incorporating social and environmental factors in highway planning and design

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The Urban Systems Laboratory of the Massachusetts Institute of Technology has been doing research on the theme, "Incorporating Social and Environmental Factors in Highway Planning and Design," for approximately 4 years. We have felt the necessity for a strong base of theoretical research on which to build. More fundamental work on the theories of transportation systems analysis, decision-making, and design was conducted prior to the start of our research on transportation and community values in 1968. Our efforts to focus on the practical problem of incorporating social and environmental factors in highway planning and design began when we first received research support in this general area from the National Cooperative Highway Research Program. Since then, additional research support has been provided by the California Division of Highways and most recently by the Federal Highway Administration through its Office of Environmental Policy. In addition, in the early stages of this research, we had some start-up support from a Ford Foundation grant.

Each of the 3 major sponsors has asked us to produce practical results, capable of being implemented immediately and directly responsive to their needs as they perceive them. For us, this has been a challenging and productive opportunity. The problem itself is broad and difficult and pertains not only to the highway field but also more generally to the role of technology in modern society, the relation of the individual to the political process, and other equally extensive and philosophical issues. For each of these sponsors, we have been producing directly operational results (or so we hope and believe!). Therefore, we find it particularly useful to take this opportunity to step back from our research, to summarize the basic principles that are reflected in our recommendations, and to determine where we stand.

We start by summarizing the basic principles of our approach to transportation systems analysis and the process of reaching decisions about transportation and highway projects. In subsequent sections, we summarize briefly the practical results that have followed from application of these principles to three problem areas. For the National Cooperative Highway Research Program, we have produced a procedural guide (2),
which is being used on an experimental basis by several state highway departments in cooperation with M.I.T. For California, we have just completed and submitted conclusions and recommendations from a 2-year program of research on incorporating community and environmental factors in highway and transportation planning in California. Finally, for the Federal Highway Administration, we have produced a set of process guidelines in response to Section 136(b) of the Federal-Aid Highway Act of 1970.

BASIC PRINCIPLES

Our conclusions regarding some basic principles on which planning and analysis of transportation systems should be based have evolved during a period of years and serve as a framework for our more specific recommendations to NCHRP, California, and FHWA.

Single Multimodal Transportation System

A governmental transportation organization should work to provide transportation as a service, using all modes of a region and all options, including not only investment in fixed facilities but also pricing and operating policies.

Planning and analysis of transportation systems should treat all modes of transport in a region together and emphasize their complementary and competitive relations. For example, transit, highway, and other modes must be considered simultaneously in an urban transportation planning study, and aviation, rail, bus, automobile, and truck should be considered together in a statewide transportation study. As special issues emerge, the scope of analysis may focus on a single mode or facility.

Alternatives and Options

A range of transportation options are available and should be developed at all levels of technical studies to bring out the issues and to assist the community in clarifying its objectives and reaching a decision.

A wide range of options are available in regional as well as facility-oriented transportation studies and should be examined as part of any decision-making process. These include:

1. Investment in either new or improved fixed facilities such as highways, transit lines, busways, airports, terminals, and parking facilities;
2. Operating policies such as flow metering, traffic surveillance systems, restriction of lane usage, exclusive or priority use of lanes for buses, public transportation routes and schedules, exclusion of automobiles from certain areas, and other policies affecting congestion or demand;
3. Pricing policy such as transit fares, parking charges, toll facility charges, and various mechanisms to increase car-pooling; and
4. New technologies such as people movers, personalized rapid transit, automated guideways, and area-wide demand-responsive bus systems.

A variety of other options are also available and include land use controls and staggered work hours. Transportation options should be effectively coordinated with replacement housing, impact amelioration programs, and joint development.

Effects

Identification and prediction of social, economic, and environmental effects should be based on the people and group affected.
Traditional impacts determined for the users of a transportation system include changes in travel time, vehicle operating expenses, and other aspects of the cost or level of service that travelers perceive. Impacts on nonusers of the transportation system include changes in the competitive patterns of shopping and industrial areas in the central business district and suburban communities, changes in population distribution and land use, displacement of families and jobs, and tax losses.

The incidence of all impacts should be identified. When changes to a transportation system are implemented, some people will be adversely affected while others will benefit. The incidence and the manner of these gains and losses should serve as the primary orientation of impact-prediction activities.

Social, economic, and environmental data should be developed in parallel with project alternatives and related engineering data, and the development should begin early in technical studies. Impact information should be timely and responsive to the needs of a transportation study. Procedures available to predict particular kinds of impacts range from quick and approximate techniques to detailed, in-depth investigations. The choice of technique will depend on the particular needs of a study.

**Analysis Tools**

The technical analysis tools, particularly those for system studies, should be responsive to the principles of supply-demand equilibrium and to community-environmental impacts.

The complete set of models, computer programs, and other analysis tools used in developing transportation projects should be relevant to the issues, be free of built-in biases, and be based explicitly on the theory of supply and demand equilibrium in transportation networks (1). This means that the way in which congestion occurs must be accurately represented and that the volume of travel should be assumed to be not independent but a function of travel time, fare, and other factors that consumers consider to be important.

This also means that a variety of attributes of service should be considered. The time it takes to get access to the system, such as walking from an office to a parking lot, moving over local streets to an expressway, or moving by foot or bus to a rapid transit facility, must be considered in addition to the time spent on the line-haul portion of the system. Furthermore, the problems of short- and long-run equilibrium need to be addressed specifically. Behavior of traffic in the short run as well as behavior of the land use system in the long run should be dealt with explicitly.

The analysis tools used for transportation planning should give increased emphasis to the variety of social, economic, and environmental impacts. In general, existing models concentrate primarily on user impacts and do not consider nonuser effects.

**Uncertainty**

The transportation decision process should explicitly recognize uncertainty.

There are many ways in which transportation environment is changing. Changes in demand, technology, and priorities that reflect individual values must be anticipated. This means that, instead of a master plan being developed for a target year based on highly uncertain estimates of probable impact, a plan should be developed that involves a series of decisions taking place over time. A master plan has certain advantages in that it is tangible and easy to visualize, but it tends to be fixed and unable to respond to new information, revised impact estimates, or changes in land use, socioeconomic activity patterns, and operating policies. A plan formulated on a strategy of staged decision-making is flexible and can more adequately account for uncertainty. As particular stages of the plan are implemented and as events are discovered to be different than those originally anticipated, the strategy can be revised. It is important to main-
tain an attitude of searching for flexible plans in the face of uncertainty, keeping op-
tions open, and determining what future options are being foreclosed by current decisions.

An emphasis on uncertainty also means that attention is paid to experiments and
demonstration projects as important actions to undertake because of their value in
reducing uncertainty.

**Evaluation**

Evaluation of a planning process should occur periodically throughout the course of studies and
should guide a process by suggesting priorities for subsequent activities.

Evaluation should do more than simply compare alternatives or analyze impact data.
Evaluation must account for both the incidence of all significant impacts and the dif-
ferent viewpoints held by those affected.

Evaluation should be based on the premise that a consistent and operational state-
ment of goals cannot be ascertained. The wide variety of interest groups potentially
affected by a project will each have different objectives. Different interest groups
will likely not be able to agree on goals except at a very abstract and nonoperational
level. Instead of trying to reach agreement on goals, decision-makers should try to
develop an action on which the various interest groups can agree. This means that
the emphasis in planning is on the development of such actions.

The fact that a community cannot articulate a set of goals should not be taken to
mean that a range of acceptable alternatives or policies cannot be identified. In any
community such a range can be roughly defined from an examination of past policy
decisions on related matters. Similarly, there are other policy goals that clearly lie
outside the perimeters of acceptability to a given community.

Evaluation should occur continually throughout the planning process. Information
developed during explicit and periodic evaluation analysis should help to determine
priorities for subsequent study activities. Evaluation thus can structure the learning
that should take place among all the participants in a transportation planning process.
The various technical staffs must learn about action alternatives available and about
alternative objectives that might be achieved. The various interest groups also must
learn about actions available and must communicate a wide variety of information to
the relevant technical teams.

**Public Involvement**

Interaction between the technical team and potentially affected communities should occur at all
planning levels.

Constructive involvement of the public and of local officials and private groups is
necessary and desirable in all phases of transportation planning. It should start dur-
ing system planning and continue through corridor, location, and design studies, and
even into construction. Public involvement should be broadly defined as the two-way
process of interaction and communication between the technical team and all communi-
ties and through which the technical team and the communities learn about each other
and work together.

Interaction involving a wide range of interests can be used to help identify and pre-
dict both the incidence and the magnitude of social and environmental impacts. For
example, the effects of a proposed facility on community cohesion can best be deter-
mained through developing an understanding of the community affected via face-to-face
contact. Community interaction enables the technical team to learn what various groups
consider to be important and unimportant issues. Also, community groups can serve
as a useful source of solutions to transportation and related community problems.

The public must provide inputs to the decision-making process. Efforts should be
made to search out and involve all elements of the public, especially those who may be
reluctant to participate, so that a decision-maker can effectively weigh the full range of different viewpoints.

The tone of community interaction should be one of assistance and cooperation and of clarifying the issues of choice. A position of attempting to "sell" a particular kind of transportation facility should not be taken.

Decision Process

The process through which decisions are reached should provide opportunities for negotiation among affected interest groups.

A decision-making process should be participatory yet decisive and have agreed-to time tables for necessary decisions. Some even argue that decisions in today's political climate cannot be decisive without public participation.

In a participatory decision process, the role of technical analysis is different from that in a non- or low-participatory process. The premise that professionals are best able to determine what is in the best overall public interest is no longer accepted.

The role of professional staff in a participatory process should be to clarify the issues of choice and to assist the total community in reaching a decision. This places the professional staff in a role of stimulating debate among those affected rather than one of recommending a particular course of action.

Equity

Transportation decisions should internalize to the fullest extent possible adverse and beneficial social, economic, and environmental effects. In most situations implementation of a particular transportation plan is likely to impose costs on some and bring benefits to others, thus creating a transfer among interest groups. In some situations, this may be desirable, as for example when transit service to suburban job locations is subsidized to increase employment opportunities for central city residents. However, in most transportation situations, the existence of a transfer from one group to another is not a desirable policy. According to the principle of equity, groups that bear costs in order that other groups may benefit should be compensated in an acceptable way. Compensation to residents displaced by highway construction is an example.

Prior to recent legislation, families displaced by highway construction frequently had to absorb certain tangible and intangible costs for which they were not fully compensated.

Institutions

The arrangement and the organizational structure of political and technical institutions influence the degree to which social and environmental considerations are incorporated into transportation decision-making.

Decisions should be made at the lowest level of government practicable. Affected individuals and groups should be represented or participate directly in decision-making processes. Conflict is inevitable among interest groups and institutions, and the structure should make it possible for such conflicts to be resolved constructively. The appropriate institutional structure depends on the local situation. State governments can encourage local institutions to develop capabilities that will allow them to take more responsibility for transportation decisions.
NATIONAL COOPERATIVE HIGHWAY RESEARCH PROGRAM

The Transportation and Community Values Project of the Urban Systems Laboratory at M.I.T. is performing research on the impacts of highways on environmental values under sponsorship of the National Cooperative Highway Research Program. The major objective of these research studies, begun in October 1968, is to develop practical approaches for incorporating community and environmental factors into all phases of highway planning, location, and design. The major product of the studies to date is a report submitted to the research sponsors in September 1971 (2).

Out of that research has come the following statement of the objective of the technical team doing highway planning studies: The objective of the technical team is to achieve substantial effective community agreement on a course of action that is feasible, equitable, and desirable.

That objective reflects the principles described earlier and a basic conclusion that significant changes in current attitudes and work styles are necessary if social and environmental factors are to be fully incorporated into transportation analyses. Its implications are quite different from those of objectives frequently used: to construct a highway. The proposed objective focuses on achieving agreement on a course of action, not agreement on values. The role of the highway professional is to assist the community in reaching a decision and to enhance the political process by stimulating the constructive involvement of interest groups and individuals who do not usually participate as well as those who usually do. The proposed objective is based on the concepts of equity and openness, particularly with respect to the clarification of issues relevant to potentially affected interest groups. Although full achievement of this process objective is admittedly difficult, we believe that it should serve as the goal of every location team.

Five basic kinds of activities are implied for a location team: development of alternatives, community interaction, impact prediction, evaluation, and management. To assist in achieving the process objective, these activities can be structured into an overall 4-stage process strategy of initial survey, issue analysis, design and negotiation, and ratification.

An initial survey is desirable prior to the development of proposed solutions to acquire a base of social, economic, political, transport, and environmental data and to develop an initial understanding of potentially affected community interests.

In the issue analysis phase, the technical team develops a variety of alternative actions and presents them in various formal and informal ways to a large number of groups and individuals. As a result of continual interaction, the technical team learns what issues are important to different groups and receives ideas and suggestions about problems that might be solved in the community in coordination with the highway program and about alternative actions that might be of particular interest to particular segments of the community. Issue analysis should stimulate identification and expression of conflicting values. The objective is to develop a clear understanding of the issues for both the location team and those potentially affected in the community. This should be accomplished while a wide range of possible solutions is available and not after the location team has narrowed its choice to one or two alternatives. These solutions normally will involve basically different design standards and nonhighway or compensatory program elements as well as variations in location, design, and structural geometry. Presentation of a wide range of basically different alternatives early in the process will stimulate community groups to question and clarify their own objective and to be willing to interact with the location team.

In the design and negotiation stage, emphasis shifts from developing a wide range of alternatives to exploring variations on a few alternatives. The objective is to develop one or more actions that have high potential for achieving substantial, effective agreement. There must be opportunity for meaningful negotiation among conflicting interest groups in reaching an agreement on what comprises an equitable distribution of gains and losses.

The role of the required public hearings and other formal decision processes should be that of formal ratification of previously agreed-upon actions. The hearing cannot serve as a substitute for meaningful and constructive community interaction in previous stages of the process.
The proposed process objective and 4-stage strategy serve as a framework or guide for a location team. Many specific kinds of techniques are required throughout the duration of planning, location, and design, and part of the NCHRP research has concentrated on developing such specific techniques. For example, various aids have been developed to assist a location team in identifying those who may be potentially affected by a proposed transportation project. Also, a well-designed program of community interaction activities will normally employ a number of techniques for communicating with groups in the community and for soliciting a wide range of information from them. Techniques may include small meetings, field work, use of the media, newsletters, and field offices.

The research conducted for NCHRP synthesizes the described principles, especially those for evaluation, public involvement, equity, and decision process, into a systematic approach for incorporating social and environmental factors into all aspects of a transportation planning process. Current studies are examining the problems of treating community and environmental effects during metropolitan area and statewide systems studies. Selected states are cooperating in implementing and "testing" the procedures and recommendations developed to date. The research team has visited 10 state transportation agencies distributed geographically throughout the country. They include small and large states; those that have rural, recreational, and urban areas; and those that have centralized and decentralized operations. Based on the results of these visits, in-depth cooperative activities are being initiated with the Georgia Department of Transportation and the Michigan Department of State Highways.

CALIFORNIA

The Massachusetts Institute of Technology has been cooperating with the California Division of Highways since July 1, 1970, on research studies concerned with community and environmental factors in transportation planning. The objectives of the research are as follows:

To develop an approach and techniques for giving systematic consideration to community and environmental factors throughout the total span of the transportation planning process, from system planning and programming to design. Particular attention is to be given to the interaction of system planning and programming and route location and to the integration of this approach with the planning, programming, and budgeting system of the California Division of Highways.

Work on this project began on July 1, 1970, and was completed on June 30, 1972. During this 24-month period the M.I.T. team worked not only in Cambridge but also in California in various offices of the Division of Highways, the Department of Public Works, and the Business and Transportation Agency. Part of the research was focused directly on project planning and design, while other parts focused on urban and statewide system planning and on the development of means of more effectively integrating project and system studies.

The major focus of the project-oriented effort was the Los Angeles district, where the M.I.T. team worked with a combined route planning and community and environmental factors unit (CEFU) team on the location of the Slauson Freeway, a major east-west facility being planned for the area just south of central Los Angeles. In addition, the M.I.T. team also participated from time to time in work on other freeway projects and interviewed extensively many people in the right-of-way, design, advance planning, administration, and freeway operations of the district offices. The team also worked with the headquarters project people and also visited district offices in San Francisco, San Bernadino, and San Diego to become familiar with their operations. This approach enabled the M.I.T. team to work in-depth in one particular area, yet retain sufficient breadth so that the research findings and recommendations would be applicable to all districts.

The major base of the system planning-oriented research studies was initially in Los Angeles and subsequently in Sacramento; time was also spent in the metropolitan
areas of San Francisco and San Diego. In Sacramento, the M.I.T. team worked closely with personnel in the headquarters offices, especially those in the urban planning and CEFU groups. In addition, contact and coordination were maintained with personnel in the Department of Public Works and in the Business and Transportation agency, especially the Office of Planning and Research.

This method of approach to the research can best be described as one of "participant-observation" in which members of the M.I.T. team worked with counterparts in California on the solution of actual location, planning, and policy problems while simultaneously observing operations of the state transportation organization through work experiences, interviews, and meetings. This same basic approach is being followed in our cooperative activities with Georgia and Michigan. One of the major characteristics of the approach is the opportunity to work closely with professional staff from all levels of an agency. The experience in California has been extremely stimulating and rewarding, particularly the opportunities to observe the processes of policy formulation and implementation, and we are extremely grateful to the state of California for this opportunity of viewing its operations from the perspective of many different levels.

Detailed findings from our Californian studies are presented as part of 6 in-depth reports covering each of the major areas of investigation. We have, however, synthesized certain basic findings from these more detailed observations. Although these findings are based primarily on our California experience and observations, they are broadly applicable to many, and possibly most, highway agencies, according to our observations in other states.

Our primary observation is that, although many states have responded to the challenges posed by the increased concerns for community and environmental considerations, significant problems still exist. The problem is manifested by the public concerns expressed in various ways that social and environmental factors should be considered more centrally in highway planning and decision-making than has traditionally been done. Some segments of the public feel these sentiments so strongly that there is a substantial base of anti-highway opinion within almost every state. Those who hold that opinion are found in many state legislatures and in politically active citizen groups, and their goal is to block most if not all major highway improvements. These actions suggest a "crisis of confidence." Many segments of the public no longer have confidence in highway engineering professionals and, rightly or wrongly, highway engineers are perceived as being opposed to many of the things that these citizens think are important.

The changes in public attitude, coupled with the recent almost complete reliance on Interstate-standard facilities, has also resulted in what can be called a "crisis of solutions." People no longer automatically accept the notion that a limited-access, multilane highway may be "needed." They, along with the U.S. Congress, are requesting that "need" be based not primarily on the provision of fast, safe, and efficient transportation but related to the costs of eliminating or minimizing adverse social, economic, and environmental effects [Federal-Aid Highway Act of 1970, Sec. 109(h), 23 U.S.C., Sec. 136(b)]. This implies that explicit consideration must be given to the options of no new highway construction, different standards or types of highway improvements, and other modal forms.

These crises of confidence and solutions have resulted in a high level of concern regarding the processes by which highway projects are developed and decisions made. This represents a major shift from the traditional almost exclusive concern with the projects, or products, resulting from this process. Highway agencies have sometimes considered these processes, and their associated assignments of responsibility, to be internal operations, but they are now being increasingly subjected to public scrutiny. People are reluctant to have confidence in the decisions of a highway agency and to accept a highway project when the process used to plan and develop that project does not itself merit confidence.

Problems also are manifested in terms of issues within state transportation organizations. There are problems of morale as professional staff within these agencies become increasingly frustrated by citizen opposition and question their roles and ob-
jectives in light of this increasing public concern. As a result, there is considerable uncertainty about the direction in which these agencies are or should be moving.

Many organizations are aware of these problems and are actively searching for new directions, new techniques, and new philosophies. Even though many states have taken important and constructive steps, these actions represent only the beginning of a response. Actual practices change slowly within organizations as large and complex as many state highway and transportation departments. Many constraints and problems still exist.

Among the findings resulting from the collaboration on project studies in California, and confirmed by our observations on other states, are several of particular importance.

1. Implementation of major new approaches takes time. The M.I.T. approach as developed in the NCHRP research is fundamentally different in many ways from present practices within most highway agencies. We have found that implementation of such a new approach takes a substantial period of time, measured in years rather than in days or weeks.

2. People of a high professional caliber, such as the staff within a state transportation agency, cannot be forced to do things in which they do not believe. Stated another way, to bring about change within an organization, the professional must first become convinced that change is necessary and that the proposed direction of change is useful and productive. Unfortunately, many people in highway agencies are not now convinced that problems exist and that change is necessary.

3. Many significant, hidden organization pressures work against the consideration of possible adverse effects of a proposed facility. For example, different status levels are associated with different professional specialities; right-of-way, environmental, and system planning groups are generally considered to be of lower status than either route location or design groups. As a consequence, environmental or planning-oriented groups in many agencies immediately have several strikes against them at the outset.

4. The reward structure as perceived by professional staff is critically related to the success of planning procedures. Most route planners see that their promotion and advancement opportunities are directly related to their success in getting a route developed and implemented. Yet, a major tenet of the M.I.T. approach is that the decision not to build a freeway may in fact be the best decision, provided that the community has reached that decision with full information about the alternatives and their consequences. Thus, the basic reward structure, as perceived by personnel with direct responsibility, may work against adoption of the M.I.T. approach.

5. Attitudes and constraints existing within all organizations tend to inhibit innovation and experimentation and to encourage patterns that have worked well in the past, even in the face of signs that those patterns may not work well at the present.

In summary, within an agency are many significant organizational and procedural obstacles to implementing a new approach. This is not to say that new approaches cannot be implemented. In fact, we have observed over time gradual acceptance within California and elsewhere of the recommended approach, with changing attitudes and work styles as a consequence. This acceptance, however, has been slow and indicates to us the real depth to which efforts must go to successfully bring about change within any state highway agency.

A few states, including California, are initiating basically new approaches and policies for the analysis of transportation corridors. A great deal depends on how these policies are implemented. For example, the California corridor policy involves the signing of a cooperative agreement between the state and each affected town or city, indicating among other things the kinds of studies to be undertaken. In addition, a corridor study is to determine the kind of highway improvement needed, if any, and the relation of the proposed highway improvement to other transportation modes.

There may well be serious problems in getting local governments and the affected communities to believe that the highway division truly intends to take a broad, multimodal approach in corridor studies if the division is unable or unwilling to fund alternatives other than freeways. To achieve acceptance, the division must demonstrate that it really means to do a true multimodal transportation study at the corridor level and
that the option of a no-highway improvement is in fact an alternative that will be given
serious consideration.

A true corridor study should provide a close and responsive link between system
planning and corridor studies and between corridor studies and design. Many of the
options that local communities may wish to explore in corridor studies will likely have
implications for the overall system plan for a metropolitan area or region. Unless a
continuing system planning process exists and is responsive to the corridor study needs,
a proposed system will not be reappraised and these issues will not be addressed.
Similarly, to determine the feasibility of a corridor for a specific type of transportation
facility and to enable the full set of impacts to be predicted requires that specific align-
ments be identified and designs developed. It may even be necessary to make certain
design commitments or at least to set design "performance standards." A corridor
study will have serious credibility problems if a close and responsive integration with
system planning and design is not achieved.

We note also several indications that the philosophy inherent in planning and decision-
making at the urban and statewide system level lags seriously behind the philosophy
that has been emerging in planning and decision-making at the project level (again,
observations are based on an in-depth analysis of California, but general experience
indicates that the points are equally applicable in most other states as well).

1. No explicit or systematic provisions currently exist for the treatment of social
and environmental factors during either statewide or urban area system planning.
2. Little effective community interaction occurs in system planning.
3. The alternatives considered are constrained because of limits in funding (i.e.,
ways and areas in which funds can be spent) and because of a mandated and highway-
based master plan.
4. The present use of the needs study and the functional classification contribute to
the problems of credibility and acceptance between a highway agency and the public.
In fact, one could argue that in some respects the needs study and the functional classi-
fication evade the very issues with which many local communities and many significant
sectors of the public are most concerned, for they provide no capability for dealing with
community and environmental factors or for dealing with transportation as a multimodal
system.
5. The models and analysis tools currently used in system planning do not adequately
address the equilibrium between supply and demand in a transportation system, thereby
ignoring effects of congestion and contributing to inaccurate traffic forecasts and im-
pact predictions.
6. Current institutional arrangements are such that relatively little effective
decision-making responsibility or authority and relatively little technical analysis cap-
bility rest with metropolitan areas or local communities. As such, channels for the
input of viewpoints from these levels of government are not so effective as they might be.

These basic findings have led to a series of specific action-oriented recommenda-
tions to the state of California. A summary follows of our major conclusion and our
primary recommendations regarding mission, institutions, and personnel.

Conclusion

Effective treatment of community and environmental factors throughout all stages of
transportation planning requires major changes. What is needed is a broad program
of action consisting of (a) a clearly articulated philosophy, (b) a coherent strategy for
implementing this philosophy, (c) actions in addition to those already undertaken, and
(d) changes in mission, procedures, and organization.

Mission Recommendation

The mission of a state transportation organization should be to assist communities
in reaching decisions about transportation and implementing those decisions.
1. A state must determine the extent and the character of its role in transportation decision-making. We believe that the mission of a state transportation organization should be to assist in reaching decisions, not to make those decisions for communities. The role of the state transportation organization should be as a catalyst and stimulus to decision-making by political bodies at state, regional, metropolitan, and local levels.

2. The decisions reached should reflect substantial, effective agreement on courses of action that are feasible, equitable, desirable, and consistent with the recommended approach to project planning.

3. An organization's primary strength is in the professional skills and services it provides.

Institution Recommendation

A state transportation organization should work to develop the capabilities of regional institutions to reach transportation-related decisions and work to provide transportation as a multimodal service.

1. The state's transportation objectives must be defined as distinct from the transportation objectives of its urban areas.

2. Maximum responsibility for regional and local area transportation planning and programs should be placed at the lowest possible levels of government.

3. The state must identify and encourage the development of institutions through which local determinations relating to transportation can be made. Incentives should be provided through funding and other devices to strengthen appropriate regional institutional capabilities to fulfill these responsibilities.

4. Institutional arrangements should be of a form appropriate to each region. Different forms within a region or subregion should be encouraged where necessary and desirable.

5. The structure of the decision-making process should be clearly articulated and the role of each institution clearly identified. The relation of state, regional, subregional, and local institutions should be developed to facilitate an orderly process of reaching decisions about transportation, including restructuring of current district level responsibilities. Where possible, individual decisions should be made at a single institutional level.

6. Fiscal constraints that may inhibit the freedom of an organization in taking a truly multimodal approach to transportation should be removed at the state and at the federal levels.

7. Multiyear financial programs should be multimodal in nature and should include not only investments in fixed facilities but also options such as operating policies, experiments, and demonstration projects.

8. Consistent with the recommended mission of a state transportation organization, the attitude of all personnel should be one of providing transportation as a "service," not construction or completion of a preconceived system.

9. The relation of highway improvements to other transportation modes should be considered throughout systems and project planning. Both the long-range and short-range impacts of a proposed highway project on the viability of existing or possible future uses of nonhighway transport modes should be predicted. In other words, what options are being foreclosed by implementation of a particular course of action?

Personnel Recommendation

Personnel, promotional, and reward policies should be reviewed and realigned where necessary.

1. New training programs for present and new personnel are required to increase skills in community interaction, impact prediction, and management and to increase the ability of individuals to work effectively as part of interdisciplinary teams.

2. The present system of personal rewards, informal as well as formal, should be reassessed. Service to communities should become a major criterion for advance-
ment, consistent with the proposed mission of assisting communities in reaching transportation-related decisions and in implementing those decisions.

3. Important qualifications for a manager of a project team should be the abilities to manage an interdisciplinary team effectively and to work with community groups effectively and constructively.

4. Career patterns should be developed to provide meaningful advancement opportunities within the agency without requiring individuals to assume management responsibilities. Although opportunities for management positions should not be closed to any person, opportunities for advancement in grade and salary without management responsibility should also be available. The creation of such multiple avenues of advancement would provide promotional opportunities including status and financial reward for those persons who are particularly well qualified in an individual technical area but who do not have the interest or capability to assume management responsibilities.

5. The functional organization should be revised to promote the use of interdisciplinary project teams on all major projects. A single team would be responsible for all phases of project planning through the approval of plans, specifications, and estimates. Where numerous small projects exist, these might be handled by a single sub-area team. The team should be located in one physical location to promote intragroup dynamics and communication. Team members should include representatives of various disciplines such as political science and sociology and of functional departments such as systems planning, design, and right-of-way. Personnel can be adjusted with needs; the composition of the team would continually change. Team members are responsible to their respective teams, not to their functional departments.

6. The present engineering-oriented qualifications for project management and for management at various levels within the organization, especially the top levels, should be revised to allow positions to be filled by professionals other than civil engineers. Many of us on the M.I.T. research team are civil engineers, so we believe we can make this recommendation with some objectivity. We see no reason why engineers are more competent to deal with transportation problems than are many other professionals. This is not to say that engineers should be excluded from these important positions, rather that no specific advantage or requirement should be given to those with engineering background as opposed to those with other kinds of professional backgrounds.

FEDERAL HIGHWAY ADMINISTRATION

Since September 1971, M.I.T. has been working with the Federal Highway Administrations' Office of Environmental Policy to develop guidelines in response to the Federal-Aid Highway Act of 1970 (Sec. 109(h), 23, U.S.C., Sec. 136(b)). Section 136(b) states in part:

Not later than July 1, 1972, the Secretary [of Transportation], after consultation with appropriate federal and state officials, shall submit to Congress, and not later than 90 days after such submission, promulgate guidelines designed to assure that possible adverse economic, social, and environmental effects relating to any proposed project on any federal-aid system have been fully considered in developing such project, and that the final decisions on the project are made in the best overall public interest, taking into consideration the need for fast, safe, and efficient transportation, public services, and the cost of eliminating or minimizing such adverse effects. . . .

The guidelines will be issued as a policy and procedure memorandum for use by state highway departments in developing an action plan. The action plan is to describe the organization and processes, existing and new, to be followed in the development of federal-aid highway projects from initial planning through design. The plan must be consistent with the requirements of the Federal-Aid Highway Act of 1970, the National Environmental Policy Act of 1969, the Civil Rights Acts, Policy and Procedure Memoranda 20-8 and 90-1, and other applicable statutes and administrative directives. A
state's action plan is to address 3 primary areas: conduct of studies, process management, and implementation of the action plan.

The process guidelines are aimed at accomplishing the purpose of Section 136(b) by influencing processes and assignments of responsibility through which federal-aid highway projects are developed rather than by attempting detailed supervision or control of plans or projects or by stipulating rigid technical requirements to be fulfilled. To quote from the report submitted to Congress:

...the guidelines, while requiring that certain questions be answered by the state in preparing its action plan, leave considerable leeway to the states on how they are to be answered. The process guidelines require, for example, that each highway agency develop a procedure and assign responsibility for the early identification of economic, social, and environmental effects, but it will be up to the individual highway agency to determine the way in which these general requirements are to be met. The federal interest will be to ascertain that the response is adequate to the problem rather than to prescribe the form or substance of the response.

The M.I.T. research team has played a major role in the development of these guidelines, including the initial drafts and a number of successive revisions in coordination with the Federal Highway Administration, state and local officials, and representatives of environmental groups. The approach of these guidelines reflects many of the basic principles described earlier.

We have recommended to California that the requirement of the Federal Highway Administration for the development of an action plan be used as a stimulus for implementing the M.I.T. recommendations and other desirable changes to support the state's current planning procedures. Similarly, we recommend to all states that the action plan be used as a unique opportunity to systematically and comprehensively review current procedures, organization, and assignments of responsibility with the objective of ensuring full consideration of possible social and environmental effects, positive as well as adverse, in developing proposed highway projects.

The manner in which an action plan is prepared will affect both the content and the eventual acceptance and realization of that plan.

1. In developing an action plan, the state should examine the total mission, structure, and process of the state transportation organization at all levels of activity from systems studies to decisions at the project level.

2. Priority should be given to the early identification of potential legislation and administrative directives that are required to help an agency more effectively adjust its mission and procedures.

3. There should be wide involvement of an agency's personnel in the process of developing an action plan to promote and stimulate the attitudinal changes that will be required if the organization is to be more truly responsive to social and environmental effects. Those involved in preparing a plan should be selected because they are knowledgeable and respected and not simply because they are available.

4. Individuals who will be responsible for carrying out an action plan should be involved actively in its preparation. These people should have a clear understanding of how the changes outlined in a plan will affect the entire organization. They should also command the respect of and be granted the authority to make changes by all who will have responsibility for the new activities.

5. Top level executives from the organization should be involved early in an action plan so they fully understand and support those parts that require changes in legislation or administrative policy.

6. Adequate time and resources should be made available to develop an action plan effectively and appropriately. Individuals involved in the preparation of a plan should be relieved of some other duties so they can devote the necessary time to this activity.

SUMMARY

We have reviewed the theoretical perspective from which we have approached our investigations and its influence on specific practical recommendations to the National
Cooperative Highway Research Program, the state of California, and the Federal Highway Administration. Perhaps the best way of summarizing this discussion is as follows: Effective consideration of social and environmental factors in highway planning and design cannot be accomplished simply by additional paperwork or additional technical studies. Rather, major changes in our conception of our roles as professionals and as public agencies are required to truly respond to the public's concern regarding social and environmental issues.

We must respond to the need for these changes. We have worked closely with many highway professionals in many agencies during the last decade and particularly during the past 4 years. We have been impressed by the number of people in various agencies who perceive this problem and who are thinking, and thinking deeply, about how to respond to it. The highway profession has the capability to do so, provided we recognize the seriousness of this challenge and the depth of response required.

We have enjoyed very much our close collaboration with individuals in many agencies in many states during the course of this research. We look forward to working further with many of them as we all strive as individuals and as organizations to respond to the challenge facing us.

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The opinions and conclusions expressed or implied are those of the authors and the research agency. They are not necessarily those of the sponsoring agencies.

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