for safety and urban transportation problems. Program changes in the Federal-Aid Highway Acts of 1973 and 1976 and in environmental law were applied selectively to challenge not only the adequacy of environmental mitigation measures on projects nearing design completion and under construction but also the need for the project. This had the effect of interrupting the design process on major projects because the design steps had to be repeated to ensure compliance with new federal environmental regulations.

CHANGING FINANCIAL SUPPORT

The financial planning for California's state highway program has traditionally accommodated the state's funding allocation process, which operates in cycles of 4 years. Long lead times for the development of major projects require planning for capital outlay at least 8 years in advance. Projected resources and program levels were traditionally balanced over an 8- to 11-year period. Estimates of state and federal highway revenues were made, future fixed expenses (such as administration, maintenance, and operations) were projected, and local assistance subventions based on previous trends were subtracted. The remaining funds were assigned to capital outlay and support costs. Programs were revised annually to reflect changes in fixed costs and revenue projections. Programmed projects were adjusted to reflect new data and conditions, and new projects were added, when necessary, to adjust to changes during the program period.

The keys to programming success were (a) good revenue forecasts, (b) accurate estimates of project costs and development lead times, and (c) relative stability in program objectives. During the late 1950s and 1960s the only real weakness in the programming process was in obtaining accurate estimates of cost and lead time. Caltrans continually sought ways to more accurately estimate cost at various stages of project development and ways to anticipate normal cost escalations and to ensure accurate forecasts of project delivery dates for start of construction. State revenues were predictable; therefore, changes in revenue forecasts resulted mainly from biennial revisions to Federal-Aid Highway Act programs and funding. Increases in Interstate funding, for instance, were typically offset by increasing the staff or project development productivity or by using projects that were planned and ready for construction advertising. The program objective, during this period, was to build

as many new kilometers of freeway and expressway as funds would allow. This translated into a desire to complete the state's share of the Interstate system [3540 km (2200 miles)] and the additional 16 580 km (10 300 miles) on the state's statutorily designated freeway and expressway system as soon as practical.

California developed, with the help of the construction industry, a well-oiled freeway production machine that gained worldwide recognition. Then the pattern of community acceptance changed. The federal government responded to community objections by requiring public hearings and multidisciplinary design teams. Mitigation measures added to the cost of projects and soon successive needs studies reflected increases in the cost to satisfy highway needs each year, despite substantial annual investments in the new highway plant.

California trimmed its highway program toward a more realistic level of accomplishment. This led to two actions—scaling down project designs and systematically reducing project development and right-of-way inventories. We reevaluated the scope of the design of projects from a cost-effectiveness viewpoint, for example, we eliminated freeway interchanges in favor of at-grade intersections, reduced the number of lanes to be constructed, provided passing lanes instead of continuous widening, and emphasized spot improvements rather than extensive new construction.

We found that too many freeway routes were adopted in relation to pipeline needs and that we had made an excessive advance investment in rights-of-way along the many freeway routes, which were no longer affordable over the next 20 years. In 1974 we began to eliminate routes and sell excess land, and we continue to do so. We have not adopted a new freeway location in the past 4 years. To date we have given up 626 km (389 miles) and sold $34 million of property on the rescinded routes. We were overstaffed for the new program levels, so we froze hiring. Our non-maintenance-related staff was reduced gradually from a high of 14 600 to 11 600 by 1974.

Then, the Arab oil embargo confronted us with increased project costs and decreased revenue. A fiscal crisis was imminent because we use future revenue for future contract payments. In other words, we start construction without the funds on hand to cover the full value of the contract; we expect to make the monthly progress payments out of anticipated revenues. With the prospect of decreased revenues from gasoline tax, we imposed an immediate moratorium on state-funded construction contracts.

A short while later the President announced the immediate release of $2 billion of federal highway funds on a first come, first served basis in an effort to stimulate work in the construction industry. We advertised as many federally aided projects for construction as we could get ready. This further aggravated our projected state cash situation, so we extended our moratorium to all but emergency reconstruction projects. We also reviewed internal expenditures, instituted cost-saving measures in overtime, travel, supplies, and new equipment and considered further staff reduction. This resulted in an immediate 1-year saving of $55 million.

Each person-year of work costs Caltrans about $30 000/year, including overhead. We set a goal of a 2700-person staff reduction by July 1, 1976. Reduction of a multidisciplinary staff, dispersed in 11 districts and in a headquarters office, was difficult. All decisions had to stand the test of personnel grievance hearings and legal redress by employee groups.

An early requirement of the staff-reduction process was the development of a short-range 3-year work plan. We needed to look at what the highway program's emphasis should be and what changes were required. We responded by announcing some new priorities.

The staff-reduction process was executed successfully. On July 1, 1976, we had 2722 fewer personnel than we had in July 1975. Of those, only 588 were actually laid off. Jobs were found in state service or with outside employers for the majority of the others. Special legislation made early retirement possible by offering 2 years of service credit toward retirement; 631 employees availed themselves of this option.

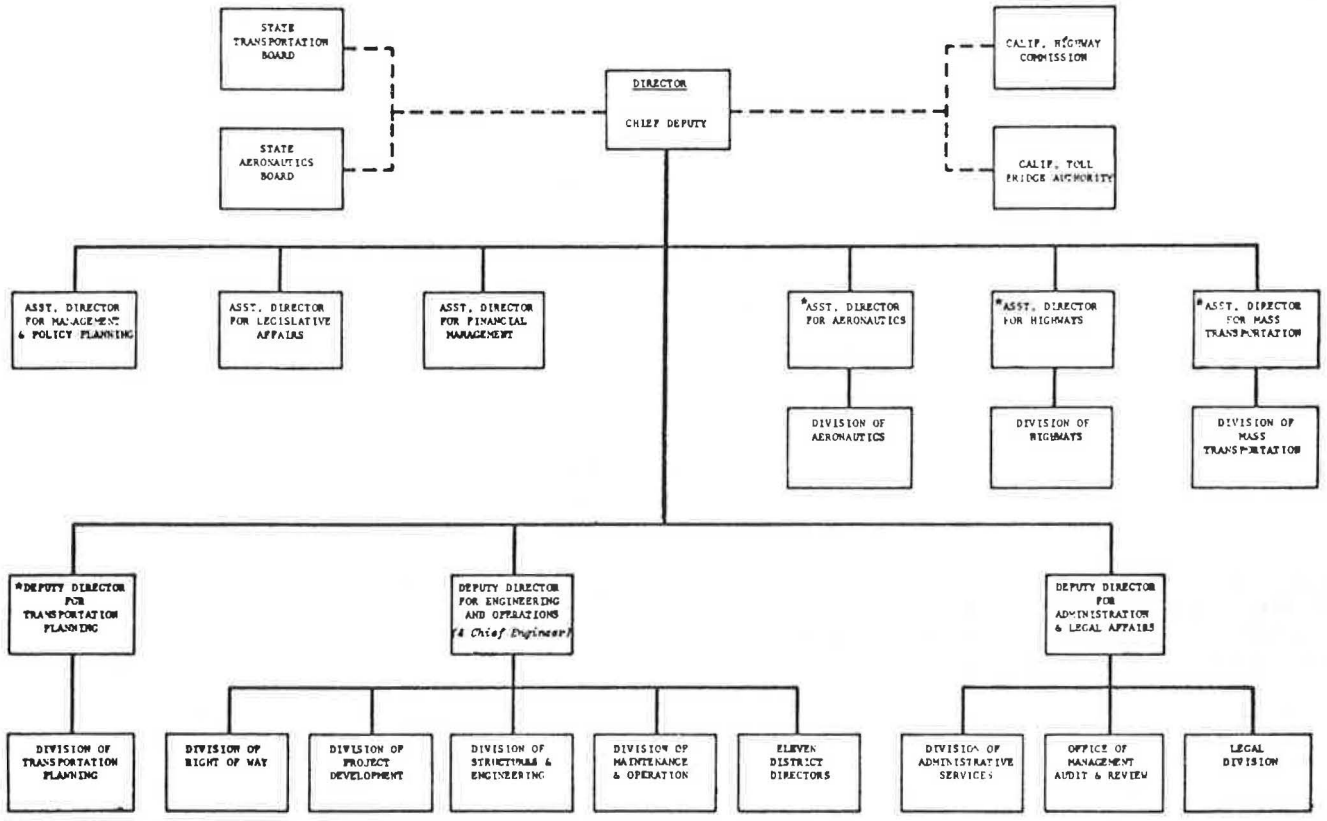
We also reorganized our headquarters office by removing programming activities from the state highway engineer and creating a separate programming and budgeting organization under a new assistant director for highways. The chief engineer's new role was the design and construction of all types of facilities and the maintenance and operations of the state highway system (Figure 1). The 11 district directors report to the chief engineer (a line position), but functional responsibility for the highway system is divided between 2 headquarters administrators. This continues an organizational trend started 6 years earlier, when a headquarters Division of Administrative Services was created to have functional responsibility for administrative management (personnel, fiscal, and office facilities) within the department. This concept was expanded further with the creation of Caltrans on July 1, 1973, when the divisions of mass transportation, transportation planning, and financial management were added.

The intent of these changes was to (a) remove transportation system planning from the direct influence of highway planners in order to develop a multimodal state transportation plan and (b) remove state highway system programming and budgeting from the direct influence of highway engineers in order to develop a program emphasis on highway expenditures. The goals of the highway program were expressed by the director of transportation in a statement on August 26, 1976, to the State Transportation Board about the second draft of the California Transportation Program. The goals are

1. To provide for maintenance, rehabilitation, and reconstruction of the existing system;
2. To make operational improvements to the existing system, both to improve traffic flow and safety (for example, by means of left-turn pockets and median barriers) and to encourage greater efficiency in facility use through traffic management techniques designed to move greater numbers of people in fewer vehicles;
3. To make our highways environmentally compatible with their surroundings, landscaping and noise walls are an essential component of highway facilities. People who live in areas adjacent to highways should nor be forced to absorb unnecessary health and aesthetic costs of highways; and
4. To build new facilities only where they are the most cost-effective solution to a particular transportation problem.

An immediate problem for the highway program is a legacy of unfulfilled promises regarding the construction of new freeway projects that remain in the development plans of many cities and counties. These require reaffirmation, renegotiation to more modest scale, or abandonment, according to the amount of highway improvement resources that become available. Clearly, highway improvements planned for construction as recently as 3 years ago are now no longer affordable. The department has to redefine need based on newly expressed public attitudes, to renegotiate project scopes,

Figure 1. Organizational chart of the California Department of Transportation.



* The Assistant or Deputy Director is also the Chief of the Reporting Division

and to develop annual short-range (5- to 6-year) programs of implementation. This is now being done.

A 6-year highway program was developed in line with the program objectives stated above. The program is constrained by the level of anticipated resources and assumes no tax increases over the next 6 years. It was presented to the California Highway Commission in July 1976. Major policy differences between the California Highway Commission and Caltrans regarding three issues—(a) revenue forecasting methods, (b) program emphasis, and (c) the reservation of money in the early years of the program in order to match federal aid funds later—prevented adoption of this program. These differences may not be resolved before January 1977, when the composition of the commission will change.

The adoption of the 1977-1978 budget enables us to prepare a work plan for the projects and activities authorized and to identify additional projects that require immediate work because of their long lead time or the desirability of maintaining projects ready for construction in case of project casualties or new resources.

Simultaneously, the department has begun a needs study, which is required by state law every 4 years to report the level of construction needed now on the state highway system. The department has expanded this study, which is due in January 1977, to include all immediate needs on the state highway system, including maintenance, operations, administration, and capital outlay. The approach establishes cost-effectiveness criteria to solve problems on the existing highway system. Each nominated capital outlay project will have to pass the test of need posed by questions such as whether maintenance is more effective than rehabilitation, whether rehabilitation or an operational improvement to the existing system is better than providing a new facility, and whether a nonhighway solution to the transportation problem is available.

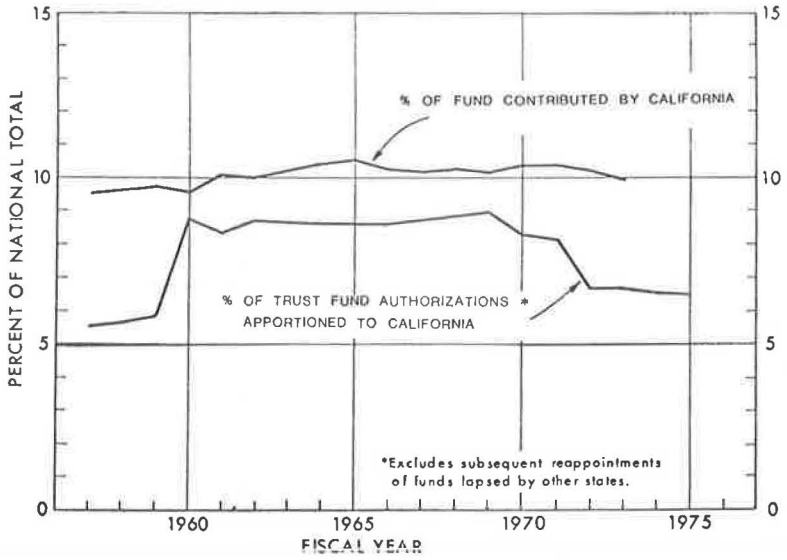
CHANGING FEDERAL PROGRAMS

As the level of state and federal resources remains relatively stable, federal programs have an increasingly important influence on the state highway program. The federal government supplies nearly half of the money received as revenue in the state highway account. Federal funds do not support administration and maintenance but reimburse state and local governments for capital expenditures. Each year more of the available state funds are needed for maintenance. Since maintenance costs continue to increase as facilities age and there is additional inventory, less state money is available for construction purposes, and the program becomes federally dominated. This has serious implications for the state's program because federal programs address the composite needs of all 50 states.

The federal-aid highway program forces the establishment of relations and cooperation for administrative purposes, while at the same time constraining flexibility in the expenditure of already limited resources to programs written to satisfy a national purpose. If California does not need a federal program, we either lose apportionment or undertake federal-aid projects of low priority to the state. New federal-aid highway acts seem to offer these alternatives: (a) more flexible programs, (b) block grants, or (c) transfer collection of taxes to the states.

A further concern to some states is their low rate of return from the Highway Trust Fund. California enjoyed a high rate of return in the 1960s but recently has received only about 65 percent of its total contribution

Figure 2. California and the Federal Highway Trust Fund.



(Figure 2). As a matter of policy, California is not contesting the need for donor states in the Interstate program since, by its nature, the program requires some states to contribute to the building of highway segments in sparsely populated states. California is concerned about contributing 30 percent of its taxes to the non-Interstate programs in other states.

In California, by law, federal funds are commingled with state funds into a state highway account, which is allocated among projects by geographic distribution formulas. In many areas of the state, statutory allocation amounts are more than satisfied by the Interstate program. Non-Interstate funding is used in other areas of the state. This leaves little discretion for allocating the remaining funds to projects on a merit basis. As state capital outlay funds decrease, many low-priority Interstate and non-Interstate projects may be constructed.

The increased federal funding of local highway projects as a result of federal emphasis on urban system, off-system, and safety improvements has been at the expense of improvements on the federal aid primary and Interstate systems in California. The state's road system receives fewer federal dollars and the local road systems more, yet the relative needs of these systems remain in about the same ratio. Local governments, in effect, use the federal funds to reduce their own contributions to improvements of their systems; the effect on the state's systems has been reduced expenditure.

Before enactment of the Federal-Aid Highway Act of 1970, the major portion of the funds used for capital outlay in our non-Interstate capital outlay program came from state funds. Therefore, the state could select the activities and projects to be qualified for federal aid. We qualified all Interstate projects but only the largest capital outlay projects on the non-Interstate system. Right-of-way acquisition, design engineering, and small projects were funded by state funds. The benefits in circumventing federal red tape are obvious. Now nearly all of our capital outlay program is subject to federal processing. Further, in order to continue to qualify for all of our anticipated federal apportionments over the next 6 years without increasing state taxes, we need to reserve state funds for use as matching funds in the late years of the program period.

The influence of federal design requirements and standards prevents us from taking full advantage of the change the Federal-Aid Highway Act of 1976 made in the definition of construction to include reconstruction, restoration, and rehabilitation. We cannot, for instance, qualify some resurfacing projects where roadway widths, including shoulders or guardrail installations, are substandard, even though no safety problems have been identified under existing traffic conditions. California, in response to these concerns, continues to advocate increased federal program flexibility; our primary effort is to reduce the overall level of federal programs.

The change in emphasis in the federal highway program toward urban system improvements has increased the state's involvement in local projects. The Federal Highway Administration (FHWA) uses the states as the middlemen in dealing with local agencies. A state-federal agreement is necessary on all federally aided projects, whether they are on the state or local road systems. The federal government can then rely on the state's ability to explain federal requirements as part of other state-local liaison activities. The state can also apply what it has learned in processing federally aided projects to bettering the process. California supports this administrative system and would like to see it extended to other federal transportation programs. The main weakness in the system is a natural tendency among the participants to pass the blame for problems. For example, the local authorities may become confused as to where to place the blame when projects experience processing delays. A common concern is whether delay is the result of (a) federal requirements, (b) federal requirements misinterpreted or overzealously applied by the state, or (c) state administrative requirements that have nothing to do with the federal government. Better communications and good will can solve these concerns. These problems cannot be legislated out of the administrative system.

California has applied for certification acceptance. Certification acceptance delegates project approvals to the states based on a federal finding that the state and local administrative processes for project standards and development are equal to those of the federal agency. This may reduce some of the confusion concerning roles and responsibilities.

A more recent concern regarding federal requirements is in the area of metropolitan planning. Transportation improvement programs (TIP) in urban areas have imposed another layer of program review and approval, which requires adjustment of past procedure and process. Transportation agencies are being forced to adjust their own programming and budgeting cycles to

ensure that federal aid projects authorized by their own policy groups can qualify for funding by obtaining the additional endorsement of the Metropolitan Planning Organization (MPO). The concept is good if applied appropriately to those projects associated with system capacity enhancements, i.e., new facilities and operational improvements that seek to remove bottlenecks. The approval of smaller rehabilitation, restoration, and repair projects, which are responses to the need to restore safety and existing service levels, should be addressed through some exception or blanket-approval process. Projects of this type should not be commingled with the other major projects on a project-specific basis. As more of these projects qualify for federal aid, this problem will be magnified.

ENVIRONMENTAL CONCERNS

The impact of environmental concerns, including energy conservation, on the highway program in California is difficult to assess. To date, there seem to be two primary influences: (a) the redirection of a major portion of the program from expansion to the maintenance and operation of the existing highway system, including greater emphasis on high-occupancy vehicle programs, and (b) delays in implementing projects because of the length of time involved in the preparation and processing of documentation of environmental impacts.

Awareness of the environmental impact of the highway program on urban areas developed slowly because of the overwhelming public support for projects offering congestion relief in the period following World War II. Another difficulty is that highways are facilities that are used by several modes of transportation from walking to transit. Establishing the ultimate responsibility for environmental planning between the facility supplier and the user is, therefore, difficult.

The original concerns about highways were the impacts of the facility on the directly affected community. Later concerns of urban sprawl, air pollution, and energy conservation expanded considerations to the automobile mode. These were addressed sequentially by requiring (a) public hearings, (b) environmental statements, and now (c) the state's action plan. The state's action plan, approved in late 1973, documents our process for ensuring full consideration of possible social, economic, and environmental impacts and ensuring that the public interest is served by proposed highway projects.

The increasing length of time necessary to develop the project reduces the probability of initiating large public transportation improvements, such as California's freeway and expressway system or the Bay Area Rapid Transit (BART) system, unless small elements of the system can be implemented incrementally. Increasingly, the highway program is becoming a short-range program so that public decisions can be implemented while the facts remain relevant and politically acceptable. Public agency projects can now become mired in a continuous environmental review, especially if public ratification of financing is required.

These considerations limit the number of new and innovative alternatives that are available for solving current transportation problems and refocus attention on existing facilities and technology. We are now emphasizing ways to make better use of our existing facilities to increase the flow of people and goods but avoid the extensive impact of enlargements and new facilities. Emphasis is placed on better traffic management of all elements of the highway system. Success in operating urban freeways relates to the identification and relief of bottleneck sections. Bottlenecks are of three types: (a) constriction in flow because of unbalanced design (capacity) of successive sections of the same highway or between local and freeway systems at interchanges, (b) constriction in flow because short sections of freeway are not yet completed, or (c) demand in excess of capacity. We are trying to develop cost-effective operational and new facility solutions to relieve the first two problems on a priority basis, within existing financial constraints. Where demand exceeds capacity, or is expected to, we are installing ramp metering to smooth out freeway flow and are providing preferential treatments in the form of bypass or exclusive lanes for car pools and buses. This strategy is effective in implementing urban air pollution control strategies and reducing energy consumption. These capital investments are supplemented by state investment in car-pool, van-pool, and bus matching programs.

The Caltrans highway program also places increased emphasis on noise abatement structures, on both new facilities and existing facilities. A new noise policy is being implemented to handle situations in which readings exceed the FHWA's standard of 70 dB(A) in residential areas where freeways have intruded. We expect local communities, through subdivision, housing, and planning regulations, to control new development against noise intrusion from existing freeways. State law also requires remedial work at schools where classroom noise exceeds 50 dB(A).

Emphasis is also being placed on special facilities for transit, including exclusive lanes, special loading areas, and park-and-ride facilities. The state constitution was recently amended to allow the expenditure of state and local gasoline-tax revenue for the construction of mass transit guideways in those counties that vote to do so. Thus far, seven urban counties have passed enabling legislation. Four years ago, when the state extended the sales tax to gasoline sales, 0.25 cent of the state sales tax was set aside as a local transportation fund for capital outlay and operating subsidy use by transit properties. At the present time, this provides the opportunity to expand transit systems in most communities and allows transit properties to share in the funding of special freeway facilities provided for transit.

Special consideration has also been given to the protection of the sensitive coastline of California. Coastal commissions have formulated plans to control development, including highways, within the coastal zone. The department responded earlier by restricting the development of interregional routes along the coast.

An assessment of the cumulative impact of the concern placed on environmental protection by the highway program is difficult because of the overriding influence of the current fiscal constraints. It appears, however, that an apparent reduction in automobile air pollution emissions and an increase in automobile energy efficiency will continue to focus concern on the highway facility's proper role in community development. In summary, California is currently coping with highway program changes in the following ways:

1. Increased emphasis on maintaining and operating the existing system,
2. Encouragement of the use of high-occupancy vehicles by fostering facility programs that are supportive of this goal,
3. Balancing programs and resources at a realistic level of accomplishment, and
4. Fostering greater flexibility in the use of federal transportation funds.

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Abridgment

Operating Cost Model for Transit Based on Direct System Characteristics

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Most procedures for estimating the operating costs of proposed mass transit systems are called unit cost models. Unit cost models are of the form

$$\text{Operating cost} = \sum_{i=1}^{n} A(i) \cdot [\text{Level of causal factor (i)}] \quad (1)$$

where the causal factor is a physical characteristic of the system (such as total vehicle kilometers, total vehicle hours, or number of passengers) and A(i) is the cost per unit of causal factor i (1, 2, 3). Some cost models divide the operating cost into categories and calculate the total operating cost by adding the costs in each category. Nonlinear cost models have also been considered (1), but linear models have been shown to be at least as accurate as nonlinear models for predictive purposes.

If a model is to be useful in general settings, the independent variables used should reflect, as much as possible, the true nature of the system under consideration. Previous models of operating costs for transit systems may give accurate cost estimates in a particular situation, but they do not consider all of the characteristics that can influence cost; their usefulness in general settings should be carefully determined. These cost models (except for the supervisory cost for the Washington Metropolitan Area Transit Authority study) never use, for example, the number of operators in their cost computations, although the wages paid to operators make up a significant portion of the cost of any transportation system. This may lead to questions about the rationale for these models. Scheduling crews is a complicated and time-consuming operation when it is done manually; therefore, the planner is forced to use a surrogate factor (such as in-service hours) to estimate crew costs. However, the relationship between operators' wages and the surrogate factor is tenuous; therefore, the estimate of operators' wages may be inaccurate. Furthermore, the estimation of costs for maintenance, fuel, leases, and tires requires accurate estimates of both the distances traveled by vehicles in service and deadhead and the peak number of vehicles. However, due to layover times, deadheading, and other intricacies of scheduling, the levels of vehicle kilometers and peak numbers of vehicles in operation cannot be estimated accurately without vehicle schedules.

Our approach estimates operating costs based on accurate estimates of the underlying physical characteristics of the system. This approach can therefore be transferred among systems without loss of accuracy. Also, it is an extremely fast computational approach. In particular, this cost model produces estimates of worker requirements over the day and actual vehicle schedules for the proposed systems. Because costs are sensitive to numbers of workers, numbers of vehicles, and the distances traveled by vehicles, knowledge of the temporal allocation of crews and vehicles is extremely important to the derivation of accurate cost estimates. The model described in this paper separates operating costs of a proposed multimodal transportation system into 15 categories. Each category is either a financial accounting and reporting elements (FARE) category, an aggregation of FARE categories, or a part of a FARE category (4).

Although costs for many of the categories are based on unit costs, the costs for several cost categories are based on the temporal characteristics of the vehicle schedule and crew estimates. These cost categories constitute most of the operating costs for transit systems. Determining the costs for these cost categories by the procedures described below represents a major change from existing cost estimation procedures. The underlying characteristics and causal factors used in this cost model are listed below:

1. Number of crews by type of shift required by time of day;
2. Number of peak vehicles required;
3. Distance traveled deadhead;
4. Distance traveled in service, broken down by speed;
5. Number of right-of-way kilometers;
6. Number of crew hours required by urban transportation planning system (UTPS) time period; and
7. Number of passengers.

In this model, operators' salaries are based not only on the number of operators required but also on the length of operators' shifts and their times of reporting and leaving. Fuel costs and other costs are based on the distance vehicles travel deadhead and in service.

MANPOWER AND VEHICLE REQUIREMENTS

Cost estimates of the proposed transportation system are derived by first finding the system's characteristics, such as number of operators required by time of day, number of vehicles in service and deadheading by time of day, and the distance traveled deadhead and in service during the day. To determine these estimates of system characteristics, fast algorithmic procedures for estimating staffing requirements and for constructing vehicle schedules were developed. A timetable for the systems was necessary to form the vehicle schedules. Since UTPS does not require a timetable as input, we developed a procedure for forming a timetable for the proposed transit system from the data input to UTPS.

The following components were developed and implemented by means of the UCOST program, which is described in more detail elsewhere (5).

1. The line-scheduling component converts the network description of the transit system and a specification of headways into a timetable. The objective used in forming the timetable is to synchronize the lines to reduce the total passenger transfer time.
2. The vehicle-scheduling component calculates the

size of the fleet and vehicle schedules for the proposed transit system. The technique used to form the vehicle schedule is the Dilworth chain decomposition algorithm (5).

3. The staffing estimation component calculates an estimate of the work force requirements for the proposed system. This is based on the algorithm presented by Segal (6).

These components give the planner knowledge of the fundamental causal factors that determine costs for transit systems. We know of no other cost model that provides this information.

OPERATING COST MODEL

The operating cost model implemented by means of the UCOST program is divided into 15 cost categories. Because UTPS allows the consideration of transportation systems with up to five different modes (such as local bus, express bus, and rapid rail), the operating cost for each category is further broken down by mode. If the planner, for example, allows the vehicles and staff to serve only one mode, this cost model treats each mode separately. If the planner allows staff or vehicles to serve more than one mode, UCOST is used to compute the appropriate costs for the combination of modes and these costs are prorated to the individual modes. For cost categories that can be computed by line, this proration is not necessary. Since proration of costs to modes is somewhat arbitrary, any attempt to avoid this proration is desirable.

The precise cost model categories are given in Table 1, as are the corresponding FARE categories and the dependent variable. The major categories in FARE are considered individual dependent variables and the others are combined.

Implementation

The important aspects of the UCOST program include:

1. An analysis of the cost and operation of the transportation system by transit mode (up to five modes allowed),
2. The options of a user input timetable or user input constraints on the formation of the timetable, and
3. The flexibility in the planner's design of the final shape of the cost model.

To run the UCOST program during a normal execution of UTPS, the planner must specify cost parameters of the system (for the cost categories he or she decides to use) and other characteristics of the transportation system that are used to form the line schedules, vehicle schedules, and estimates of crew size. All other characteristics are generated by other programs of UTPS, which are executed before the UCOST program is run.

The UCOST program gives the planner the option of modifying the cost model in several ways. The planner may decide to expand, combine, or delete some of the cost categories. Most changes of this type are easy to make in UCOST programs through the use of data cards.

The planner may wish to make major changes to the cost model but still use many characteristics of the proposed transportation system found in the first three components of the UCOST program. In this case, the UCOST program allows the planner, using a user-coded subroutine, to write his or her own cost model (or section of cost model). An incremental analysis can be integrated with the cost model to give the planner a myriad of options in costing a transportation system (5).

Cost Parameters and Examples

This cost model requires the use of certain cost parameters. Unit cost factors are necessary for many of the cost categories, but more detailed cost specifications are desired for a few categories. Default cost parameters were set within UCOST to allow the planner to run UCOST without having to determine his or her own parameter values. The default values are based on results reported elsewhere (5, 7, 8). These parameters are formulated so that costs are given on a daily basis. Many of the default cost parameters have been given zero values and aggregated into the general fraction category. The aggregation of many marginal costs into one category simplifies the list of default values.

In Table 1, the term "equivalent operator" was used. The number of equivalent operators is equal to the total number of operator minutes (determined from the staffing estimation component) divided by 480.

Default fuel costs and shift specifications were also developed for the UCOST program and used in the example that was tested. The fuel costs were interpolated from a table based both on the fuel-use figures presented in Characteristics of Urban Transportation Systems (7) and an assumed cost of diesel fuel of 30 cents/km/d (50 cents/mile/d).

Shift costs were based on a base wage rate of $5.99/h plus premiums for split shifts ($3.00 for two 4-h shifts) and overtime (50 percent of the excess time). These cost factors were used in several runs made

Table 1. Default cost categories.

Category Name	Equivalent Fare Categories	Dependent Variable	Default Coefficient per Day
Operator's salaries	501-01-030	Operator's hours	See text
Fringe benefits and other salaries per revenue vehicle operators	501-02-030, 502-15-020	Number of equivalent operators	$17.10
Fuel lubricants and power including fuel taxes per revenue vehicles	503-08-030, 504-01-030, 510-05-030	Vehicle miles	See text
Tires and tubes per revenue vehicle operator	510-02-030	Vehicle miles	$0.014
Lease and licensing of revenue vehicles	506-04-030, 510-04-030	Number of vehicles	0
Transportation operations	010	Number of equivalent operators	$2.53
Servicing revenue equipment	050	Number of vehicles	$4.00
Inspection and maintenance of revenue equipment	060	Vehicle miles	$0.10
Repairs of vandalized revenue vehicles	070	Number of passengers	0
Fuel, service, inspection, and maintenance of service vehicles	080, 090	Vehicle miles	0
Ticketing and fare collection, including maintenance	110, 150	Number of passengers	0
Operation and maintenance of power facilities	140	Right-of-way miles	0
Other maintenance and maintenance administration	100, 120, 130	Number of vehicles	$4.00
Scheduling and general administration	020, 160	Number of passengers	0
General function	180	Vehicle miles	$0.401

Note: Calculations for this paper were made in U.S. customary units.

through the UCOST program. These test runs were based on an existing transit system that has approximately 25 lines, 675 runs, 51 buses, and 69 drivers. The vehicle and staffing routines were first tested by executing these routines on the existing timetable for this transit system; 49 vehicles and 68 drivers were obtained as the requirement for this system. The system was then modified by implementing constant headways for each time period, by splitting the system into two companies, and by extending all service for the duration of the 19-h day. The complete version of the UCOST program was then run. At this point in the process of implementation, certain routines (such as generation of deadhead times and transfer demands) had not been completed. The solution was 53 vehicles (31 for company A and 29 for company B, less a 10 percent surplus for spares) and 88 full-time drivers and 36 part-time drivers. The increase in workers was due to the increased service in the off-peak hours caused by the modifications.

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**Mr. Roark was with Schimpeler-Corradino Associates when this research was performed.*

Abridgment

Nonevent Planning

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The traditional urban planning process is the sequential development of (a) goals, (b) inventory, (c) forecasts, (d) plan development, (e) system simulation, (f) evaluation, (g) adoption, and (h) implementation (and appropriate feedback loops). One of the major accomplishments of the process has always been the formal adoption of the project-specific plan by the appropriate elected body. The introduction of the continuous planning effort has created some conflict between the adoption of a specific plan and the implementation of the continuous process. After a plan has been adopted, most political bodies are unwilling to modify the plan on a short-term, periodic basis (2 to 5 years). This has created the existence of plans that are no longer realistic or appropriate and has also led to unnecessary conflicts between planning and programming functions.

The nonevent planning concept suggests that political bodies should adopt transportation goals and criteria rather than a project-specific plan. This would precipitate public discussion and involvement in goal adoption rather than in the individual aspects of specific projects. The process also suggests the existence of two types of goals: (a) those that have a high probability of remaining important and (b) goals (some of which may be unidentifiable at this time) that may change in their importance as time passes. The assumption is that, although goals may vary with time, they represent a more stable set of parameters than does a set of individual projects.

The concept also emphasizes the use of probability theory to identify realistic ranges for forecasting primary variables. These ranges should be used throughout the process to identify probable ranges of demand (by mode, if that is desired). Alternatives would be developed, as is traditionally the case, and measured against the probable ranges and the adopted goals. Since some projects are probably justifiable throughout the realistic range of future demand, the process would then identify those components. Alternative themes would be developed for components that are justifiable only under some conditions of or assumptions about future demand. The continuing planning process would then operate on this second set of projects.

The nonevent planning concept is based on the need to identify and analyze goals and to make these activities the primary political activities in the planning process. Decisions about individual projects would then become short-range planning (programming) functions, performed on a continuous basis. The political difficulty of officially updating project-specific plans has left many

urban areas with plans that do not adequately reflect:

1. Changes that have occurred in urban development since their adoption;
2. Changes in government regulations and public concern;
3. Changes in technology and management expertise in transportation systems; or
4. Current estimates of likely conditions and demands for the future.

The philosophical basis for nonevent planning rests on a belief that legislative action is most effective when it is related to policy and goals rather than to detailed project development.

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Implementing Transportation Policy: Lessons From the Interstate Highway Program

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Traditionally, state and local governments have responsibility for the implementation of federal highway programs and policies. The effectiveness and outcomes of these programs, therefore, largely depend on the complex relations between federal and state highway agencies and policies that are directly affected by individual differences in state political and socioeconomic conditions. To investigate differences in state highway policy implementation, data on political and economic conditions, highway revenue and expenditures, federal aid, and highway program development were compiled and analyzed. The relations among these variables are examined using factor and path analyses methods. The findings of this research suggest that the implementation of highway policy is weakened by inflexibility and internal contradictions between federal and state policies caused by differences in state and local transportation needs and categorical federal aid policy. In particular, the Interstate highway program depended on attractive federal aid matching incentives that were not necessarily responsive to or appropriate for state and local transportation requirements. A transportation trust fund that is subdivided into a hierarchy of separate interstate, regional, and urban transportation funds is recommended. The trust funds would promote the integration of the different transportation networks and would permit transportation agencies to draw on these funds as needed to match their individual problems to appropriate solutions, unhindered by categorical or model restrictions. Future policy decisions should include provisions for testing and evaluating results and performance.

In the past 20 years, about 54 700 km (34 000 miles) of rural and 14 500 km (9000 miles) of urban Interstate highways have been constructed. The total cost of the Interstate highway system (IHS) may exceed $80 billion. The project has preoccupied federal highway policy since the system was first authorized by the Federal-Aid Highway Act of 1956. This act also created the Highway Trust Fund, which provided the means for the construction of the Interstate highways. The trust fund has been a unique and efficient means for producing the fiscal resources and stability required to build the vast Interstate system. The implementation of federal highway policies and programs has traditionally been the responsibility of state and local governments; the founders of the program, therefore, included powerful incentives by providing 90 percent of the costs of construction. Such strong, single-purpose incentives inevitably created equally strong constraints to balanced transportation planning. Other transportation problems, impacts, and alternative modes were neglected (1). Indeed, the creation of the U.S. Department of Transportation (DOT) and the Urban Mass Transportation Administration (UMTA) was a response to the need for greater integration and balance in transportation programs (2).

The original purpose of the IHS, for example, was diverted for the purpose of building urban freeways simply because large amounts of federal aid were available. Although only about 20 percent of the IHS is within urban areas, urban areas absorbed nearly 50 percent of the total cost of the system. Transportation decisions were thus suboptimized by focusing too narrowly on federal aid for Interstate highways regardless of whether the solution was appropriate for specific local and regional transportation problems.

The thesis of this paper is that transportation development decisions must provide appropriate solutions to specific urban, regional, and national transportation network problems without unnecessary restrictions on category or mode. Federal aid programs must be flexible enough to allow decentralized decision making, planning, and implementation of transportation systems.

HISTORICAL PERSPECTIVES

The Federal Highway Act of 1921 set the pattern of cooperation between federal and state governments by requiring the development of state highway departments and creating the primary and secondary highway classification system as a basic framework for federal highway aid (3). The highway system grew rapidly as engineering practices and technology improved. The Federal-Aid Highway Act of 1944 created a national system of Interstate highways, not to exceed 64 000 km (40 000 miles) in length. No construction funding was authorized. The idea gained momentum and support during the early 1950s under Project Adequate Roads, which was broadly supported by highway user groups. In 1954, President Eisenhower appointed the Clay

committee to devise a means for financing the development of the IHS. After 2 years of congressional debate (mostly over financing) the Federal-Aid Highway Act of 1956 was passed, creating the Interstate highway program financially energized by the Highway Trust Fund. This was the benchmark legislation for what became a 25-year and $80 billion committment to the construction of the Interstate system.

Congress periodically reviews and changes the Interstate highway program. It has authorized increased expenditures and highway distances, extended the construction period, broadened the tax base and rates of the Highway Trust Fund, and modified the goals of the Interstate program. The Federal-Aid Highway Act of 1962 increased the emphasis on comprehensive planning and urban freeways. Legislative and judicial decisions require officials to consider the social, economic, and environmental impacts of the highway systems. This includes comprehensive urban land use planning and increased citizen participation.

During the early 1960s, the environmental and social consequences of Interstate highways registered on the public mind, and greater attention was given to urban transportation problems (1, 4). The basic nature of urban transportation problems and the uneven role of the federal government in urban transportation (1, 5) were reassessed. Since then, highway policy has shifted more toward the integration of different transportation modes (2). The Federal-Aid Highway Act of 1973 opened the Highway Trust Fund to mass transit programs and renewed the emphasis on highway safety, planning, and relocation assistance, as well as on the completion of the Interstate system.

In total, the Interstate highway program brought new practices and standards for administration, comprehensive planning, safety, and environmental protection. However, the radical changes in the orientation of federal policy, matching formulas, and incentives for the development of the Interstate highways have created problems as well as progress. Perhaps the most significant of these problems relates to the ability of state and local governments to develop and implement flexible local solutions to regional rather than national transportation problems and needs. A number of constraints and disincentives to optimizing local transportation planning and problem solving are the natural outcome of strong and uneven incentives for achieving national interstate transportation goals.

The rapid increase of federal highway aid from $500 million/year to $4.5 billion/year between 1956 and 1972 is indicative of the impact of the IHS. Federal aid for primary highway programs (FAP) decreased from 48 to 10 percent of the total while the IHS required 75 percent of all federal highway aid by 1970. The availability of categorical federal aid in turn affected state highway policy expenditures. State expenditures showed a corresponding but more balanced rate of change; on the average, Interstate highway expenditures exceeded primary expenditures by 10 to 20 percent/year. As shown in the annual Highway Statistics reports published by the Federal Highway Administration (FHWA) for 1958 to 1972, capital outlays for urban primary and Interstate highways increased at a faster rate than rural highway expenditures during this period.

Interstate highway funds were especially attractive to metropolitan areas that had serious urban transportation problems (6). In response, the construction of urban freeways was emphasized. The outcome was a relative increase in the length and the cost of urban Interstate highways. More importantly, during the initial implementation of the program, urban sections of the IHS were started and completed at a more vigorous pace than were rural sections. Highway Statistics shows that this trend was reversed by 1968, as urban freeways became more controversial and impacts were politicized.

Many of the central problems of IHS implementation revolve around the stress between federal and state policy based on the differences between urban and rural transportation needs and local political and economic conditions. The categorical grant programs' different matching formulas for FAP, federal aid for secondary highway programs (FAS), and IHS aid were too inflexible and misleading for states to develop appropriate responses to local rural and urban transportation problems. This is widely recognized by highway policy makers, who have already recommended modifications to the present system of categorical grants. The singular commitment to the IHS prevented the development of a balanced and integrated transportation system by concentrating most of the available resources in one area. This situation limited the real options available for urban transportation to urban freeway construction because this was by far the largest source of federal aid.

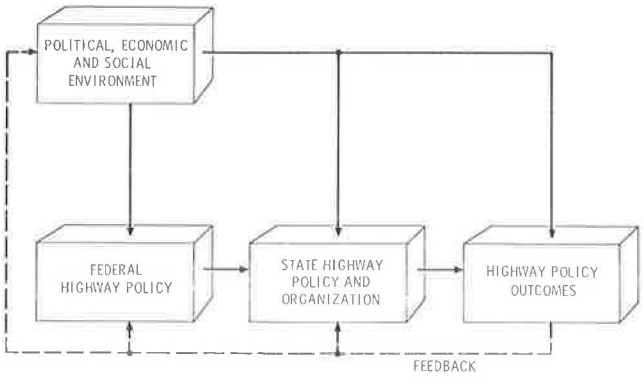
To test these observations, a quantitative analysis of the relations between federal and state highway policy was conducted. The concept of decentralized policy implementation suggests the testing of two initial propositions:

1. The outcomes of highway policy will depend on the political and socioeconomic variables in the individual states where the policy will be implemented.
2. Where federal policies and state needs are contradictory, policy implementation and the development of transportation systems will be suboptimized because the states act more independently or intervene between federal aid programs and respective environmental circumstances.

CONCEPTUAL MODELS

A simplified conceptual model is needed to define the scope, select variables, and conceptualize research hypotheses (7). The policy system model used for this analysis of the highway system is illustrated in Figure 1. The highway policy model includes four general components: (a) federal highway policy; (b) state highway policy and organization; (c) political, economic, and social environment; and (d) highway policy outcomes. These components encompass variables that characterize the policies, programs, and operations of state highway departments and the FHWA as well as actual outcomes of highway system developments.

Figure 1. Analytical model of highway policy system.



Many of my initial research questions are based on previous studies of highway expenditure and revenue policy (8), state highway politics (9), transportation planning (2), and other historical accounts (3). The process of data selection and analysis was aided by Thomas Dye's research on the correlations between socioeconomic factors and state highway policy (10). The methodological model for this research and the use of factor analysis for the study of underlying relations among highway policy, politics, and economic factors were demonstrated by Sharkansky and Hofferbert (11). The analytical procedures are intended to develop simple multivariate measures of each component of the highway policy model by using factor analysis methods. This allows us to make generalizations about the basic properties of the highway policy system and to test the conceptual model itself via correlation and regression analysis of the factors (12).

First, available data were compiled, and a number of preliminary factor analyses were conducted to reduce the total number of variables to just the underlying correlations in the data set. A series of final factor analyses provided the multivariate indexes of each conceptual block of the highway policy model. Then, the generalized relations between these factors were examined by using correlation, partial correlation, and regression analyses. The actual study involved several hundred variables; only the highlights of the methods and findings are reported here (13).

Highway Policy Factors

Variables that represented the main underlying associations in the data were selected to construct the final set of multivariate indexes of federal and state highway policy, highway policy outcomes, and environmental factors. The selected variables were then subjected to a series of factor analyses, from which factor scores were computed. In most cases, the factors explain most of the orthogonal sources of variation in the data representing (a) measures of total level of highway expenditures or other measures of program activity and (b) distributive measures that include percentages or per capita variables. The analyses each yielded two factors of differing weighted importance that summarized the important sources of variation within each data set as follows.

1. The two political and economic factors represented (a) urban-industrial size based on personal income, general expenditures, and automotive business sales and (b) industrial and population density of the states based on an inverse relation between rural population and personal income from government versus suburban population, population density, and personal income from private industry (Table 1).

Table 1. Factor analysis of state politics and economy.

Variable	Factor 1: Urban-Industrial Size	Factor 2: Population Density
Personal income	0.95	0.26
Retail automobile sales	0.96	0.23
Vehicle kilometers of travel	0.94	0.24
Total state expenditures	0.97	0.12
Rural population, %	-0.46	-0.53
Suburban population, %	0.36	0.67
State expenditures per personal income	-0.25	-0.74
Personal income from government, %	0.00	-0.66
Personal income from industry, %	-0.24	0.70
Population density	0.09	0.70
Eigen value	5.35	1.69
Variance, %	76	24

2. Federal highway policy factors were related to (a) total federal aid expenditures, especially for IHS, and (b) the federal aid priority based on a positive loading of the percentages of federal aid for IHS and planning versus a negative loading of FAP and FAS aid (Table 2).

Table 2. Factor analysis of federal highway policy.

Variable	Factor 3: Federal-Aid	Factor 4: Federal Priority
FAS aid, %	-0.14	-0.89
FAP aid, %	-0.07	-0.91
IHS aid, %	-0.02	0.93
Planning aid	0.86	0.40
FAS aid	0.86	-0.24
IHS aid	0.85	0.47
FAP apportionment	0.99	-0.06
FAS apportionment	0.88	-0.21
Urban apportionment	0.82	0.32
IHS apportionment	0.84	0.46
Eigen value	5.83	2.83
Variance, %	67	33

3. State highway policy factors were structured like the federal factors by using total state highway expenditures data and the percentage distribution of state highway expenditure priority (Table 3).

Table 3. Factor analysis of state highway policy.

Expenditure Variable	Factor 5: State Expenditure	Factor 6: State Priority
Planning and research	0.98	-0.02
Total highway	0.98	-0.21
IHS	0.93	0.05
FAP	0.88	-0.33
FAS	0.64	-0.14
Research, %	0.12	0.45
Planning and research, %	-0.20	0.64
Highway payroll	-0.15	0.27
FAP, %	0.17	-0.65
IHS, %	-0.03	0.59
Eigen value	4.33	1.14
Variance, %	75	25

4. The highway policy outcome factors distinguish between variables related to (a) Interstate highway development based on the length of Interstate highways open to traffic, length of urban freeway, and high-density traffic volume on the urban IHS and (b) primary highway system development based on the length of the FAP system, motor vehicle distances traveled, and motor fuel use per motor vehicle kilometer (Table 4). The relations between these factors were then analyzed and several general causal inferences were made about

Table 4. Factor analysis of highway policy outcomes.

Variable	Factor 7: FAP Development	Factor 8: IHS Development
Urban IHS open	-0.18	0.97
Rural IHS open	0.44	0.80
High-density urban IHS	-0.35	0.75
IHS improved	0.30	0.91
Rural FAP, %	0.88	0.12
Urban FAP, %	-0.88	-0.12
Highway deaths	0.76	-0.16
Motor fuel use	0.49	0.00
Urban IHS use	-0.73	0.37
Rural IHS unstarted, %	-0.33	-0.13
Eigen value	3.47	3.17
Variance, %	52	48

highway policy implementation structures from the partial correlation and path analysis.

The eight factors serve as indexes of the key parameters of the highway policy system in the United States. As predicted, the correlations in Table 5 show a high degree of association among political and economic conditions, federal and state highway expenditures, and highway policy outcomes. When the urban-industrial size (factor 1) is greater, for example, the federal highway expenditures (factor 3) and the state highway expenditures (factor 5) are also greater. Federal and state highway expenditures are directly associated with Interstate highway development (factor 8). The second set of correlations in Table 5 shows an inverse relationship between the federal aid system priority (factor 4) and primary highway system development (factor 7). That is, the greater the percentage of federal aid for the IHS, the less the development of the primary system. State highway system priority (factor 6) is directly related to primary system development (factor 7) and inversely related to population density (factor 2).

Table 5. Bivariate correlations of highway policy factors.

Highway Policy Factor	F1	F2	F3	F4	F5	F6	F7	F8
Factor 1	1.0							
Factor 2	0.00[a]	1.0						
Factor 3	0.92	0.05[a]	1.0					
Factor 4	0.08[a]	0.39	-0.04[a]	1.0				
Factor 5	0.92	0.22[a]	0.87	0.25	1.0			
Factor 6	-0.02[a]	-0.43	0.10[a]	0.02[a]	-0.21[a]	1.0		
Factor 7	-0.10[a]	-0.71	0.01[a]	-0.52	-0.21[a]	0.40	1.0	
Factor 8	0.78	0.04[a]	0.88	-0.07	0.75	0.14[a]	0.00	1.0

[a]Not significant at 0.05 level of probability.

When we control for the effects of political and economic factors (factors 1 and 2), several interesting patterns in the data persist and new relations emerge. The relation between federal expenditure policy (factor 3) and the development of the IHS (factor 8) remains strong even though we controlled for the effects of political and economic differences in the states (Table 6). The previously high bivariate correlations between state highway policy factors and outcomes were all substantially reduced, including the relation between (a) state and federal expenditure factors and (b) state expenditures and urban Interstate development factors. This indicates that state policy factors are related to highway outcomes as intervening variables.

When the effects of state highway expenditures (factor 5) are examined more closely, state highway policies behave as intervening variables do, much as depicted by the policy system model. Rather than acting as independent causal determinates, state highway policies are influenced to varying degrees by both federal highway policies and state political and economic conditions.

Table 6. Partial correlation of highway policy factors controlling for political and economic factors.

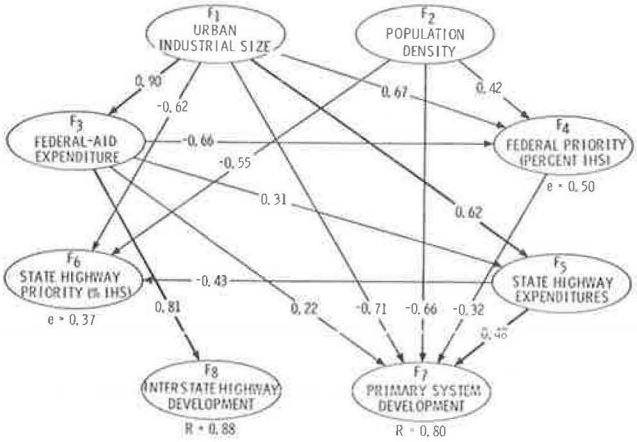
Highway Policy Factor	F3	F4	F5	F6	F7	F8
Factor 3	1.0					
Factor 4	-0.32	1.0				
Factor 5	0.28	0.29	1.0			
Factor 6	0.33	0.23	0.31	1.0		
Factor 7	0.39	-0.36	0.16[a]	0.14[a]	1.0	
Factor 8	0.64	-0.25	0.13[a]	0.31	0.24	1.0

[a]Not significant at 0.05 level of probability.

State highway policy, in turn, partly influences some aspects of the development of the state highway system.

Previous findings are summarized in the path diagram in Figure 2. The beta weight or partial standardized regression coefficient (β) shown on the paths between each pair of factors is equivalent to a partial correlation

Figure 2. Path analysis of highway policy factors.



between the two variables at either end of a given path, when we simultaneously control for all preceding variables. We can see that the hypothesized relations among federal policy, state policy, environment, and outcome factors correspond to the path network. However, we now find an additional strong path from federal aid expenditures (factor 3) directly to Interstate highway development (factor 8). Each factor provides an estimate of the variation in each of the different blocks of the policy system model, and the interrelations among factors are examined via multiple regression analysis reported in the path diagram (Figure 2). Two distinct patterns are observed in the path analysis.

1. A direct relation among urban-industrial size, federal expenditure policy, and Interstate development forms a separate causal path that bypasses state expenditure policy factors.
2. Urban-industrial size is more closely related to state expenditure policy and primary system developments.

Thus, federal policy is most directly associated with Interstate highway development outcomes, and state highway policy exercises some independent influence, especially with respect to the development of the FAP.

These findings are not surprising, considering that the federal government pays for 90 percent of the IHS program but only for 50 percent of the FAP. The other patterns, however, suggest a schism between federal policies and state implementation. Inferences from the path analysis (Figure 2) suggest that federal policy is completely determined by urban-industrial interests that, at the national level, lead directly to urban Interstate highway development. In other words, individual state highway policies do not affect urban Interstate development outcomes even though these policies are implemented by state highway departments. Urban states would, of course, embrace urban Interstate priorities underlying recent highway policy, but large rural states would naturally resist, as shown by the finding that the greater the total state expenditures, the less the relative priority given to the IHS.

States that can afford to follow their own priorities give greater emphasis to other highway needs.

Some states follow their own priorities in spite of the federal government's enticement of $0.90/$1.00 spent for building the IHS versus $0.50/$1.00 spent for building primary highways. In fact, state highway expenditures are determined mostly by state urban-industrial size (β = 0.62) and are only partly influenced by federal aid (β = 0.31). The effects of federal policy cancel each other out as far as explaining primary system development. State expenditure policy is directly related to the development of the FAP system when we control for the effects of all other variables (β = 0.48). Note also that the relation is much stronger than it appears in rural states, because if the urban-industrial size is less, the primary system development is greater.

CONCLUSIONS

The findings of the preceding analysis are numerous and complex and will require further research and evaluation.

The political and economic environment is highly associated with highway transportation variables. For instance, total retail automotive sales and vehicle kilometers traveled are highly intercorrelated with total personal income and general expenditure of state governments. Rural and urban political and economic conditions vary in several important respects so that as the population density and personal income from industry are greater, the state government expenditures per capita and the personal income derived from government employment are less (Table 1).

Federal highway policy is dominated by the Interstate highway program, although the use of these funds varies tremendously from state to state. Federal aid for planning and research is directly associated with the percentage of IHS aid and inversely related to FAS and FAP aid. The percentage of total federal aid for secondary and primary systems is inversely related to Interstate highway aid, i.e., the more federal aid received by the states for the IHS, the less federal aid received for FAP and FAS highways (Table 2).

State highway policy factors show that the percentage of capital outlays for FAP is inversely related to both IHS and total expenditures (Table 3). However, changes in state policy have not been as radical as those in federal policy; the states have retained their responsibility for building and maintaining the primary and other highway systems.

Highway policy outcome factors are clearly differentiated according to FAP and IHS highway development. States that have a higher percentage of the rural FAP system are characterized by a higher number of traffic deaths and higher fuel consumption per motor vehicle distance traveled. The total length of urban IHS open to traffic is correlated with high-density traffic volume, kilometers of IHS completed to standard, and the percentage of vehicle kilometers of travel on the urban IHS (Table 4).

Federal highway expenditures are most directly determined by urban-industrial factors. Consequently, federal aid expenditures are the main determinant of Interstate highway development, but federal highway expenditures are only slightly related to primary highway development. State highway expenditures are partly determined by state urban-industrial factors but are also influenced by federal policy. Acting as an intervening factor, state highway expenditure policy has its greatest impact on primary highway development and a smaller inverse effect on the percentage of Interstate highways within the state.

The relative effect of each highway policy and environmental factor on outcomes also shows a clear separation both according to whether conditions are urban or rural and according to whether it is federal or state highway policy. Interstate highway development is almost entirely explained by federal aid expenditures. In contrast, primary system development is influenced by a number of factors, but state highway expenditures have the largest direct effect; therefore, the greater the total expenditures, the greater the development of the FAP system. Primary system development is also greater in rural states, i.e., the greater the urban-industrial size and population density, the less the FAP development. The complex patterns set up between federal and state highway policy and political and economic conditions in the states indicate some basic differences and frictions between federal highway policy, which is oriented toward urban Interstate highway needs, and state policy implementation, which is sometimes oriented toward the primary highway needs of larger and rural states.

IMPLICATIONS AND RECOMMENDATIONS

The early commitment of the U.S. Bureau of Public Roads to high standards of engineering and organization are reflected in the overall quality of today's federal aid highway system and the technical and administrative capabilities of state highway departments. However, my analysis suggests several fundamental weaknesses in these implementation structures, which tend to limit the flexibility and responsiveness of federal and state policy to changing transportation needs, and wide-ranging political, economic, and environmental problems in the states. As the Interstate highway program nears completion, new highway policies must be developed for a postsuperhighway era of transportation needs. Decisions should reflect the lessons of the Interstate highway experience. Three observations about the implementation structure of the highway policy system are especially important.

1. The political and economic characteristics of the different states affect every stage in the policy process. The dominant political coalition that decides federal highway policy favored development of the urban Interstate system.
2. The differentiation between federal and state policy based on these political and economic variations in the states has two implications for policy making: (a) federal policies that tend to contradict political, economic, and social conditions of various states are less likely to be implemented uniformly and as originally intended and (b) implementation capabilities will vary with the technical and economic resources available to the respective states.
3. The original purposes of the Interstate highway program were partly diverted in the 1960s for urban freeways, thus increasing the cost of the program and helping to create the crisis in mobility that we face today. Part of this diversion and the consequent effects on urban transportation could have been avoided if there had been balanced transportation planning and institutionalized provisions for monitoring and reviewing the impacts of the program as it was being implemented.

The criteria for effective transportation problem solving and successful program implementation should include:

1. Implicit recognition of different hierarchical levels of transportation functions, including urban,

rural, regional, and Interstate;
2. Flexible use of funds to optimize transportation systems according to specific needs and political and economic conditions;
3. Encouragement of the development of technical and administrative capability at all levels of implementation; and
4. Ensuring the integration between and within different transportation networks and modes.

Federal policy makers have already taken steps toward changing the way federal aid is apportioned by recommending the creation of a single urban fund to be used for both mass transit and highway programs within metropolitan areas and the creation of a rural federal-aid system for highway projects and a rural general transportation fund for other surface transportation projects (14). Forty percent of the urban funds would be allocated to individual metropolitan area governments, 40 percent would be allocated directly to the states for use in metropolitan areas, and DOT would keep 20 percent as discretionary funds for urban mass transit projects. The plan would allow greater choice and flexibility for transportation programs but fail to provide for integration of the national, state, rural, and urban transportation networks. It may be even more serious that it places a federal wedge between urban and state authorities by dividing urban funds between different state, metropolitan, and federal agencies, although the opposite effect was probably intended.

As an alternative, federal transportation policy could be organized to promote the integration and optimization of all transportation modes within and between a hierarchy of interstate, regional, and urban transportation networks. This can be accomplished by establishing integrated federal aid programs for each regional network that have additional provisions to ensure proper comprehensive planning, implementation, effective use, and balance of different transport modes. An integrated transportation trust fund could be set up as follows:

1. Urban Transportation Fund—to be used for all transportation programs within metropolitan areas and smaller urban places apportioned according to urban population, population density, and standard metropolitan statistical area (SMSA) land area. Projects would be planned and implemented by metropolitan and urban governments and coordinated within respective regional and interstate networks.
2. Regional Transportation Fund—to be used for intercity transportation links, including extensions through metropolitan areas, and for rural transportation networks. These funds would be apportioned on the basis of total population, rural population, and total land area and would be planned and implemented by state and rural government agencies.
3. Interstate Transportation Fund—to be used to develop an interstate transportation network, including the completion of the IHS, and to develop workable alternatives for surface and air transportation. Future national programs should be planned and implemented by DOT, which must also provide research and development, technical assistance, and coordination for regional and urban transportation authorities.

The responsibility for transportation integration must rest at all levels, but upward integration—from local networks that connect and interface at higher levels—is theoretically easier. Given the authority and responsibility for their own transportation, states and cities would be encouraged to develop their planning, implementation, and technological capacities instead of depending on the federal government. This would mean more state responsibility and shift federal responsibility to truly national transportation systems. If the IHS had been built by the Bureau of Public Roads and the U.S. Army Corps of Engineers, for example, perhaps the system could have been completed in less time and at less cost. More importantly, the program may not have been diverted into excessive building of urban freeways and consequent underemphasis of mass transportation technology.

Public policies must include not only the means for implementation but also the means to regulate, monitor, and assess the impacts and overall performance of the policy and to provide for its regular review. The long delays between the decision, implementation, feedback on effects, and finally, some governmental response is a major problem, especially with respect to large-scale technological developments. When the impacts are known, regulatory procedures should be set up and negative impacts corrected in the process of implementation. When effects are uncertain and risks are great, experimental or prototype programs should be conducted so that impacts can be adequately evaluated before full-scale development and implementation proceed. All future transportation programs and policies should include explicit provisions and authority for testing and evaluation of performance, periodic reviews of the policy, and appropriate channels for performance feedback from affected population groups. Preferably, this evaluation authority should be independent of the implementation agency for the program.

The integrated and hierarchical organization of transportation authority and programs will, it is hoped, permit better policy analysis and decision making by allowing the vertical and horizontal integration of transportation networks and modes between different geopolitical areas. This would be accomplished without violating the political integrity of existing governments but would depend on formal cooperation and coordination. New federal policies should take a leading role in the development of a modern and integrated transportation system by improving intergovernmental implementation and administrative structures.

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