ECONOMIC ANALYSIS AND THE ENVIRONMENTAL OVERVIEW: SUGGESTIONS FOR PROJECT RECOMMENDATIONS BY LOCAL GOVERNMENTS

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Recent trends in transportation planning and in federal and state legislation are leading to greater public participation in transportation project evaluation. Although these trends represent an opportunity, they also obligate citizens and local governments to evaluate the multitude of social, economic, and environmental factors involved in project evaluation, even though they have limited experience and few resources for doing so. The paper suggests a framework for organizing potential project impacts, which emphasizes (a) the development of an environmental overview before project recommendations are made and (b) an understanding of the relationship between the effects considered in the overview and those included in traditional economic analysis. Effects on road users and nonusers are analyzed to determine whether they are treated explicitly or implicitly in benefit-cost analysis or whether they should be placed in such categories as (a) natural resources and environmental quality, (b) community impacts, (c) leisure and recreation, and (d) economic effects. A technique for rating and weighting the project effects is outlined in order to facilitate the formulation of project recommendations. The paper should be useful to local governments either in providing an approach to be implemented or as a point of departure for developing a system that is responsive to specific local needs.

•RECENT TRENDS in transportation planning and in federal and state legislation are leading to greater public participation in evaluating transportation projects. In Oregon, for example, the Action Plan, state land use legislation, state legislation to divert motor vehicle revenue to public transportation investments, and a proposed $150 million bond sale all invite or require public involvement in the project selection process. The result is an opportunity for citizen groups and local government agencies to explicitly incorporate their preferences into project recommendations and for state transportation agencies to respond to a variety of local needs in a systematic way when they select from the recommendations.

The opportunity, however, carries with it an additional obligation. It is necessary for citizens and local governments to evaluate numerous social, economic, and environmental factors (SEEF) even though they have limited experience and few resources for doing so. Whereas environmental impact statements have frequently been the tool for clarifying and evaluating SEEF, local governments do not have the capabilities for analyzing project effects in the depth required for detailed impact statements. Furthermore, whereas an impact statement is useful in presenting information for corridor and design hearings, it is unnecessary and, in fact, impractical to prepare one for each project recommendation. In some instances, a local government recommendation will be made at the project concept level with no well-defined corridor. In these cases, an involved impact statement would be impossible. Nevertheless, some consideration of SEEF is essential at an early stage. Consequently, guidance is necessary if project effects are to be measured and evaluated in a meaningful manner.

This paper suggests to local governments a framework for organizing the myriad of potential project impacts. The key to the approach is the development of an environmental overview and an understanding of the relationship between the effects considered in the overview and those included in traditional economic analysis. Ideally, it would be used in conjunction with systems planning, but the approach is also useful if a comprehensive plan does not exist.

BENEFIT-COST ANALYSIS AND THE ENVIRONMENTAL OVERVIEW

Ideally, a local government unit evaluates prospective highway projects with reference to how well they correspond to specific regional objectives. Unfortunately, however, most local governments have not generated a set of operational objectives to which highway improvements can be related. Furthermore, many project effects are not easily measured in comparable units. Consequently, a productive approach is to organize project impacts according to those factors that can be evaluated in dollar terms and that are included in benefit-cost analysis (to the extent that the state of the art permits) and those that pertain to other social or community goals. In this framework, project effects should be scrutinized to determine which are considered in benefit-cost analysis and which should be treated in an environmental overview, taking care not to double count any factors.

Road-User Benefit-Cost Analysis

The benefits of highway projects occur primarily because of highway use; road users are the initial beneficiaries of both reductions in cost and improvements in road quality. Savings to automobile and truck operators in terms of shorter or faster trips, reduced operating costs, and safer travel (to the extent that they can be measured) are included in traditional road-user analysis. These benefits are compared with costs to the highway agency to arrive at an index of project desirability.

Road-user analysis is not used to analyze general benefits and costs to the community, impacts on wildlife and natural resources, or air and noise pollution effects; environmental impact statements have typically focused on these variables. Because the analysis compares only some of the benefits from highway construction with some of the costs, the result cannot be considered sufficient in itself for choosing projects. However, the analysis does provide important but frequently misinterpreted information about the nature and magnitude of the factors usually treated in an environmental impact statement. An understanding of the relationship between road-user benefit analysis and all costs and benefits from highway projects reveals that road-user analysis is a more powerful tool than would first appear to be the case.

The most frequent analytical errors (2, 3, 4) committed in evaluating highway projects are (a) failing to recognize that most of the new economic activity that does arise is implicitly measured by road-user analysis and (b) counting too many observed effects as net increases in economic activity, not realizing that they are possibly offset by unobserved effects.

Transferred Benefits—The savings or benefits to road users represent real income gains that are "consumed" in a variety of ways, including more time on the job, increased convenience and leisure, additional break time for drivers, and more or faster trips for housewives. Many observed effects in the area of a highway project are results of these real income gains that are transferred or passed on to land owners, apartment landlords and tenants, and sellers and purchasers of goods as the economy adjusts to the change in the transportation network. Too frequently, road-user savings and transferred benefits are lumped together as total benefits from a project. Benefits are overstated whenever the analyst includes both transferred benefits and road-user savings.

It is possible to invent many cases of overcounting to illustrate this point. For example, a highway improvement might reduce the cost of grain to a farmer who uses it to feed his cattle from which milk and meat are produced and sold. If the analyst were to count the transportation savings and the value of the grain, milk, and meat, he would arrive at huge benefits and an impressive benefit-cost ratio. All these effects represent only one benefit that is passed from one stage of production to another.

Relocations of Economic Activity—Highway improvements and the consequent user benefits often create conditions conducive to increased commercial activity in the area of the project. Before this increase is characterized as a net benefit, whether and where the economic activity would have taken place without the highway must be known. Frequently, apparent increases in economic activity are erroneously included as benefits only because the researcher fails to view the project from a perspective that is broad enough to include all project effects, not just those occurring in its close proximity. That is, frequently a gain to one firm is a loss to another. For example, construction of a bypass might result in a strip of restaurants, bars, and gas stations, while there is accompanying decline in commerce and land values on the "old road." Although the corridor may reflect more prosperous conditions, the overall level of economic activity may not have changed. Just as with transferred benefits, there is a danger of overcounting if apparent benefits are accepted uncritically.

The Environmental Overview

The environmental overview encompasses analyses of the "other" SEEF arising from project construction. It provides a mechanism by which projects can be evaluated before priorities are formulated. Later, if the highway agency selects a project for construction, an environmental impact statement that analyzes the same effects in more detail or from a different perspective can be prepared, if necessary. For small projects with few effects on nonusers, the project proponents would need to do no more than explain that no adverse impacts are expected. Major projects, of course, would require more elaborate investigation. In no case, however, does the overview represent a detailed analysis of the anticipated effects. Rather, it highlights the major potential problems so that local area recommendations can be based on a recognition of their existence and an evaluation of their importance.

The general categories given below represent a possible classification of effects for the overview. They are presented here as a suggested rather than a definitive list; the subcategories are not all-inclusive but are indicative of how the factors might be organized. It would be extremely difficult to devise a set of categories that are applicable to projects in both urban and rural areas and that are accepted by all potential users.

1. Natural resources and quality of the environment
   a. Fish and wildlife
   b. Vegetation
   c. Earth
   d. Water
   e. Air
   f. Noise
2. Community impacts
   a. Land use
   b. Neighborhood effects
   c. Services and utilities
   d. Schools and churches
3. Leisure and recreation
   a. Parks and open space
   b. Monuments and historical sites
   c. Recreation areas or activities made available
4. Economic effects
   a. Use of unemployed resources
   b. "Opening-up" effects (reorganization of inputs or economies of scale)
   c. Effects of construction expenditures
   d. Structures affected and not taken

Whatever classification scheme is adopted, it is imperative that the categories be clearly defined and not overlap so that persons using them will not be confused about their meaning and will understand that each effect is included under only one heading. If such a system is not used, it is likely that citizens and local government representa-

tives will be overwhelmed by the number and variety of project consequences and may mentally classify and evaluate them in different ways.

The section that follows indicates how project effects can be grouped into these or similar categories.

CLASSIFICATION OF PROJECT EFFECTS

Local governments should understand which project effects are explicitly and implicitly measured by benefit-cost analysis and which effects must be included in the various categories of the environmental overview. Regardless of how many categories are used or how they are defined, essentially the same effects must be analyzed. Project impacts are viewed as being either developmental (because of or during construction) or operational (related to the volume of highway use). Within these general classifications, effects on both road users and non-road users are examined.

Developmental Effects

Developmental effects can usually be separated into those that are compensated and those that are uncompensated. If compensation is paid for a project impact, the payment will be included in the cost component of the benefit-cost analysis and, consequently, should not be counted again. If compensation is not paid, then the effects should be considered in one of the categories of the environmental overview.

Compensated Effects—Highway agencies compensate the owners of private property (including land, structures, and improvements) acquired for highway investments and pay for costs associated with relocation. Thus, for an environmental overview, it is not necessary to describe such specific effects as business structures and residential units removed because they are already included as right-of-way costs. Details concerning the property taken and relocations can be included as supporting information for the benefit-cost analysis, however. The risk of overemphasizing these effects by counting them twice is especially great because they appear to be both dollar costs and "real" losses in structures and residences.

Uncompensated Effects—Many of the uncompensated effects described below have the potential to become compensated because, if they represent acute problems, a highway agency will have to take steps to minimize them. The costs of these steps are included in the benefit-cost calculation.

Uncompensated effects on people or property should be considered in the environmental overview. Several categories of effects are discussed so that it can be shown which impacts are included in benefit-cost analysis and which should be treated in the environmental overview. Three types of impacts are analyzed.

1. For highway users, the construction process can result in increased operating costs, reduced comfort and convenience, and additional trip time arising from construction delays and detours. Usually, these effects are negligible when compared with total benefits and costs from a project and, consequently, are ignored. If they are counted, they are included in the benefit-cost calculation and need not be considered separately. There are also costs that drivers impose on each other related to congestion, air and noise pollution, and visual disamenities. These are assumed to be either related to comfort and convenience or treated explicitly when air, noise, and visual pollution are evaluated.
2. Non-road users are sometimes affected by the presence of men and equipment used in the construction process. Noise, dirt, and unsightly machinery and materials are among the potential adverse effects on nonusers. Also, though a home is not physically altered by highway construction, the homeowner might consider himself worse off if a highway now passes near his doorstep. Such losses are not compensated and represent costs (or gains if one prefers the situation with the new highway) for which one is paid (or pays) nothing. Generally, these effects are also small when compared with the total impact of the project. Consequently, there is justification for treating these effects as negligible or, if the effects are substantial, for including them in the environmental overview either as a community impact or as an effect on the quality of the environment.

3. Some highway projects disrupt the environment in ways that ultimately affect common property. There are impacts on natural resources and environmental quality such as air, soil, water, vegetation, and wildlife and on the items included in the leisure and recreation category such as parks, open space, and historical sites and monuments. In most cases, the effects are considered to be negative, but it is possible that monuments and historical sites can be made accessible, parks can be created, or undesirable species can be eliminated. In either case, the effects should be considered in the environmental overview.

A review of the compensated and uncompensated developmental effects reveals that the environmental overview is concerned only with impacts on nonusers. When efforts are made to minimize these impacts, the costs of these efforts become part of the benefit-cost analysis. In such cases, descriptions of these effects should serve only as supporting information in benefit-cost analysis rather than as components of the environmental overview.

Operational Effects

The most important effect of a highway project is that for which it is intended: enabling the highway user to move himself and his goods faster, cheaper, safer, and more comfortably and conveniently. Of course, there are other effects related to highway use that accrue to nonusers both within and outside the corridor.

Proper evaluation of the effects on users and nonusers requires that the analyst distinguish between diverted and generated traffic. Although the causes of diverted and generated traffic may be the same, the evaluations of the two sources of traffic as impacts of the highway improvement should be very different. When traffic is diverted, the effects of that traffic are diverted too. Thus, an appropriate evaluation of the consequences of a highway improvement includes the changes in effects on the roads from which the traffic is diverted, as well as the effects of the diverted traffic on the improved highway.

It should be noted that the offsetting effects on the highways from which traffic is diverted frequently go unnoticed. Traffic that is diverted to the improved highway tends to come from several highways in the system; thus, traffic reductions are dispersed over many roads and the traffic increase is concentrated on the improved road. Also, traffic reductions on the rest of the highway system may actually never be apparent if they are offset by normal traffic growth.

User Effects—Highway projects benefit users primarily by (a) reducing vehicle operating costs, (b) reducing travel time, (c) reducing the frequency and severity of traffic accidents, and (d) increasing the comfort and convenience of traveling. Standard benefit-cost analyses usually include estimates of a and b and sometimes c. Increased comfort and convenience and some elements of improved driver safety, however, have not yet been adequately measured. Eventually, perhaps, values can be assigned to these factors, and they can be incorporated into benefit-cost analysis. Until then, road-user benefit-cost measures will continue to be imperfect.

Nonuser Effects—Highway investments typically increase traffic flows, which, in turn, have effects on nonusers both in the proximity of the corridor and in other areas. These impacts are felt specifically by those owning property and those living or operating businesses in the affected areas and generally by the entire regional population.

Highway improvements and the consequent user benefits often create conditions that are conducive to more economic activity in the area of the project. However, as was pointed out earlier, much of the apparent increase in activity may simply be diverted along with the traffic from other areas in the network or may represent a result of road-user savings already included in benefit-cost analysis.

There is no a priori reason to expect a net gain or loss for the land component of property values or in the tax base. In contrast, the value of structures in the aggregate might be expected to decline in response to highway construction. This is the case when relatively durable and immobile structures become inefficiently located because of the change in the highway network. Eventually, perhaps, gains and losses in the value of structures can be treated in an expanded benefit-cost framework, especially

inasmuch as they are measurable in dollar terms. Until then, these results of highway improvements should be included as economic effects in the environmental overview.

Most highway construction projects cause or at least permit some negative environmental effects in the operational stage, although their net effect is probably smaller than expected. The primary reason for the overstatement of adverse air, noise, or visual effects is that much of the observed traffic on the improved facility is diverted from other highways and the effects of the traffic are diverted along with it. For example, polluted air along the improved corridor may be offset by cleaner air along other highways in the system.

Of course, any additional traffic on the entire highway system caused by the highway improvement will tend to accelerate the deterioration of the physical environment. The relevant question is not how much environmental damage appears on the improved highway, but how much of the damage would not have occurred anywhere on the highway system in the absence of the improvement.

As a result of their construction, improvement, and use, highways affect the structure and activities of neighborhoods and communities. If there is generated traffic, the net impact will be greater. Also, there can be important effects from traffic diversion from less populated to more populated areas or from areas without structured neighborhoods to organized communities. Although the traffic still carries its effects with it, more people may be exposed to them.

Community effects are not likely to be great for the majority of projects that involve only grading and paving or widening of existing roads. New highways, on the other hand, can be expected to have consequences for public services, school districts, and community interaction. Because these impacts are not included in benefit-cost analysis, they should be evaluated as community impacts in the environmental overview.

Some projects, usually new construction, act as catalysts in tapping an area's development potential, providing economies of scale, or causing unemployed resources to be used. Whereas many of the observed benefits to an "opened-up" area are either relocated activities or are included in the benefit-cost analysis, the net effects from such investments should be noted. With this type of effect, especially, care must be taken to avoid double-counting. These effects should only be counted when it is clear that they are entirely dependent on the new highway.

Opening-up effects may not be so important now or in the future as they were in the past. When areas are penetrated by new highway construction, the new project is less likely to be a better investment than an alternative use of funds, assuming that the best opening-up project presumably would have been chosen previously. In these cases, the movement of raw materials, goods, and services will be facilitated, but the increased mobility and its related benefits are merely experienced in one area rather than in another where the alternative investment would have been undertaken.

Summary of Developmental and Operational Effects

Many publications that address impacts of highway construction compile long lists of project effects. Frequently, these listings include practically everything that happens in the immediate area of the project, whether or not the impacts can be traced to the project, and ignore effects resulting from the project but not taking place in the corridor. Furthermore, in the attempt to be comprehensive, overcounting of effects is common.

A typical collection of effects and items to which effects are related is given in Table 1. By way of a summary, these variables are classified according to how they fit the organizational framework just discussed.

RATING AND WEIGHTING PROJECT EFFECTS

The organizational scheme just outlined provides a systematic framework within which local governments can review highway project impacts. Although the effects expressed in dollars are relatively easy to understand, many of the SEEF included in the environmental overview are subject to a number of interpretations. When local governments generate priorities based on these data, it is convenient for them to have at their disposal some means of rating (estimating the magnitude of the impacts) and weighting

(evaluating their importance) project effects (5, 6, 7). A general approach to weighting and rating is suggested below.

Assigning Weights to Project Effects

Although it is nearly impossible to assign weights to a heterogeneous collection of project effects, such weights are assigned implicitly and often unsystematically whenever projects are recommended. If weights are not explicit, then the decision-making rationale is not clear. Consequently, either decision-makers tend to impute their personal preferences, or technicians usurp the role of decision-makers by assigning their own values.

Two weighting processes are recommended: The relative importance of categories in the environmental overview should be established, and user benefits, as expressed in the benefit-cost ratio, should be compared with the nonuser effects summarized in the environmental overview.

A simple procedure for establishing the relative importance of categories in the environmental overview is to allocate 100 points to each member of a citizen committee, for example, and have them assign these points according to their perceptions. Once each member "votes," the numbers can be averaged and the results discussed. The discussion will very likely affect a second round of voting. The averages from the second round could be accepted as representing the valuations of each class of effects, or more rounds could be undertaken before the final averages are accepted. Table 2 gives a hypothetical result of the process.

A similar procedure could be followed to determine the relative importance of user benefits shown in benefit-cost analysis and nonuser effects shown in the environmental overview. Assuming that an allocation such as 40:60 resulted, the 60 points could be assigned to the weighted categories from Table 2 as given in Table 3.

The result would be weights that represent the collective preferences of the group. Whereas experience in applying the weighting scheme would likely lead to modifications, establishing some weights tends to confine discussions concerning project priorities within reasonable bounds.

Rating Project Effects

Because a common denominator such as dollars cannot be assigned to all project effects, the use of a relative scale appears to be the most practical approach to the rating process. For example, a scale of -3 to +3 could be used to express the estimated magnitude of each category of effects (Table 4).

Even with limited experience, both the benefit-cost analysis and the categories of the environmental overview could be assigned a heavy, moderate, slight, or negligible rating for each project, within bounds of accuracy required for the recommendation process. The values corresponding to the general ratings can be multiplied by the weights for the categories as previously determined, and a total could be assigned to each project (Table 5). There are some conceptual problems in establishing rating scales for all factors. This is certainly true with respect to benefit-cost analysis and other factors in which the relationship between estimated or measured results and the rating might not be linear. Generally, however, at this stage in project evaluation assumed linearity is not a big problem. For purposes of the example, it is assumed that a benefit-cost ratio of 1.3 is equivalent to a rating of +1.

In Table 5, the negative nonuser effects outweigh the benefit-cost ratio of 1.3 and the positive impact on leisure and recreation, and the project receives a score of -8. If all projects under consideration are subjected to the same procedure, they can be ranked according to their scores.

Although the ranking process can be very useful to local governments, it should not be expected that projects could be selected directly from the rankings. There are several reasons for this. First, the procedure is probably not accurate enough to distinguish between projects that have very close total scores. Because the scores are products of several processes, all of which have some degree of error, the final numbers are accurate only within a given range. It should be possible, however, to conclude

Table 1. Proposed treatment of effects of highway improvements.

Type of Effect	Impact	Effect	Proposed Treatment
Developmental	Disruptions during construction	On users	Benefit-cost analysis
		On nonusers	Evaluated in environmental overview as natural resource effect or community impact
	Acres taken, buildings taken, jobs lost or relocated	Compensated	Benefit-cost analysis
	Structures affected but not taken	Uncompensated	Evaluated in environmental overview as community effect if residential and economic effect if business
	Earth and erosion, fish and wild life, vegetation, parks and space, monuments and historical sites	Compensated and uncompensated	Supporting information in benefit-cost analysis if compensated; natural resource or leisure and recreation categories of environmental overview if uncompensated
Operational	Driving time, operating cost, accident reduction	User benefits	Benefit-cost analysis
	Safety, comfort and convenience	User benefits	Not yet valued in benefit-cost analysis
	Noise and air pollution	User and nonuser effects caused by users	Evaluated in environmental overview as natural resource effects
	Congestion	User effects caused by users	Benefit-cost analysis or not yet valued in benefit-cost analysis
	Commercial: agricultural, industrial, sales, taxes, employment, property values	Usually transferred and relocated effects	Results of effects treated in benefit-cost analysis; should not be evaluated in environmental overview; if net impacts, then treated below as "opening-up" effects
	Community: neighborhood changes, schools, churches, public services	Some net effects but often transferred and relocated	Net effects only; included in the environmental overview as community impacts
	Opening up: developmental potential, unemployed resources, effects of construction expenditures	Net economic effects if clearly an addition to economic activity	Evaluated as economic effects in environmental overview

Table 2. Hypothetical results of assigning weights to project effects.

	Citizen				
Category	No. 1	No. 2	No. 3	No. 4	Average
Natural resources and quality of the environment	35	30	50	45	40
Community impacts	20	25	20	35	25
Leisure and recreation	10	20	5	5	10
Economic effects	35	25	25	15	25

Table 3. Assigning weights to environmental overview categories.

Category	Value[a]	Weight (value × 0.60)
Natural resources and quality of the environment	40	24
Community impacts	25	15
Leisure and recreation	10	6
Economic effects	25	15

[a]Value from Table 2.

Table 4. Relative scale for rating project effects.

Magnitude	Value	
Heavy	+3	Favorable
Moderate	+2	
Slight	+1	
Negligible	0	
Slight	-1	Unfavorable
Moderate	-2	
Heavy	-3	

Table 5. Sample scoring of a project.

Effects	Description of Effects	Weight	Rating	Score (weight × rating)
Benefit-cost analysis	1.3	40	+1	40
Natural resources and environment	-Slight	24	-1	-24
Community impacts	-Moderate	15	-2	-30
Leisure and recreation	+Slight	6	+1	6
Economic effects	Negligible	15	0	0
Total				-8

that projects in the 75 to 80 range are better than those in the 50 to 55 range.

Second, there may be special circumstances that suggest that a project is better or worse than its score. Each project with extenuating circumstances should be supplemented by remarks indicating their importance. For example, if there are severe environmental problems that are not expressed adequately by a -3 rating, it may be decided to defer a project with a high score. Alternatively, a project that would significantly reduce fatalities at a dangerous interchange may have a low benefit-cost ratio (given existing imperfections in the measurement of accident costs) and a negligible environmental impact—resulting in a score near zero—but still be considered desirable.

Finally, funding requirements may cause a change in the ranking. For example, it might be considered desirable to substitute a project for which a greater share of federal funds can be used for one with a higher ranking that receives a higher proportion of state funds. Similarly, it may be possible only to maintain a given section requiring major reconstruction until federal funding is available.

Although considerable work remains to be done to gain a commitment on the environmental overview concept and on rating and weighting techniques, the approach offers an opportunity to enhance local government project recommendation procedures to keep up with the demands of federal and state legislation. Whether the discussion in this paper is used as a basis for project recommendations or as a point of departure for the development of a local government project evaluation framework, some efforts in this direction could be valuable. The framework presented or a similar approach would help to (a) systematize the consideration of SEEF, (b) advance the time in the selection process at which important project effects are considered, and (c) increase the opportunity for local groups to express their preferences and their evaluations of project impacts.

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DISCUSSION

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This paper presents some new wine in old bottles and some old wine in new bottles. While I disagree with some of the authors' concepts about the shifting or relocating of environmental impacts, I do find the work to be informative and timely. It presents tools to aid local governments in reaching more viable decisions relative to highway programs. This is especially useful because the tools suggested are rather elementary and relatively easy to use, and these characteristics take on increasing importance in these days of scarce money. The particular relevance of this paper is made increas-

ingly so because of the surge of new regulations relevant to the highway programs such as the National Environmental Policy Act and the inclusion of environmental requirements in federal highway legislation. It discusses economically related environmental considerations for both user and nonuser in easily understood language.

In summary this is a useful, nuts and bolts, how-to-do-it paper that should prove useful not only to local governments, but to other levels of government as well.