Practical Planning Techniques: Review and Rethinking

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This paper emphasizes improved understanding of practical, operational techniques that are responsive to current and short-term issues. Included are (a) documentation of issues; (b) documentation of the state-of-practice for identifying and measuring economic, energy, and environmental indexes; and (c) operational guidance for the use of validated techniques. Major findings are that most earlier and current planning is of a single mode, single discipline nature. Multimodal state and regional planning, pricing, or policy formulation is rarely attempted. The literature contains very little on truly integrated economic, social, environmental, and energy evaluations. The indicators to address these current and changing issues are poorly organized, and techniques for measuring the indicators are rarely evaluated or validated. Consequently planners and decision makers have poor understanding and use techniques and approaches that are faulty.

The current transportation literature is flooded with publications titled, "social, economic, and environmental impacts." Indications are that a meaningful change is taking place and that this flood of articles reflects the depth of the change. In the past, any action that facilitated the transportation of goods and passengers in greater numbers or more quickly appeared to represent a contribution to the public interest. In the new age of increasingly scarce resources and critical pollution thresholds, this is no longer the case. Basic factors critical to transportation planning are also changing. The birth rate has fallen below the basic replacement rate despite the highest household formation rate in history. Equally important, the recent growth in small cities and towns has signaled one of the most dramatic changes in population location in this century. The rate of growth of nonmetropolitan areas is exceeding that of the big cities and suburbs. Continuation of these shifts could have a profound effect on state and regional transportation planning.

Transportation improvements have become, whether actively or passively, vehicles of public policy. Proof that volume, safety, or speed will be increased, or even that direct costs to users will be reduced is no longer adequate evidence of the desirability of a transportation project. If the best overall public interest (1) is truly to be served, many other factors must be considered, particularly since an aroused citizenry have the legal tools to delay and possibly stop projects that are detrimental to either the human or the physical environment.

This is not to say that transportation improvements are not socially desirable or, in fact, essential. We, as planners, must consider the more subtle and far-reaching impacts a proposed project might have and not just the immediate benefits to be derived. Transportation improvements should no longer be assessed apart from the broader context of societal goals.

Changing conditions, attitudes, and values place tremendous new pressures on state and regional planners and decision makers. Techniques for evaluating transportation improvements in light of these changes are not readily available. An improved understanding of practical and operational impact identification and measurement techniques must be developed for the regional land use-transportation planner who is strongly influenced by new social mores, energy shortages, environmental problems, and the current state of the economy. Techniques are needed that are applicable to pricing, regulation, and policy formulation, as well as to planning.

While some improvements are proposed in this paper, I have not developed a single approach that is universally applicable, easily applied, and based upon quantifiable criteria alone. This paper attempts to contribute to improved understandings and to identify techniques relevant to short-term conditions for this range of decision-making activities. The following discussion is directed primarily toward state and substate regional planning, program development, and policy analyses. Because of strong relationships, urban considerations are also included. The discussion focuses on methods broadly applicable to all modes of movement of passenger and goods and covers all levels of capital investment (new construction, low capital investments, no build, and abandonment), operational improvements, and pricing and regulatory measures. The scope is broad, but no broader than that faced daily by most planners and decision makers.

ISSUES, INDICATORS, AND TECHNIQUES

Transportation planning and decision-making processes have improved rapidly over the past decade, stimulated in part by National Environmental Policy Act of 1969 (NEPA). This type of legislation has raised the awareness of issues outside of, but closely related to, transportation planning. In fact, techniques used by some states in creative policy formulations have, in turn, led to successful, multiagency planning and budgeting efforts (2, 3). These and similar recent improvements are overshadowed, however, by the basic changes taking place in the traditional response-to-growth type of transportation planning. Hammer (4) gives an excellent summary of the increasing use of normative planning or managed growth approaches:

> The emerging policymaking is a welter of crisscrossed lines. On one hand the new [U.S. Department of Housing and Urban Development] HUD Act is testimony of the acceptance of a new federalism that admits the limitations of top-down approaches to the management of physical development. On the other hand, the new [U.S. Environmental Protection Agency] EPA and [Federal Energy Administration] FEA regulations are startling in their reassertion of federal force in the face of new environmental and energy crises.... Now the states, for the first time in U.S. history, are asserting their constitutional power over land use and settlement patterns. Most important are the emerging actions of local jurisdictions and their plans and implementation programs dealing with the management of growth.

Instead of merely upgrading traditional, single-mode techniques for comparing alternatives after the decision to build has already been made, we now have techniques to determine whether transportation improvements or some other improvements are needed to support broader socioeconomic and land use goals. If transportation improvements are needed, we choose which combination of capital investments and pricing or regulatory mechanisms will be most effective in accomplishing those goals. The traditional response-to-growth approach is not yet a thing of the past. Fortunately, most of the

findings regarding impacts and techniques apply equally well to the response-to-growth, normative, and growth management approaches.

The results of earlier work on improving techniques indicate that still more monitoring and postevaluation work are needed. For example, economic research by Harral and others in the transportation research program of the Brookings Institution (5) provides an excellent base in that discipline. This is supported by recent work by Llewellyn (6) in the socioeconomic area; by Wolf (7) in the social area; by Yukubouski of the New York State Department of Transportation (8) or Manheim (9) in the citizen participation area; by the state of Oregon (10) in the energy discipline; and by the state of Georgia (11) and the Smithsonian Center for Natural Areas (12) in the environmental area. Most of these works have not been organized into an overall framework for planning, pricing, and policy formulation that uses multimodal systems assessments and integrated economic, social, environmental, and energy (ESEE) evaluations.

The issues that state and regional transportation planners must deal with were assembled from direct contacts with planners and decision makers and from some excellent recent references (13, 14, 15). Most were old issues, many as old as transportation itself. During the last three decades, planners responded to tremendous growth pressures and found little time to respond to energy or environmental issues. As a consequence, responses (in the form of alternative approaches and techniques) are poorly developed for issues such as:

1. Developing meaningful state goals,
2. Learning to deal with change and uncertainty,
3. Planning for multimodal systems, and
4. Pricing and regulatory mechanisms for coordinating private and public sector investments and operations.

Major new issues include state and local attempts to manage growth, energy problems and the corresponding issue of resource management, and reliability problems in predicting socioeconomic trends. Each of these issues is drawing transportation planning and decision making out of the transportation field and into the complex field of land use and socioeconomic planning. ESEE relations are poorly understood in this larger field. For example, land use is often used as a surrogate for social and economic issues. While an important consideration in itself, land use is a poor surrogate for issues such as energy conservation or neighborhood cohesion. Similarly, environmental impacts are frequently labeled as indirect and thereafter ignored, even though indirect impacts are among the most important to informed decision making. Also, terms used in economic analyses, such as externality or financial versus economic analysis, are often used incorrectly.

All of these factors have contributed to the existing state-of-practice in state and regional transportation planning. Systems planning is minimal in this country. Most state and regional plans are sum-of-projects by mode and then sum-of-mode efforts; little or no analysis is made of economic, energy, social, or environmental relations. This situation is changing as more states adopt policies regarding land use. An example is Colorado's goals in redirecting economic and population growth (16).

Some techniques are so well understood and documented that we can identify issues, document impacts, identify operational methodologies, and develop guidelines for their use in various decision-making activities. These techniques include those for finance, fuel consumption, transportation accidents, and noise assessments. A relatively high level of confidence can be placed in predictive techniques in these areas.

With the exception of those mentioned above, impacts and techniques currently employed to address major issues are at very uneven stages of development. Generally, they combine single-mode and single-discipline assessments, which rarely discuss system or discipline relations, and offer short-term evaluations almost to the exclusion of long-term considerations. Frequently, the techniques are methodologically incorrect or used incorrectly. Almost no postevaluations have been performed to validate the reliability of recent, observable impacts or of currently used techniques. One recent postevaluation of highway impact methods, completed for the Federal Highway Administration (FHWA) (6) summarizes, "The results of this study indicate that a large proportion of the research on highway impacts is poorly conceived, lacking in substance, and replete with errors in methodology and research design." Most postevaluations are either harsh condemnations of the techniques in use or such poor evaluations themselves as to be inadequate to establish the reliability of the techniques in question.

Indicators comprise the logical link between issues and measurement techniques. They are key characteristics of major issues that can be measured quantitively. Unfortunately, decision makers rarely agree on issues, indicators, and techniques. Thus the National Cooperative Highway Research Program (NCHRP) (17) proposes organizations in this regard for the economic, social, environmental, and energy disciplines (Table 1 is an example).

PRACTICAL TECHNIQUES AND IMPLICATIONS TO DECISION MAKING

Generally, our understanding of how to use economics for state and regional transportation planning and evaluation is poor. Most earlier economic analyses were (a) justifications rather than evaluations; (b) single-mode projects rather than multimode systems oriented; (c) predominantly short-term instead of short- and long-term considerations; and (d) often of a financial instead of economic nature. For example, most economic analyses of airports, pipelines, ports, and railroads are, in fact, financial assessments of costs and revenues needed for investment purposes. Employment and related benefit data are used for justification purposes. Costs and revenues are necessary analyses for a broader economic assessment, but they are only fragmentary inputs to that broader assessment.

Table 1. Energy issues, indicators, and techniques.

Issue	Indicators	Measurement Techniques
Fuel energy consumption	Modal energy intensiveness	1. Sketch and detailed analyses 2. Models of existing systems
	Operating fuel consumption	1. Multiply modal energy intensiveness by number of seats and total distance traveled
Capital energy consumption	Energy costs for such things as vehicle manufacture, traveled way and facility construction, manufacture and operation of traffic control, and signals	1. Sketch analysis 2. Multiply project dollar cost by total U.S. energy consumption for year in question and divide by GNP for the same year 3. Detailed analysis 4. Input-output

Waterway development evaluations provide an example of invalid economic or financial analyses. Current practice is to compare rates for heavily subsidized waterway carriage with regulated rates for the same cargo on a real or imaginary parallel rail line. Economic analyses for regional systems are rarely performed. The most widely recognized technique, benefit/cost analysis, is used primarily for project evaluation instead of for state or regional system planning, and then only to select between highway alignments once the decision has been made to build a highway. This technique has valid uses; however, it can provide only a part of the input required for economic analyses of concern to planners. Other findings are that:

1. Requirements for economic assessments are changing so that many traditional terms such as externality, second order, and indirect are less relevant than they once were;
2. Economic analyses, subject to data availabilities, are equally applicable to all modes—no major economic techniques are mode specific; and
3. Multiple techniques are needed for overall economic evaluations; rarely is a single technique adequate to address more than one issue nor will a single technique provide useful information for all decisions about planning, pricing, regulation, or policy formulation.

The technical requirements and limitations of economic analyses must be better understood. These include (a) the use of with and without analyses, (b) the establishment of causal effects, (c) the understanding that tax analyses merely reflect internal transfers in an economy, and (d) the delineation of clear boundaries for economic analysis.

The implications of the state-of-practice in economic analysis are twofold. The first implication for state and regional transportation goals confirms Hand's findings (18, p. 4):

> State development policies and planning, including transportation, need to reflect a common base of population, economic, and resource information and analyses. State governments need to be encouraged to move more in the direction of a goals definition that is part of a systematic consideration of overall objectives, targets, needs, deficiencies, implementing programs and projects, and the periodic recycling of these judgments.
>
> Functional elements will always compete for priority of attention and support, e.g., transportation versus education and welfare versus environment. But if each functional element is to be viewed and understood as fitting into a total structure rather than as being the umbrella for the solution to all questions, then overall definition and direction must gain the same recognition and support...
>
> This larger context is important for transportation decisions. It is essential to intermodal judgments. This larger context is important and is essential to transportation decisions and intermodal judgments, among other reasons, because these decisions and judgments should be used by society in shaping what it determines it wishes to be.

The second implication is that state and regional transportation planners will require inputs from trained economists. These economists should have a societal viewpoint rather than view transportation as an economic activity in itself. Further, the economist, according to Munger and Edwards (19):

> ...will have to spend the time and effort required to determine what people want and how they go about satisfying those wants. He will have to abandon exclusive reliance on an analytical tool designed... to maximize income and to develop, instead, tools capable of guiding public decisions aimed at achieving multiple objectives, some of which are subjective in nature. And, most important, he must remember that the search for acceptable alternatives is a political bargaining process which he can assist by providing needed information and withholding personal value judgments.

Energy issues are relatively new to planning in this country. Except for scattered works, like that in Oregon (10), few energy assessments have been completed at the statewide, multimodal planning level. Energy assessments are largely the application of well-known physical laws. Issues in the energy discipline do not have numerous or highly qualitative indicators. Because of the strong relationships between energy and economic, social, or environmental assessments, future energy assessments will be critical

1. To state policy formulation, pricing, regulation, planning, and financing of multimodal operations;
2. To an understanding of a state's energy balance, to the need for energy imports (into a state), and to related long-term effects on the state's economy; and
3. To planning the modal balance for new systems and, more importantly, to the organization of priorities for marginal improvements to existing systems.

The indicators and techniques for fuel energy consumption are well developed and are a direct counterpart to dollar costs for transportation operations. These techniques, which are easily understood and applied, are currently part of many state-level analyses.

Capital energy costs are less well understood and rarely used. They have their direct counterpart in dollar costs for such things as transportation facilities and equipment, and therefore, may be as important to long-term transportation decisions as fuel energy analyses. For example, capital energy requirements will be very important to future decisions on the trade-off between short-haul air service, which is highly energy intensive but may have minimal capital energy requirements, versus high-speed rail, which is not nearly so energy intensive, but could have enormous capital energy requirements. Energy implications to land use, economics, resource management, and social subsystems are so strong that energy assessments of the future may force vastly improved interagency planning and budgeting activities. Further, modal energy comparisons may be easier to develop than cost comparisons, and the economic implications may be more easily understood.

Much work remains to be done in relating energy assessments to those for economic, social, and environmental analyses. Because their economic implications are easily understandable, capital and operating energy assessments will have an immediate, long-lasting, and pervasive impact on transportation decisions. Energy and economic evaluations will be of particular importance in times of uncertainty and scarcity.

Social assessments are used as the underlying basis for many court suits against transportation projects. But, the social discipline appears to be the least well developed and the most lacking in terms of an overall understanding of how social considerations can be used in transportation decision making. By far, most information about social impacts is related to highways. The predominant need for value judgments in social assessments may make the development of good understandings difficult and the assembly of a comprehensive body of reliable social assessment techniques even more difficult. Value judgments vary so much from person to person over time; the development of predictive analytical techniques for interrelated social issues, therefore, appears to be an unrealistic goal. Several considerations indicate that social assessments may be even more important in the future than they are now.

1. Strong socioeconomic ties contribute to a growing consensus among planners that social considerations may

be the most important of future ESEE evaluations; and

2. Energy considerations indicate that future transportation developments may have key social implications, such as on the quality and distribution of state and regional growth.

An effective community participation program may be the most reliable central mechanism for addressing social issues; however, participatory programs at the state and regional level are not yet well developed. Thus, the testing and development by individual states of alternatives identified by Yukubousky (8), Bigelow (20), Ortolano (21), and Manheim (9) should be a priority item—particularly if the findings of Llewellyn (6), Crane (22), and Wolf (7) regarding the inadequacy of current social techniques prove to be correct.

Participation programs alone will not be adequate to address social and related issues. A long-term, well-organized program to verify social impacts and develop techniques for their prediction will be necessary if social considerations are to be given meaningful consideration in transportation decision-making processes. Until these techniques are available, the use of an effective citizen participation approach appears to offer the best potential for reliably incorporating social concerns in state and regional decision-making processes.

Existing noise level standards reflect a consensus on the importance of noise issues. A long history of research has resulted in the development of relatively reliable predictive techniques for noise impacts. Also, validations have been performed on the effectiveness of noise techniques. More work on noise techniques is needed to make them universally applicable to all modes and conditions and less costly to perform.

Air pollution impacts on humans, biota, and buildings are fairly well documented. In addition, predictive techniques are available for the generation of pollution by all transportation modes. However, dispersion and concentration of air pollutants in rural air basins are not well understood, and the available techniques for their practical reliability are unvalidated.

Water pollution impacts are not well documented because the generation and dispersion of transportation-related pollutants have not been thoroughly researched. In particular, the dispersion of transportation-related pollutants in groundwater supplies is not understood. Thus, while some of these pollutants are known to be highly toxic (such as asbestos and mercury), only sketch techniques are available for generation and dispersion predictions.

Ecological considerations are less well understood and ecological impacts of transportation systems are not well documented. Impact indicators are not agreed upon and analytical techniques are neither well developed nor easily documented in the literature. No meaningful validations of currently used techniques were found in the literature.

While ecological issues were primarily responsible for the NEPA legislation, most environmental assessments have been little more than inventories of species (particularly endangered species) or climatic and soil conditions. Key ecological considerations, such as community, food webs, and triggering factors are rarely mentioned. Work for the Georgia Department of Transportation is an exception (11).

The implications for state and regional transportation planners are that, although existing techniques can be used to perform noise and energy assessments with a relatively high level of confidence, reliable air and water pollution and ecological assessments will require the further development of predictive techniques. Until such techniques are developed, the identification and monitoring of critical areas (air basins, water resources, or ecological areas) appear to be an excellent alternative for considering these impacts at the state level. The U.S. Department of the Interior initiated such a program based on work initiated by the Smithsonian Institution (12). Given the difficulties in developing predictive techniques, the identification and monitoring of critical areas may be the only practical short-term approach available to planners.

CONCLUSIONS

Some of the newer issues, such as growth management and energy, provide opportunities to deal more effectively with the older issues of risk and uncertainty. However, techniques to address related issues and impacts need to be better organized. Most state planning is done on the basis of summing regional or local projects by mode and then summing sets of modal projects. Multimodal system planning is rare; therefore, little documentation exists on the impacts of system planning. Reliable impact documentation is even more rare. Most impact documentation ignores relationships, is too narrow in scope, or is faulty. Post project evaluations are frequently justifications of earlier decisions rather than evaluations of the reliability of the planning techniques. Thus, a common finding of reports of planning or evaluation techniques is that monitoring programs and postevaluations are among the highest priority needs.

Available techniques can significantly improve decision processes, but reliable techniques do not exist to address some major issues or for measuring some relationships. Currently available techniques are broadly applicable to decisions on capital versus operating investments, abandonments, pricing, regulation, and policy formulation. Six years of experience with the NEPA legislation shows that ESEE assessments and community participation must take place at the outset of planning rather than after plans are complete and public approval is sought. Thus, we are approaching the point at which the distinction between planning and impact assessments may disappear.

As a reflection of earlier single mode and single discipline assessments, the ESEE disciplines are at very uneven stages of development and critical discipline relationships are poorly defined. New issues give policy makers the responsibility of balancing ESEE trade-offs, but the poor state-of-practice leaves them without adequate information for doing so.

Energy and economic techniques are among the most reliable and well developed. Environmental and social impacts are the least well organized, documented, and developed. Energy assessments and community involvement techniques appear to offer the best alternatives for improving understanding of ESEE relationships. Both can be employed by the existing staff of state transportation agencies. Most current impact evaluations are negative in character, largely as a reflection of the inadequate use of available procedures. For example, the use of the without alternative (a technical requirement for the valid comparison of alternatives) can significantly add to planning understanding.

The five modes plus the ESEE disciplines and relationships, when placed in the existing institutional and financial context, result in a complex network of considerations that confront state and regional transportation planners and decision makers. As planners, we must learn to deal with this complexity and not avoid it by searching for easy answers or fast solutions.

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Transportation and Land Use Planning to Achieve National Goals: the Netherlands

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The Netherlands is one of the most densely populated countries in the world. The Dutch people have a long history of rigid land use controls; urban sprawl is unknown there. High-rise apartment complexes generally mark the boundary between urban and agricultural land uses. Urban expansion and some decentralization of urban activities since World War II have placed a difficult burden on transportation. The number of passenger automobiles has increased fivefold between 1960 and 1970. Transportation policy goals for the Amsterdam region call for public transportation in the future to accommodate about 60 percent of the journey to work traffic (it now accommodates about 25 percent), bicycle and pedestrian trips will be 30 percent, and the private automobile will account for the remaining 10 percent. To help achieve the