HIGHWAY RESEARCH RECORD

Number 410

Use of Economic, Social, and Environmental Indicators in Transportation Planning

7 reports
prepared for the
51st Annual Meeting

Subject Areas

15	Transportation Economics
24	Roadside Development
82	Urban Community Values
84	Urban Transportation Systems

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FOREWORD

The papers in this RECORD deal with the use of economic, social, and environmental indicators in transportation planning. In different ways, the authors describe their approach to trading off benefits and disadvantages of transportation systems.

The paper by Bouchard, Lehr, Redding, and Thomas suggests ways of analyzing costs and disadvantages during transportation systems planning, corridor planning, design, construction, and operation. The authors emphasize that to minimize harmful effects, to use beneficial effects fully, and, in short, to protect the environment require that community values be considered during the right phase of transportation planning. This will help ensure the right depth and detail in the consideration.

The paper by Ryan, Nedwek, and Beimborn describes ways of identifying highway effects on different groups, how these groups perceive these effects, and ways of offsetting benefits and disadvantages of different groups. The paper also describes the way different groups perceive the need for a particular highway project, for highways in general, and for other public services. This includes consideration of neighborhood disadvantages near the highway and advantages accruing to a larger group, especially highway users, outside the immediate area.

The paper authored by Lee, Covault, and Willeke suggests that the benefits and disadvantages of such matters as curtailing bus service can be analyzed with the help of social indicators. They apply the approach to a real situation by weighing the disadvantage of curtailed service for some bus riders against the benefit of decreased vandalism on buses.

Goldberg's paper weighs the gains and costs of advance right-of-way acquisition and excess acquisition. The economic costs exceed the benefits, he suggests, although advance and excess acquisitions may be fully justified on other grounds.

The paper by Hornbeck and Okerlund describes ways of enhancing benefits for highway users in the form of pleasant views and safety. Costs to highway users or disadvantages to nonusers are outside the consideration of the paper. However, some of the authors' recommendations, e.g., fencing to screen certain views, may provide some benefits for communities near the roadway as well as for highway users.

The abridgment by Redding and Peterson involves preferences for neighborhood services. For example, the authors show that married couples with children might prefer to have a park and playground about three blocks away and a shopping center six blocks away rather than having the park and playground about six blocks away and the shopping center three blocks away.

The final paper, by Vollmer, is a philosophical discussion of aesthetics and its relation to highways. A highway has gone from an aesthetically pleasing slender ribbon with sinuous beauty to an insensitively conceived design that acts as a blight on the cityscape. Part of the problem appears to be that bigness seems to exclude the possibility of beauty. Vollmer suggests that our best hope to make highways aesthetically pleasing is to bring them back to manageable proportions.

—Floyd I. Thiel

TECHNIQUES FOR CONSIDERING SOCIAL, ECONOMIC, AND ENVIRONMENTAL FACTORS IN PLANNING TRANSPORTATION SYSTEMS

Richard J. Bouchard, Eugene L. Lehr, Martin J. Redding, and Garold R. Thomas,
U. S. Department of Transportation

An urban planning matrix has been developed as a tool to assist in the comprehensive transportation planning process. It provides a framework for systematically examining at the several stages of planning, design, construction, and operation the interrelationships of community values and modes of transportation. Eleven categories of impacts that affect community quality have been incorporated into the matrix. They are noise, air quality, water quality, resource conservation, ecological factors, transportation factors, aesthetics and visual factors, economic factors, sociopolitical factors, land use, and historical and cultural factors. The present state of the art of techniques dealing with each of the potential impacts during the transportation planning process is briefly discussed. Particular attention is given to assessment of the applicability and relative importance of current information, and a rationale is given for estimating the degree of impact. Potential trade-offs between adverse effects and beneficial impacts are discussed, and a tentative scheme for evaluation is proposed. Stress is placed on the importance of understanding what effects decisions made at one phase will exert on other phases. The completed project will serve two purposes: provide an integrated set of guides for planners and decision-makers and provide an analysis to identify areas where further research is needed to supplement existing knowledge of community values affected by transportation systems.

•IN THE FALL of 1970, the Highway Research Board Committee on Social, Economic and Environmental Factors of Transportation formed a task force to identify community values. The material discussed in this paper represents, to some degree, the work of this task force in combination with some of the results of research undertaken within the Office of the Assistant Secretary for Environment and Urban Systems, Department of Transportation.

The purpose of the task force was to identify needed research in procedures and techniques to identify community values. Very early in the task force discussion, the following points became abundantly clear:

1. Statements of community values are unidentifiable in any usable form, except within the framework of project development. In addition, the community itself has several components, each of which has its own set of values, and even these values change over time or some other less identifiable unit.
2. Techniques to identify community values must be composed of some elements such as (a) technical analysis, either quantifiable or nonquantifiable, that enables the technician to deal with the factor; (b) a community participation element that permits the technical analysis to be modified by real-world conditions; and (c) a trade-off framework, involving both of these, that permits the ranking of one community value with another.

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Within this framework, the task force initiated the development of a two-phased repo that documents the current state of the art in techniques for determining community values and that outlines needed research in this area. This effort is nearing completio

Concurrently, the Department of Transportation had under way several research efforts both with its own staff and through consultants (Arthur D. Little, Inc.; Real Esta Research Corporation; Ed Devine; AIP; Applied Decision Systems, Inc.; CLM Systems, Inc.; University of Pennsylvania) to develop ways to modify the current transportation planning process to be more responsive to community values and environmental issues During the course of this work several things became clear. Currently, most critical decisions regarding transportation are made at the project stage, whereas the systems planning phase is pretty much of an academic exercise. We saw the need to strengthen the relevance of the system planning stage and to introduce, between system and projec planning, a new phase called corridor planning, which was emerging in some quarters through the "design team" appraoch.

Also, there was a need to clearly distinguish the precise job of each phase of the planning process, particularly in regard to the role of the elected official, the professional, and the citizen in each phase. There was a need to more closely tie one phase with another, both to conceive a better system of checks and balances between broad and narrow goals and to attempt to close the long lead time now existing between projec conception and actual construction.

PLANNING PROCESS

The three-dimensional matrix shown in Figure 1 distinguishes among the phases of transportation decision-making. Clearly, the critical phases are system planning, corridor planning, project planning, project construction, and project operation. For the purposes of this discussion, these phases are described in the following sections.

System Planning

System planning is basically the traditional comprehensive, coordinated, continuing transportation planning process but with reduced emphasis on land use and traffic modeling and increased emphasis on items that reflect community values. This chang in emphasis is necessary because a 25- or 30-year horizon for planning on a regional scale neither warrants nor requires the detailed attention and expenditure that is now made in traffic and land use analysis.

Directions of growth and orders of magnitude of traffic are all that are required at this stage of the planning process. However, at the same time, this phase should be doing more to identify the current state of affairs in the region from two points of view the constraints to transportation development, particularly an identification or map of "untouchables," and the opportunities for transportation projects to serve as a catalyst for solving other problems in the area, such as noise, housing, recreation, and redevelopment.

In summary, the system planning phase should be concerned with setting regional priorities for large-scale transportation improvements and for pointing out the limits, both restrictions and opporutnities, to which further studies must conform. This phas shall be largely oriented toward public officials with technical detail held to a minimum. Citizen participation in this phase should be largely devoted to general meetings and to discussions with region-wide special-interest groups and political leaders focusing on regional development goals.

Corridor Planning

The corridor phase is basically the most important phase of the entire planning pro cess. This is where all of the substantive and detailed analyses take place, the deals are made, the full design team is active, and citizen participation covers the full gamut of involvement.

Project Planning

This is basically the design phase and is largely as it is today, except that engineers and designers are freed to do their thing, inasmuch as the decisions involving citizen participation have been made in the earlier phases.

Construction and Operation Phases

In each of these phases, critical choices that affect community values are made, and therefore each phase must in some way consider community values in decision-making. The key to successful planning is to consider these values at the proper scale in each phase, to involve the proper people in these considerations, to ensure that the decisions made in one phase generate a quick action in the next phases, and to ensure that the process is capable of rapid recycling in response to unexpected developments in later phases.

FACTORS INFLUENCING DECISION-MAKING

The second axis of the matrix has to be one that includes all of the factors that must be considered in decision-making. For the purposes of this discussion, 11 broad factors are identified. These are noise, air quality, water quality, ecological factors, resource conservation, transportation service, aesthetic and visual factors, economic factors, sociopolitical factors, land use, and historical and cultural factors.

Definitions and descriptions of these factors are clearly spelled out in many literature sources, which need not be repeated here. However, each factor must be examined in each of the five phases of the planning process. The depth of examination, who does the examining, and the techniques that are used differ significantly among the phases. Table 1 gives some of the factors to be considered. The third axis of the matrix illustrates the levels of evaluation.

On the third axis, the need for clearly, adequately, and explicitly describing the factors subject to analysis has been identified. Of all of the elements of the matrix, those of this description ladder are the least clear at this point in the state of the art. However, the following seems called for, as a minimum: identification, quantification or qualification of the amount, quantification or qualification of the effect, determination of the value, ranking for trade-off analysis, and a final check.

Identification of the limitations and opportunities offered for fulfilling the transportation needs of the region within the context of other environmental and social demands should be initially accomplished in the system planning phase as the basis for the development of specific regional goals to guide more detailed planning in subsequent phases. Quantification and qualification of both amounts and effect, to any significant degree, should be done in the corridor phase. Then the relative values of these factors should be determined and the trade-off analysis performed. Although many checks and several iterations are likely over all of the phases, the final checks really occur in the project planning phase as the designs for implementation are detailed. These implementation designs may take many forms such as policy formulation, legislation, organizational or institutional changes, or, of course, construction plans.

The purpose of this matrix is to provide a manageable and complete framework that recognizes community values in all phases of planning and provides for a proper level of recognition depending on the phase. Three factors in the matrix are briefly discussed in the following paragraphs to illustrate the application of the concept described by the matrix.

Noise

At the system level, detailed examinations of noise are unwarranted. However, to neglect this factor at this stage is also unwarranted and perhaps even unwise.

So, at the system level, one must identify noise as an element for analysis but what type of analysis? In view of the earlier discussion about the purpose of the systems phase, it seems clear that such an analysis should include the following:

Figure 1. Community value impact matrix.

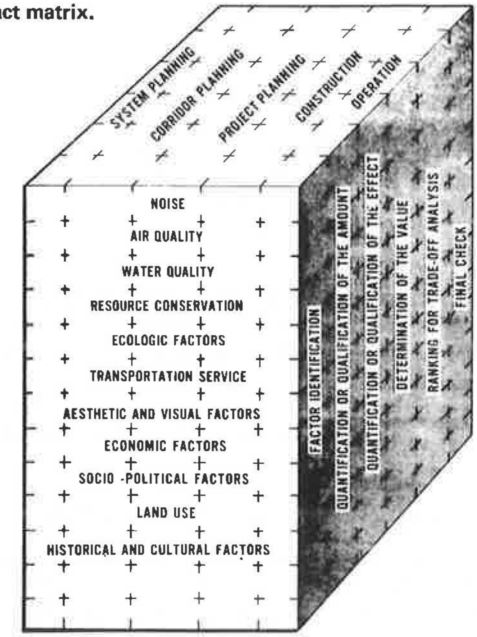

Table 1. Potential environmental impacts of transportation system by phase in which impact would occur.

	Phase				
Impact Factor	System Planning	Corridor Planning	Project Planning	Construction	Operat
Noise					
Public health				QV	QV
Land use				Q	Q
Air quality					
Public health				QV	QV
Land use				QV	QV
Water quality					
Groundwater				Q	Q
Surface water				Q	Q
Quality aspects				QV	QV
Natural resource conservation					
Soils				Q	Q
Water				Q	Q
Minerals				Q	Q
Ecosystem balance				QV	QV
Ecologic					
Flora				QV	QV
Fauna				QV	QV
Transportation services					
Accessibility					Q
Flexibility					Q
Total benefits and costs					Q
Aesthetic and visual impacts				V	V
Economic					
Land values	Q	Q	Q	Q	Q
Tax base	Q	Q	Q	Q	Q
Employment	Q	Q	Q	Q	Q
Housing and public services		Q	Q	Q	Q
Business		Q	Q	Q	Q
Income		Q	Q	Q	Q
Sociopolitical					
Life style and activities	QV	QV	QV	QV	QV
Perception of cost-benefit by groups	V	V	V	V	V
Personal safety				QV	QV
Effect on government	V	V	V	V	V
Land use					
Changes in density	Q	Q	Q	Q	Q
Changes in usage	Q	Q	Q	Q	Q
Changes in activity	Q	Q	Q	Q	Q
Historical and cultural				Q	Q

Note: Q = quantifiable; V = nonquantifiable; QV = quantitative measure may be made or estimated but determination o effect is not readily quantifiable or, conversely, the effect may be accepted and evident but not reasonably quantifiable.

1. The preparation and mapping, from field surveys, of generalized regional noise contours;
2. The identification and mapping of special areas throughout the region that may require, because of their use, that they be viewed as constraints on future transportation project locations, from a noise level standpoint (such areas might include hospitals, schools, parks, and others serving special purposes);
3. The identification and mapping of areas in the region that now have unduly high noise levels and that represent opportunities for noise reduction by separating the noise sources from those who hear the noise (such areas might be airports, noisy factories, and railroad stations), and it is possible that the proper location of transportation projects might assist in reducing these problems, if they are identified early enough; and
4. The preparation of a "scope of work" for noise analysis in the corridor phase of planning, which would indicate the current legal noise standards in effect at the national, state, and local levels (also includes the identification of currently available and validated technical procedures and techniques for detailed noise analysis and listing of groups, which might be helpful in further examination of noise problems).

In this analysis, full use should be made of noise specialists, and maps, charts, and other products of analysis should be subjected to critical comment by environmental and other groups throughout the area. The main point here is that noise is viewed only generally at the system scale but in a manner that raises both positive and negative flags for further investigation as planning proceeds to the next phases and that brings noise specialists into the process very early.

At the corridor phase, noise analysis is more detailed and explicit in quantifying and qualifying the amount, effects, and relative value or disvalue of noise in the examination of alternative plans. This analysis must include the following:

1. Determination and mapping, from detailed field surveys, of precise noise contours with a reasonable degree of precision for the corridor;
2. Use of existing modeling techniques to forecast and compare anticipated noise levels or contours of alternative transportation and associated development plans for the corridor;
3. Specific recommendations during the project planning phase for minimizing noise impact through judicious joint development design, use of all possible noise buffers in transportation design, and policies for controlling development to ensure future noise compatibility; and
4. The full exposure and discussion of all of the noise implications of each alternative with neighborhood, political, and special-interest groups in conjunction with the fair evaluation of reasonable alternatives suggested by these citizen groups (this element is essential in the corridor phase).

There are sufficient techniques and a sufficient supply of technical expertise to adequately accomplish these required analyses.

In the project planning phase, great care must be exercised to ensure that the analyses of noise, done in the corridor phase, are properly reflected in development of facility designs and that the importance of this factor is not forgotten. In addition, each design must be subjected to a review by the noise experts again, as a final check. Finally, the project planning phase must outline the standards and guides for construction and operation so that during these phases proper care is exercised to minimize noise impact.

During the construction and operation phases, inspectors must be charged and trained to monitor and enforce the guidelines developed in earlier phases of the planning process and in a more general sense by federal, state, and local units of government.

Aesthetic and Visual Factors

"Beauty is in the eye of the beholder" is a statement sometimes used to express the frustration involved in considering aesthetics, particularly in the planning of functional projects. However, beginning in the system planning phase, there are some steps that can be taken to preserve, enhance, and provide for visual harmony with natural and man-made features of the area. These steps should, at least, include the following:

1. Landmarks, particularly attractive structures or building complexes, unique natural features, and uniquely pleasing vistas should be identified and mapped with the use of all reasonable sources including citizen input;
2. The identified features should be classified by their national, state, regional, local, or neighborhood importance; and
3. Criteria for future project development in these areas should be developed and might include elements such as limitations on cut and fill operations, requirements for "clear-view" space, limitations on height or depth, specification of types of finishing materials to be used on structures, requirements for special reviews of architectural renderings of structural alternatives, requirements for total avoidance or setbacks from designated features, special construction controls on hours of operation, staging of project elements, or equipment storage during non-working hours, and special provisions for landscaping or screening of the project.

In this analysis, individuals with local and regional recognition for their concern with the attractiveness of the area should be utilized in conjunction with architects, environmentalists, artists, and other professionals who deal daily with aesthetics and visual acceptability. Essentially all elements of this analysis are judgmental in nature. However, if the potential problem areas are identified here, they can be dealt with much more effectively in subsequent phases of the planning process.

Building on the work of the systems planning phase, aesthetics can be more specifically addressed in the corridor planning phase. Here, the following should occur:

1. Areas where conflicts with transportation alternatives are evident should be described in detail by mapping, aerial or other photography, or artists' renderings;
2. Artistic renderings of specific design alternatives for each facility alternative should frequently be used to identify the potential visual impacts that may be anticipated (in some cases, it will be necessary to use models for this purpose);
3. Open, frank meetings with neighborhood groups, political officials, and organized special-interest groups must be conducted to obtain citizen reaction to the alternatives as a means of weighing their "community value" and to receive citizen input concerning other alternatives or the refinement of those presented (in support of these efforts, a consistent information dissemination program is essential); and
4. Based on the evaluation of the schematics, specific recommendations should be made for the project planning phase to produce the most pleasing blend of the project with its setting (these recommendations may include materials, shape, general dimensions, elevation, or any one of a whole array of potential joint development designs).

Project planning should be monitored to ensure that the concerns and criteria evolved in the earlier stages of the planning process are reflected in the construction plans for the process. In addition, the project planning phase may find it necessary to provide guidelines for construction and maintenance during operation to ensure that the aesthetic factors built into the design are not encroached on or destroyed in these phases.

Careful inspection, good maintenance, and strict enforcement of good construction and operating procedures must be exercised in the construction and operation phases if the total aesthetic objectives of prior planning are to become a reality.

Sociopolitical Factors

There are basically two categories of sociopolitical factors that must be considered throughout the planning process. These are (a) the existing realities of social attitude, public policy, institutional structures, legal requirements, and key personalities that form the environment of the planning process itself, and (b) those elements of attitude, policy, and the like that bear more directly on the geographical area being planned or on the projects to be evolved from the planning process rather than on the conduct of the process.

Acknowledging these constraints and opportunities is one of the first steps in system planning, which should incorporate sociopolitical factors in the planning process. It is in the system planning phase that the involvement of individuals (especially elected officials), organizations, and agencies with a broadly based and genuine regional interest in the health, welfare, and development of the area or major elements thereof is identified, selected, and solicited. All reasonable efforts should be made to maintain the continuous high interest and involvement of these participants and to add to or delete from the group as conditions warrant.

Also in this phase, federal, state, and local policies are documented, including plans, regulations, laws, and programs that may have a bearing on the planning process and the various alternatives that it may evaluate. They should be kept available for a ready reference for all participants in the process. An information dissemination system should be designed and initiated to keep the direct participants, the media, and the general public fully informed of the progress, problems, and the pros and cons involved in making each major decision on alternatives as they are considered.

Maps, photographs, and charts should be used to identify, by major subarea, housing availability and conditions; coherent neighborhoods; locations of coherent racial, ethnic, or religious enclaves; high crime areas; high accident areas; utility districts, school districts, and other political divisions of the area; and unique community features serving educational, recreational, religious, and other community needs.

Also, citizen participants, the information system, and information accumulated concerning the more physically identifiable environmental factors should be effectively used to frame the goals to guide the more detailed activities of later planning phases. A "scope of work" that highlights significant sociopolitical factors to receive particular attention in corridor planning should be developed, and an appropriate corridor-level citizen participating mechanism or process should be designed.

The transition from systems planning to corridor planning with respect to political and social factors must be particularly smooth if the necessary citizen and political interests are to be maintained in a positive sense. Intuitively, this smooth transition would best be accomplished if the corridor planning phase concentrates on the following sociopolitical factors for each land use-transportation alternative considered:

1. There should be open and careful documentation and identification of who gains, who loses, and how, with respect to key factors with which individual, interest groups, and political participants can identify. Items such as relocation of homes and businesses, division of neighborhoods, changes in property access, and removal of trees should be identified, quantified, and fully considered. This is where the trade-offs must openly be made if the final decisions are to be accepted.
2. Attitude surveys or similar tools should be used to supplement the community value rankings and judgments articulated and perceived in the meeting atmosphere of the more formal participatory process.
3. A list of dos and don'ts should be produced for subsequent phases of project planning, construction, and operations.

As with the other factors discussed, adequate monitoring and enforcement techniques must be employed in the project planning, construction, and operation phases to ensure that the conditions specified in earlier phases are met.

SUMMARY

Although the techniques in this paper are relatively general, conceptual, and exemplary in form, the authors feel that they represent a significant step forward in the state of the art with respect to understanding how to incorporate social and environmental factors into the planning process in a pragmatic way.

AN EVALUATION OF THE FEASIBILITY OF SOCIAL DIAGNOSTIC TECHNIQUES IN THE TRANSPORTATION PLANNING PROCESS

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Edward A. Beimborn, University of Wisconsin—Milwaukee

An examination is made of the feasibility of using social diagnostic techniques in the transportation planning process. This was done through a survey of values and views of residents located within the general area of the corridor of the northern extension of the Stadium Freeway in Milwaukee. A questionnaire was prepared by a team of engineers and social scientists at the University of Wisconsin—Milwaukee. Results of the survey are presented relative to demographic characteristics, attitudes toward transportation services, attitudes toward nontransportation services, and analysis of freeway support and opposition to the freeway project. Conclusions of the research are such that techniques appear to be feasible and can provide valuable information for the development of transportation plans.

•THROUGHOUT the nation, we have seen in many areas a series of seemingly endless controversies over the form or shape of transportation systems to be developed within individual communities. The time-proven process of citizen representation by elected officials appears to be unable to cope with satisfying the desires and needs of local citizens in the implementation of very broad transportation plans. Stormy public hearings, protest marches, petitions, and angry confrontations seem to have become a regular part of the transportation design and decision-making process.

This phenomenon seems to be truest in large metropolitan areas where the principle means of communication is through news media. It is difficult to obtain a true sense of opinion. Even a relatively small segment of the population may in fact involve tens of thousands of people, and an individual freeway project may require the placement of thousands of homes. It may be impossible for the local decision-makers to assess adequately the opinions of the community on every subject affecting them. If the officials are to be responsive to the needs and desires of the people they serve, certainly such information is vital. The fact that the views and desires of the local citizens who will be affected by the proposed project should be taken into account is well recognized. However, the process of determining what these values and views are has been most difficult. Frequently they conflict, and those who talk the loudest are most often the only ones who are heard. It is apparent that new mechanisms for determining these views are needed.

This paper will discuss a research project that was aimed at dealing with some of the difficulties cited. The project was concerned with an evaluation of the feasibility of using social diagnostic techniques in the highway location process as a means of measuring and translating citizens' views and values into terms usable in planning highway facilities. A series of interviews was conducted with persons affected by the northern extension of the Stadium Freeway (NESF) in Milwaukee County to gain a fuller

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understanding of the views and values that these individuals held. A questionnaire was developed and analyzed by a team of engineers and social scientists from the University of Wisconsin—Milwaukee (UWM) and administered by trained interviewers of the Wisconsin Survey Research Laboratory.

The study was in some ways similar to the national study of transportation attitudes and behavior (1) and studies of community values (2, 3); however, it differed in that it focused on a particular transportation project and on those people in the immediate area of the project.

This report will discuss the objectives of the research and the procedures used in the study and will indicate some of the findings of the survey as they relate to the respondents' attitudes toward transportation and other public services and to an analysis of freeway support and opposition. Conclusions are drawn on the general feasibility of social diagnostic techniques in the planning of large transportation projects. This report presents only a very brief summary of the project. Further details may be found in the final report (8).

OBJECTIVES OF THE RESEARCH

The primary objective of the research was to determine the feasibility of using social diagnostic techniques as a means of gathering data for dealing with problems raised by the construction of new highway facilities. Primary emphasis was placed on development of procedures that could be easily implemented by the local agencies concerned with development of highway facilities. Thus, it was considered vital that any procedures developed could easily be used by personnel from these agencies and understood by the citizens involved with the project. The feasibility question was addressed by treating a locally controversial freeway project as a case study wherein the utility of such data could be investigated. Beyond this primary objective, the research also had a series of secondary objectives. These were as follows:

1. To provide information collected in a scientific manner on the views and values held by persons affected by a proposed highway improvement;
2. To provide information that may be useful in determining means of resolving conflicts associated with highway improvements;
3. To provide information that may be used to develop means of more effectively communicating with those residents in project modification and implementation; and
4. To develop methodologies that could be used on studies of a similar nature.

STUDY AREA

The area chosen as a case study for use in this project was the corridor of the NESF in Milwaukee County. This project is in the north-central portion of the city of Milwaukee and is the combination of the completion of the gap in a partially built freeway system and the commencement of an Interstate highway between Milwaukee and Green Bay. This project has progressed through the corridor location stage including the public hearing. The location of the route has been submitted to the Wisconsin Highway Commission for its approval. The location of this highway had generated considerable public discussion and controversy. Approximately 2,000 persons were present at the public hearing on the project, which lasted from 10:00 a.m. until after midnight. Viewpoints were expressed at the public hearing by sponsoring agencies, government officials, local citizens' groups, church organizations, motor clubs, labor unions, and individual citizens. The project has an estimated total cost of approximately $120 million in Milwaukee County and would involve the dislocation of approximately 1,400 households. It will be approximately 10 miles long, and its general location is shown in Figure 1.

PROCEDURE

The study involved development of a questionnaire, administration of the questionnaire, and analysis and evaluation of the test results. The study involved the following steps:

1. Formulation of the social diagnostic team,
2. Establishment of project orientation,
3. Selection of study area,
4. Selection of a sample,
5. Preparation of questionnaire,
6. Pretesting and modification of questionnaire,
7. Collection of data,
8. Analysis and evaluation of data, and
9. Recommendation and interpretations from project.

Each of these steps is discussed in some detail in the following sections.

Formulation of the Social Diagnostic Team

A team of engineers and social scientists was formed to assist in the research project and the analysis. The members of the team were Edward Beimborn, Professor, Department of Systems Design, College of Applied Science and Engineering, UWM; Brian Nedwek, PhD candidate in political science, UWM; Charles Ryan, Chief Maintenance Engineer, District 2, Wisconsin Department of Transportation; Jonathan Slesinger, Professor and Director of Research, School of Social Welfare, UWM; and Edward Wellin, Urban Anthropologist, College of Letters and Science, UWM. They were also assisted by Harry Sharp and Charles Palit of the Wisconsin Survey Research Laboratory. This team was assembled to ensure that the research benefited the viewpoints of persons of different disciplines. The members of the team represented the disciplines of civil engineering, systems analysis, sociology, anthropology, and political science.

Project Orientation

The team was briefed on the project by consulting engineers (Howard, Needles, Tammen and Bergendoff; Engineers, Architects and Planners), who were engaged for the corridor location study. An inital evaluation of the impact area was also made to arrive at tentative population classification in sociological terms. This appraisal was necessary to allow the questionnaire to be made more meaningful and to determine area evaluations. At this point in the research, the most important question was Who? Who will be affected by the new system, and who will be involved in the resolution of project impacts?

Selection of Study Area

The universe consisted of all persons residing in housing units in the area of Milwaukee and Wauwatosa. The boundaries of this area were West Lloyd Street on the south, North 68th Street on the west, Forest Avenue on the north, North 51st Boulevard to West Burleigh on the east, West Burleigh from North 51st Boulevard to North Sherman Boulevard on the north, and North Sherman Boulevard to West Burleigh to West Lloyd Street on the east as shown in Figure 1. The study area is approximately 1 mile wide and 5 miles long. At the point in time that the study was made, the route had been recommended from the public hearing but had not been approved by the highway commission.

Sample Selection

Households were selected in the study area by randomly sampling from the 1970 Milwaukee City Directory and a 2-stage area selected from the portion of the study area not included in the directory. A sample of 550 households was drawn. This represented a sampling rate of approximately one in 37. The sample response rate was 73 percent, resulting in 373 completed interviews.

Questionnaire Preparation

The questionnaire was prepared by the social diagnostic team. Contributions were not structured but were made with little or no restraint on the input. These contributions were combined or modified through the review of the questionnaire by the team. Major contributions to the effort were made by all members, reflecting the insight and background of each. Most of the questions were used in earlier studies or were modified to be somewhat consistent with previous work (1, 4). The questionnaire was reviewed by personnel at the University of Wisconsin Survey Research Laboratory, which has had extensive experience in survey research efforts.

Questionnaire Test Run and Modification

The prepared questionnaire was pretested on a small segment of the proposed test group to evaluate the questionnaire, the techniques used, and the information received. Factors considered in modification were anxiety of interviewees, communications between interviewer and interviewee, data received, estimate of time to completion of survey, and final estimate of cost. The data collected during the pretest are not included in the analysis. The final questionnaire consisted of 195 items and took approximately 1 hour to administer.

Data Collection

The questionnaires were administered by professional interviewers at the direction of the Wisconsin Survey Research Laboratory. The hour-long interviews were administered during the months of December 1970 and January 1971. The opinions of the interviewer on the willingness of the individual to participate in the data collection effort were included.

RESULTS

A sizable amount of information was obtained from the survey, and only a small portion of it will be presented here. The questionnaire was prepared to be a survey of community values and, as such, went beyond transportation issues. The results of the survey are presented in the following four sections:

1. Demographic profile—age, home ownership, length of residence, socioeconomic analysis, automobile ownership, organization involvement, partisanship, and political involvement;
2. Attitudes toward transportation—quality of services, expenditure preference patterns, mode evaluation, mode choice evaluation, and transportation improvements;
3. Attitudes toward nontransportation services—quality of services and expenditure preference patterns for fire, police, air, health, education, welfare, and others (other attitudinal factors included criteria for home selection, political and social trust, and efficacy); and
4. An analysis of freeway support and opposition—approval rates of freeway projects as related to quality of service, expenditure preferences, demographic factors (e.g., distance from freeways), age, and others.

Demographic Profile

The area can be generally described as white (97.8 percent), middle class, and politically democratic, with an average income somewhat above the national average. Nearly half (48 percent) of the respondents were over 50 years of age, and 70 percent had graduated from high school and 11 percent from college. Nearly three-fifths (58 percent) of the respondents owned their homes or were buying them, and 42 percent of them have lived at the same residence for 10 or more years. Eighty-two percent belonged to at least one organization, and 62 percent belonged to a church-connected or labor organization. More than half (57 percent) listed themselves as Democrats or weak Democrats, and 27 percent were Republicans or weak Republicans. The highest reported occupation was clerical and sales, 35 percent; followed by skilled, 15 percent;

service, 15 percent; semiskilled, 14 percent; managerial, 9 percent; and professional, 6 percent. Two-thirds were employed full time, and an additional 7 percent were employed part time. One-sixth of the households had no automobile available, and 27 percent had two or more available. Finally, the median income of the households was around $10,000 with 16 percent of the households reporting less than $4,000 per year and 4 percent reporting over $20,000 per year.

Attitudes Toward Transportation

The attitudes of the respondents toward transportation services were found in a number of ways. They were asked to judge the quality of the services and indicate how they felt money should be spent for these services. They were also asked to evaluate different modes of transportation and to indicate how often they used them. The results of these questions are given in Tables 1 through 4.

Quality of Services—Respondents were asked to "Please give your opinion of the quality of the service listed in this area, according to the categories very good, good, good in some ways and not so good in others, not so good, and not good at all." The transportation services included were street lighting, expressways, condition of city streets, parking, and public transportation (bus services). These responses are given in Table 1.

Inspection of Table 1 reveals that the respondents tend to be most satisfied with the quality of street lighting and least satisfied with existing bus service. Moreover, the residents tend to be less satisfied with the condition of city streets and parking than with existing expressway service.

Transportation Expenditures—Some feeling of the respondents' priorites was gained from the question "For each of these services tell how much more or how much less money and effort you think should be spent for each one in this area." The responses to this question are given in Table 2. It was hypothesized that evaluations of the quality of services would be negatively related to expenditure preferences. This hypothesis was partially confirmed.

Street lighting is the service most highly rated and on which most agreement exists that the right amount of money and effort are being expended. There is a low level of satisfaction with the quality of public transportation service, and this service is ranked highest in the need for more money and effort to be expended. It is interesting to speculate why 12 percent do not know if public transportation should be improved or not. The case with expressways is also not clear. As a service, expressways are rated nearly as high as street lighting; but, unlike the situation with street lighting, expressways are the only service that a substantial proportion of the residents (25 percent) believe should have less money and effort expended. Similar findings were reported elsewhere(1).

Mode of Transportation—When the difference in the use of automobiles or buses as a mode of transportation was evaluated, the automobile rated the highest concerning least travel time, comfort, convenience, and cost. Moreover, there exists little difference in evaluation of the safety factor in comparing the automobile with the bus. Table 3 gives the percentage distribution of the evaluation of mode of transportation by characteristics.

When asked the single most important factor in choosing a means of transportation, the 371 respondents answered as follows:

Factor	Response (percent)
Convenience	37
Safety	29
Time	22
Cost	6
Comfort	6

Consideration of convenience and saving time lead to driving; safety was related to choosing the bus.

Figure 1. Proposed location of Stadium Freeway.

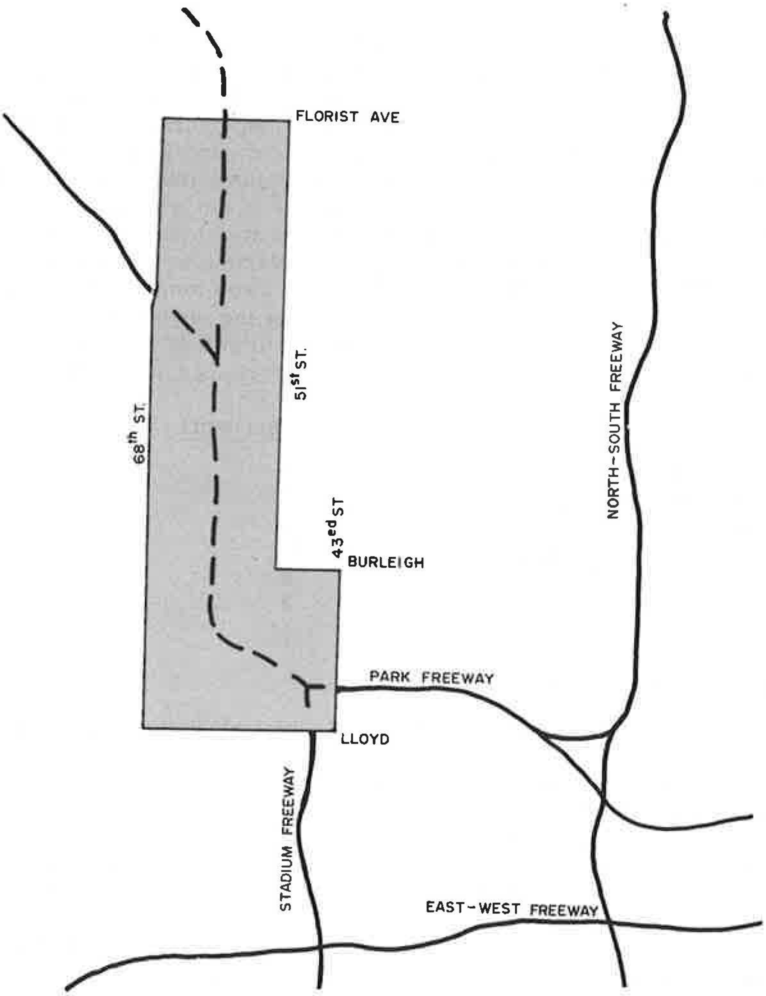


Table 1. Evaluation of the quality of transportation services.

Service	Responses (percent)					
	Very Good	Good	So So	Not So Good	Not Good at All	Undecided
Street lighting	31	49	9	7	4	0
Expressways	21	50	14	5	2	8
Condition of city streets	18	49	15	13	4	1
Parking	12	51	13	15	8	1
Public transportation (bus service)	9	27	17	20	12	15

Note: N = 373.

Table 2. Preferred change in level of expenditure for transportation services.

Service	Responses (percent)					
	Much More	More	Same	Less	Much Less	Undecided
Public transportation (bus service)	12	33	39	3	1	12
Condition of city streets	8	25	61	3	1	2
Parking	3	21	70	4	0	2
Expressways	3	15	51	17	8	6
Street lighting	2	18	76	3	0	1

Note: N = 373.

Further insight into the respondents' feelings for different means of transportation were obtained from the question "Tell me how you rate each of the means of transportation listed." The responses to this question are given in Table 4. The vast majority of respondents evaluate the automobile as the best mode of transportation. A striking contrast appears when expressways during non-rush hours and during rush hours are compared. In the former, more than 70 percent positively evaluate that mode of transportation; however, the highest proportion of dissatisfaction is found with rush-hour expressway traffic. Fairly large portions of the respondents rated local bus and train services as inferior relative to the other modes. It is also interesting to note the frequency of the response "undecided" for the public transportation modes. Apparently this finding reflects low usage rates of public transportation by the respondents.

Transportation Improvements—Each respondent was asked to select from the choices given the one that would improve his travel. The responses were as follows (N = 360):

Improvement	Response (percent)
Improved bus service	29
Improved arterials	22
Improved residential streets	20
Providing more expressways	17
Providing express buses	3
Providing rail rapid transit	3
Undecided	4

Attitudes Toward Nontransportation Services

Respondents were also asked to rate the quality of nontransportation services and their preference of level of expenditure for the services. The results of these questions are shown in Figures 2 and 3. Transportation services are also included in these figures for comparative purposes.

It is interesting to note that, in two service areas (welfare and urban renewal), nearly 40 percent of the respondents were unable to evaluate quality. One would anticipate an association between the qualitative evaluation and desired level of expenditure. Visual inspection of Figures 2 and 3 tends to support this hypothesis. The order of the percentage indicating a "good" quality of service roughly approximates the reverse order of the percentage of respondents who are willing to continue expending funds at the existing level.

Fire protection is the most highly evaluated service and on which most agreement exists that the right amount of money and effort are being expended. Air pollution control is ranked as near least satisfactory and where the highest agreement is found for spending more than the present level. Welfare and urban renewal are ranked as least satisfactory, but the high proportion of residents that could not evaluate these services (38 and 39 percent respectively) prohibits drawing reasonable conclusions about these two service areas. Expressway service is generally ranked as being good; however, it and welfare are services where a substantial portion of the respondents feel less money should be spent.

Further inspection of these figures demonstrates clearly that the vast majority of residents are satisfied with the existing quality of service provided in the area. Similar findings were reported recently in a study of Milwaukee by the Milwaukee Urban Observatory (5). The exceptions are air pollution control and bus services. In both cases there is a general feeling that the level of expenditure should be increased. This same concern for environmental services, e.g., water pollution, was reported recently elsewhere (5, 6).

Political Participation—The responses to the series of questions on political activities given in Table 5 reveal that the majority of the residents communicate their opinions by signing petitions, attending public hearings, and writing letters. Yet, due to limited time and opportunity at public hearings for individual response and the few who have done so in the past 5 years (Table 6) and to the relatively low percentage who have written or contacted officials in the same period, it would appear that the primary

Table 3. Evaluation of modes of transportation by characteristics.

	Mode (percent)		
Characteristic	Bus Passenger	Automobile Driver	Automobile Passenger
Most comfort	12	57	31
Most convenience	14	60	26
Least cost	22	36	36
Most safety	46	36	18
Least time	4	64	32

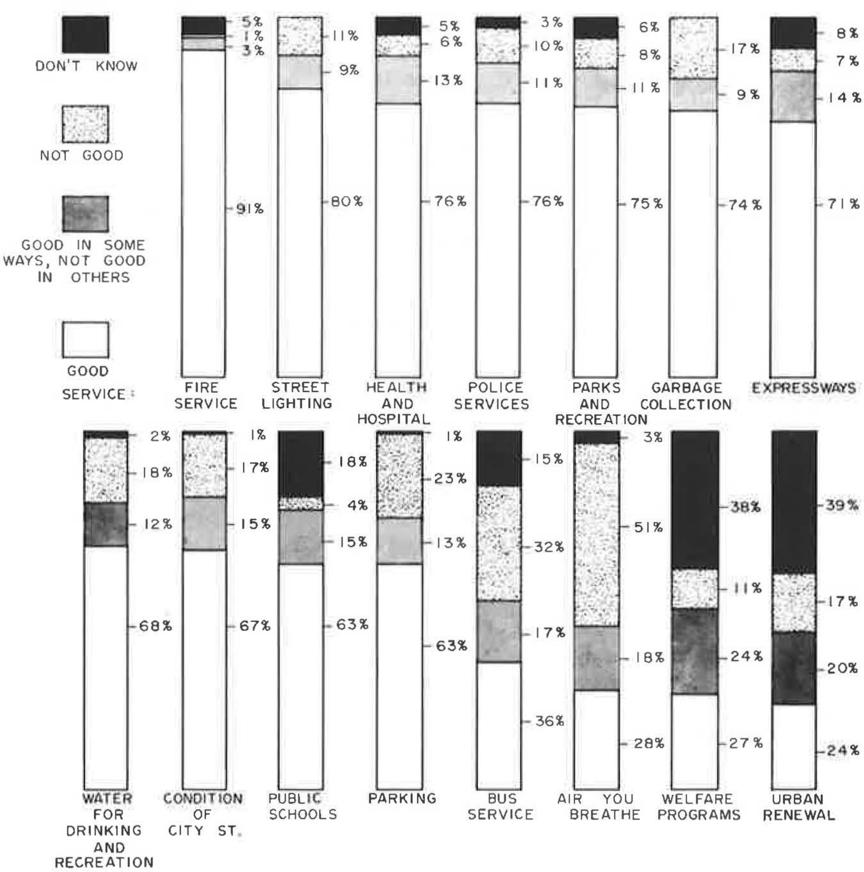
Note: N = 371.

Table 4. Evaluation of transportation modes.

	Responses (percent)			
Mode	Good	Good in Some Ways, Not Good in Others	Not Good	Undecided
Automobile	88	9	1	2
Expressway (non-rush)	77	12	4	13
Air	62	12	3	23
Taxicabs	43	20	6	31
Intercity bus	42	21	9	28
Local bus	37	30	20	13
Train	27	18	23	32
Expressway (rush)	16	16	50	18

Note: N = 373.

Figure 2. Evaluation of quality of government and public services.



effort is first through endorsement by voting, second through petitions, and third through letters, public hearings, and personal contact.

Preferred Living Place—Analysis of the responses to questions concerning preferred places to live revealed that 47 percent would prefer living in the suburbs, 40 percent in the city, and 13 percent in other places. Respondents were asked: "Which of these items would you consider most important in selecting a new house?" Table 7 gives the first, second, and third most important factors in selecting a new home. Lower taxes is the most highly valued item in selection of a home. Proximity to friends and recreation is of minimal import in home selection. Summarily, lower taxation and police and fire protection emerge as the two most important factors with proximity to shopping and the quality of schools rating very important in the selection of a new home.

Analysis of Freeway Support and Opposition

The data presented a rather unique opportunity to examine the characteristics of those persons who expressed negative attitudes about expressways. This was done through a series of bivariate analyses. Four dependent variables were selected for analysis: approval of the NESF, evaluation of the quality of expressway service, evaluation of the expenditures for expressways in the area, and attitudes concerning spending for freeways in general. A total of 53 independent variables were used in the analysis. The four questions used as dependent variables are given in Table 8.

In the following sections, a discussion of the bivariate analysis with the first dependent variable will be made. The other bivariate analyses will not be discussed here. It should be noted, however, that the results of all four analyses were generally consistent.

Comparisons With Other Dependent Variables—The first comparisons that were made were between the dependent variables to determine the consistency of the responses. The results are given in Tables 9, 10, and 11. The comparison in Table 9 of the responses to the question on approval of NESF and the responses to the question on quality of expressway service is more revealing. Evaluations of the quality of the expressway service in the corridor area indicate that 77 percent evaluated expressway service as good or very good.

The bivariate analysis of approval of the NESF to the responses on evaluation of spending on expressways in this area (Table 10) shows a sharp change in opinions from those in the previous analysis. These results are also shown in Figure 4. As noted earlier, 40 percent approve, 45 percent disapprove, and 15 percent are undecided However, in the attitude toward expressway spending in the area, 51 percent feel spending should continue at the same level, 18 percent at a higher rate, and 25 percent at a lower rate, and 6 percent are undecided. The table produced by the comparison clearly showed that those who tended to support spending on expressways in this area also tended to support the NESF, and the group that felt spending for freeways in the area should be reduced tended to oppose the NESF.

In the analysis given in Table 11, approval of the NESF and evaluation of expenditures for expressways in general, it was found that those who favor spending at the same or higher levels tend to support the NESF, and those who oppose the NESF tend to oppose spending money for expressways. There was some mix, of course. Of those who felt spending should be at about the same level, 55 percent were in favor of NESF. Of those who favored higher spending, approximately 75 percent were in favor of the NESF; and, of those who favor less spending for expressways, about 20 percent were in favor of the NESF. Thus the attitudinal orientation toward transportation services appears to be related to individual judgments concerning a specific program like the NESF.

Demographic Profile—An analysis was made of the characteristics of those persons who approve of the northern extension of the Stadium Freeway and those who oppose it. Those who were undecided were eliminated from this analysis. Comparisons will be made in this section on the basis of income, education, age, and sex. A curvilinear relationship was found between socioeconomic status (income, education) and support for the NESF. Lower income groups tend to oppose the NESF more than those with

Figure 3. Expenditure preference pattern for services.

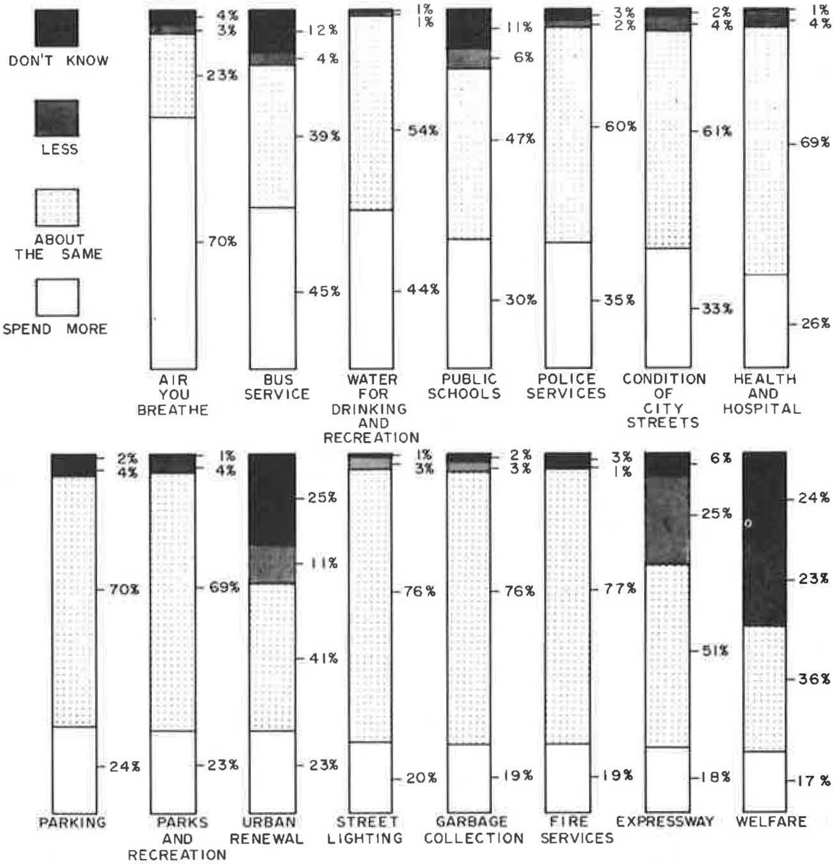


Table 5. Effectiveness of political activities.

Activity	Somewhat or Very Effective (percent)	Percentage Who Participate
Writing letters	66	54
Attending public hearings	76	62
Signing petitions	76	49
Picketing City Hall	21	4
Demonstrations	18	4
Picketing official's home	10	2
Use of force	7	2

Note: N = 373.

Table 6. General political activism within past 5 years.

Activity	Response (percent) Yes	No
Voted	82	18
Signed petitions	62	38
Wrote letters	24	76
Attended public hearing	23	77
Contacted public officials	18	82
Participated in a boycott	8	92
Picketed	5	95
Joined a political party	3	97
Marched	2	98
Ran for public office	0	100
Participated in a sit-in	0	100

Note: N = 373.

Table 7. Factors considered in selection of home.

Factor	First Choice[a] (percent)	Second Choice[b] (percent)	Third Choice[c] (percent)
Lower taxes	34	18	12
Police and fire protection	15	14	17
Location and quality of schools	13	13	9
Availability of public transportation	10	10	8
Size of lot	7	7	6
Proximity to work	7	8	8
Proximity to shopping	6	19	22
Availability of sewer and water	3	6	6
Proximity to friends	3	3	9
Proximity to recreation	2	2	3

[a]N = 370. [b]N = 366. [c]N = 361.

higher incomes (Fig. 5). However at an income level greater than $20,000 per year (6 percent of the sample) the rate of approval drops to below 50 percent. Figure 6 shows that those who have more education tend to favor the NESF with some shift on the part of those with college degrees to be evenly divided on the NESF project.

The relationship between the age of the respondents and approval of the project supports the hypothesis that age is negatively related to support of the NESF. These results are shown in Figure 7. There appears to be a "generation gap" in the opinions of the respondents on the project. This phenomenon was also observed in similar analyses with the other dependent variables. These results indicate a need for persons engaged in the planning of highways to develop a greater awareness and understanding of the impacts of their facilities on persons over 60 years of age. In summary, age appears to be a major factor in approval or disapproval of this particular highway project.

Data given in Table 12 show that sex has a definite relationship to attitudes toward the NESF. Males are rather evenly divided in their attitudes, whereas women are are opposed by a 3 to 2 ratio. Further multivariate analyses indicated that education appeared to modify the attitudes of both sexes, with those attaining a higher education tending to be more likely to support the NESF.

Comparison With Scaled Variables—Variables representing neighborhood satisfaction, personal trust, political trust, personal efficacy, civic duty, and evaluation of planners were constructed based on a Guttman scale of questions. This is a process in which an evaluation of responses is rated on the basis of a coefficient of reproducibility. The coefficients of reproducibility for the attitude scales all were above the 0.90 criterion as established by Guttman (7). The respondents were rated or scaled in comparison for a relatively high or low sense of neighborhood satisfaction; political trust; political and personal efficacy; and civic duty. In general, these sociopolitical variables were not related to evaluations of transportation services. However, those who positively evaluated highway planning tended to approve the NESF project. The same relationship remained when controlling for education and age.

Distance From Proposed Route and Rate of Approval—Information on the distance of respondents' homes from the proposed freeway was also available. It was hypothesized that those respondents who lived nearest the proposed route would tend to oppose the NESF more than those living further away. The results of the bivariate analysis of the distance from the centerline of the proposed freeway and approval of the project are shown in Figure 8. Those persons nearest the proposed freeway tended to disapprove of the freeway by a 3 to 2 ratio, whereas persons who lived more than 1,100 ft from the centerline of the proposed freeway approved of the project by a 3 to 2 ratio, confirming the hypothesis. Data given in Table 13 show that, when distance from the NESF and approval of the NESF are cross-tabulated with education, both education and distance are related to approval of the project. As the distance from the project and education increase, the rate of approval also increases. It should be noted, however, that the rate of approval as a function of distance did not increase so rapidly as expected. Nearly two-fifths of the respondents (38 percent) within 200 ft of the centerline approved of the project, and two-fifths (40 percent) of those greater than 1,400 ft away did not approve of the NESF. The rate of change of the approval rate was not so pronounced as that of age as described earlier.

Summary of Results

The preceding sections have discussed some of the results of this survey. As mentioned earlier, the quantity of data available is quite extensive, and only a limited portion is presented here.

The demographic material indicated that the respondents were nearly all white with three-fifths of them owning or buying their own homes. The area is middle income, primarily nonprofessional, and politically Democratic.

Respondents expressed satisfaction with the existing levels of public services. An exception was the quality of air. They also seem to feel that the level of expenditures should stay at about the same level for most services with the exceptions of air and water pollution control and public transit services.

Table 8. Questions used as dependent variables and responses to them.

Question	Response	Respondents Number	Respondents Percent
Did you approve of a northern extension of the Stadium Expressway?	Yes	148	40
	No	169	45
	Undecided	66	15
What is your opinion of the quality of expressway service in the area?	Good	264	71
	Good in some ways, not good in others	51	14
	Not good	28	7
	Undecided	28	8
How much money and effort should be spent for expressway services in the area?	More	65	17
	Same	191	51
	Less	95	26
	Undecided	21	6
How much money should be spent to build additional expressways?	More	105	26
	Same	117	31
	Less	136	37
	Undecided	12	4

Table 9. Bivariate comparison between approval of NESF and quality of freeway service in the area.

Quality of Expressway Service in Area	Opinion of NESF: Approve	Opinion of NESF: Disapprove	Percentage of Sample Response
Very good	58	42	24
Good	44	56	43
Good in some ways	51	49	15
Not so good	55	45	6
Not good at all	14	86	2

Note: N = 298.

Table 10. Bivariate comparison between approval of NESF and expenditure preference pattern for freeways in the area.

How Much Money and Effort Should Be Spent in This Area	Opinion of NESF: Approve	Opinion of NESF: Disapprove	Percentage of Sample Response
Much more	89	11	3
More	73	27	15
Same	55	45	51
Less	14	86	17
Much less	11	89	8

Note: N = 307.

Table 11. Bivariate comparison between approval of NESF and expenditure preference pattern for freeways in the area.

How Much Money Should Be Spent for Expressways	Opinion of NESF: Approve	Opinion of NESF: Disapprove	Percentage of Sample Response
Much more	71	29	6
More	78	22	25
Same	55	45	31
Less	23	77	20
Much less	11	89	18

Note: N = 310.

Table 12. Bivariate comparison between approval of NESF and sex of respondent.

Sex	Opinion of NESF: Approve	Opinion of NESF: Disapprove	Percentage of Sample Response
Male	53	47	48
Female	41	59	42

Note: N = 311.

Figure 4. Rate of approval of NESF as compared to expenditure preference pattern.

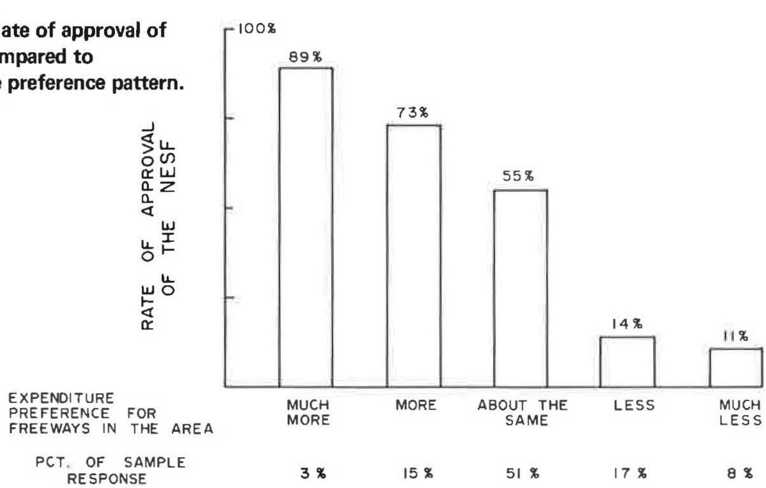


Figure 5. Rate of approval of NESF by income group.

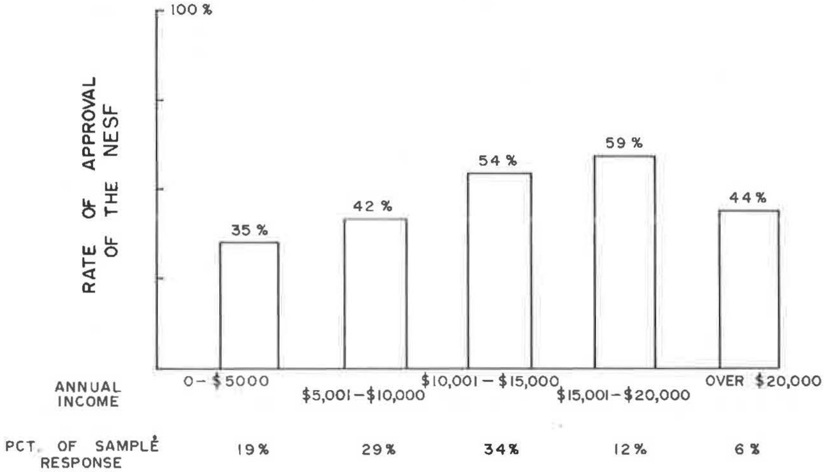


Figure 6. Rate of approval of NESF by educational level.

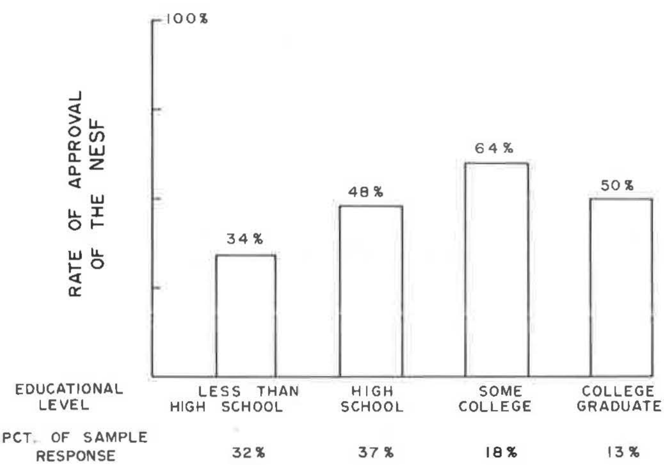


Figure 7. Rate of approval of NESF by age group.

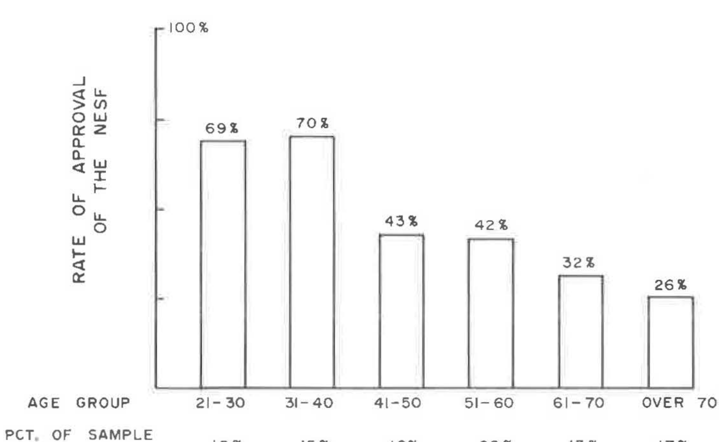


Figure 8. Rate of approval of NESF as compared to distance from proposed freeway.

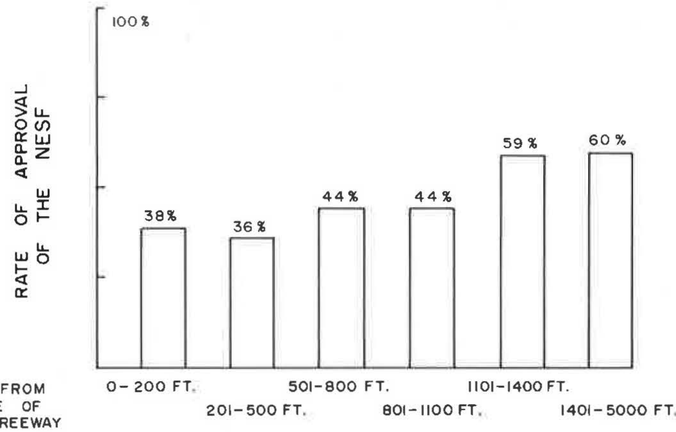


Table 13. Multivariate comparison among approval of NESF, distance of residence from centerline of proposed freeway, and education.

Education Level	NESF Attitude	Distance of Residence From Centerline of Proposed NESF (ft) 0 to 200	200 to 500	500 to 800	800 to 1,100	1,100 to 1,400	1,400 to 5,000	Percentage of N
To 8th grade	Approve	0	34	34	0	–	29	
	Disapprove	100	66	66	100	–	71	
Percentage of group		11	17	17	17	0	38	6
Some high school	Approve	33	33	25	50	57	31	
	Disapprove	67	67	75	50	43	69	
Percentage of group		8	12	11	8	9	52	25
High school graduate	Approve	50	47	46	35	45	59	
	Disapprove	50	53	54	65	55	41	
Percentage of group		10	13	11	14	9	43	40
Some college	Approve	67	33	50	78	60	62	
	Disapprove	33	67	50	22	40	38	
Percentage of group		6	6	8	17	9	54	18
College graduate	Approve	0	0	80	33	100	62	
	Disapprove	100	100	20	67	0	38	
Percentage of group		9	6	15	9	12	49	11
Percentage of N		8	11	11	13	9	48	100

Note: N = 298.

Respondents were nearly evenly divided on the proposed project in the study area. When asked about the level of expenditures for transportation services, they tend to be generally satisfied with the existing level of services. Finally, the residents registered great use and preference for the automobile over other modes.

An examination of those who oppose the proposed freeway project indicates that age may be a highly significant variable. Persons between the ages of 20 and 40 tend to approve of the project, whereas those over 60 show a high rate of disapproval. Other demographic factors, e.g., socioeconomic status and residential distance from the project, were related to support for the NESF.

CONCLUSIONS

Earlier the objectives of the research were described. Achievement of the objective cannot be ascertained, in a sense, until widespread use of such techniques occurs. However, certain elements of the feasibility question can be addressed. It is apparent that data can be collected and analyzed through social diagnostic techniques and that such data can provide useful information on the views and values of persons to be affected by a proposed project. Another element of feasibility relates to the cost of the project. Raw data were obtained at a cost of approximately $30 per interview or a total of $11,000 for the 373 completed interviews. The cost does not include the cost of questionnaire preparation or analysis of the results. When compared with the total estimated cost of the project ($120 million), these costs appear to be very minor. If data and techniques as described here succeed in reducing the delay on the project by even a small amount or in improving the project, they can easily justify themselves.

It is the view of those who participated in the project that surveys and analyses are essential to the planning of new major highway facilities, especially in urban areas. Such data should be considered as important as or more important than good maps or knowledge of soils and drainage. In a sense, they can provide cognitive and attitudinal maps of residents of the impact area. They can provide valuable information on persons affected by the project and on how they think. Such information may be of value in understanding and communicating with the community and resolving conflicts. It is hoped that the study will serve as a basis for implementation of this process in any major project in an urban area, whether or not it is transportation oriented. Further efforts should be made toward standardization of procedures and questionnaires on projects of this sort to ensure some consistency in their widespread application.

RECOMMENDATIONS

The team of social scientists and engineers involved in this research project is unanimous in their opinion that this type of data collection is desirable in the implementation of any major project likely to affect a community, whether a transportation project or otherwise. The relatively small cost in comparison to the benefits of producing a project that will be enhancing to the aggregate of community values would seem to demand this effort. Accordingly, the following recommendations were made to the project sponsors:

1. Procedures should be devised to enable serious consideration of the findings of a survey in the development of a project. Such results could be used in (a) modification of the design and location of a facility to minimize adverse effects in light of community values as determined from the survey; (b) development of public information programs more responsive to the diverse needs and fears of persons affected by the project; (c) modification of public hearing procedures and presentations that are more meaningful to the attitudes of the community; (d) development of citizen participation procedures with a clearer understanding of the issues involved in a proposed project; (e) determination of what further data should be collected to aid in negotiating some resolution of conflicts raised by a proposed project; and (f) modification of relocation procedures to deal more effectively with the concerns of the people involved, with special attention given to the relocational needs of the elderly and the poor.

2. Standardized survey techniques, questionnaires, and analysis procedures should be developed to carry out the above recommendation. Such standardization is important if consistent interpretation of survey results is to be made. Furthermore, standardization would enable comparative studies of different areas and communities to be made to assist in greater understanding of impact phenomena.

3. Strong consideration should be given to performing surveys of persons to be affected by all major transportation projects. These surveys should be scientifically conducted, and their content should reflect a number of viewpoints. Furthermore, these surveys should be conducted as part of the data collection phase of a project, prior to any location decisions on the project.

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FRAMEWORK FOR USING SOCIAL INDICATORS TO MONITOR, EVALUATE, AND IMPROVE A PUBLIC TRANSPORTATION SYSTEM

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This paper proposes a general framework for using social indicators to monitor, evaluate, and improve a public transportation system. Discussion of this framework is preceded by a definition of social indicators and an explanation of five of their functions. Some general factors and techniques concerning the selection, measurement, collection, and storage of social indicators are suggested. The specific approach presents eight areas of concern. These areas are suggested as performance criteria for evaluating any public transportation system. Furthermore, important questions are listed and are broken down by related factors. From this systematic approach, the authors specify four sample indicators. These indicators are then developed for the framework's stages of monitoring, evaluating, and improving public transportation systems. In the final section, one of the sample indicators is applied to the Atlanta Model Cities Shuttle Bus System.

A SOCIAL INDICATOR is defined as a variable that measures or reports on a single or several dimensions of the performance or condition of man and his systems. Four key distinctions are contained in this definition. First, a social indicator is a variable. It can vary with time to allow comparisons and identification of long-term trends or unusually sharp fluctuations. Second, a social indicator can either measure or report on or both the performance of man or his systems. The distinction here is measure or report. The former implies quantification by numbers or units. The latter suggests additional qualitative description.

The third distinction involves the dimensionality of the phenomenon. Social indicators can be disaggregated by relevant attributes of either the persons or the conditions measured (e.g., race and sex or peak and off-peak flows) and by the context surrounding the measure (e.g., neighborhood, city, or SMSA).

The fourth distinction underlies the words performance and condition. Normative judgment is usually required for some consensus of what the performance or condition should be (a norm) and on whether the movement of the performance or condition is toward or away from the norm.

FUNCTIONS OF SOCIAL INDICATORS

Springer (1) suggested five functions of social indicators that are based on managerial rationality. First, they can be used to assess the state of a system. This assessment implies a quantitative and descriptive statement about the character of the system. Second, they can help assess the performance of the system. This assessment suggests norms or performance standards that should be related to goals of the system.

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Third, social indicators can help to define the actions or decisions necessary to ameliorate or improve a condition. The fourth function is that of anticipating the future of the system. This function includes (a) defining of alternative futures for decision-making, (b) forewarning of an impending crisis, and (c) targeting of defined goals. Finally, social indicators could offer some guidance about areas in which existing information is inadequate and research is needed.

This overview of social indicators provides the foundation for the proposed framework. In this framework, we have addressed mainly the first three functions of social indicators.

Before discussing the approach to this framework, the authors suggest some general factors and techniques that should be considered when developing social indicators.

GENERAL FACTORS AND TECHNIQUES IN THE DEVELOPMENT OF SOCIAL INDICATORS

Certain general factors and techniques should be considered in developing social indicators to evaluate a public transportation system. Each of the factors discussed in this section applies to the selection, measurement, collection, and storage of social indicators. In addition, general techniques are described for each of these four processes.

Factors

At least six factors should be followed in the selection, measurement, collection, and storage of social indicators. First, we must consider the type—e.g., rail rapid transit, bus transit, or some combination of the two—and institutional control—i.e., control by a private corporation or public transportation authority—of the system. Different systems may require entirely different social indicators, or at least different systems may place different emphasis on similar indicators.

The second factor to be observed is the territory served by the system. Does the transportation system serve a nation, state, SMSA, town, or neighborhood? Is the system in the northern, southern, eastern, or western region of the country?

A third factor pertains to the users of the public transportation system. Users have different demographic and travel characteristics; this causes the selection, measurement, and collection of social indicators to vary. Demographic characteristics include race, sex, age, income, occupation, marital status, family size, and type and location of dwelling unit. Examples of travel characteristics are trip purpose, trip destination, trip frequency, trip mode, trip length, and trip time and frequency.

Time frame is also important. How often should one measure, collect, and store indicators—weekly, monthly, quarterly, yearly, or decennially? If one is measuring on a daily basis, should he consider peak or off-peak hours? Are indicators of short- or long-term changes needed? What is the time lag between collection of indicators and storage of results?

The selection, measurement, and collection of social indicators for public transportation might vary with the weather, seasons, or economic conditions. Thus, the fifth factor to consider is the condition or context involved.

The last and most important consideration is the usefulness of the indicator. Will the indicator provide useful and reliable information as well as information compatible with data of other agencies? The information being measured, collected, and stored must be useful in evaluating a system. For example, using many indicators to measure the same dimension of a phenomenon is wasteful. However, specifying different indicators to measure different dimensions of a phenomenon is useful.

The decision-maker must also have reliable and accurate information with which to monitor, evaluate, and ultimately improve the public transportation system. Biases in the selection, measurement, collection, and storage of social indicators should be minimized. Typical examples would be (a) selecting indicators based on existing normative interests, (b) measuring indicators improperly because of poor operational definitions or wording of survey questions, (c) collecting indicators with sample distortions or undercounting, and (d) storing erroneous data because of keypunch mistakes.

Finally, social indicator information should be compatible with that of other agencies. Will other agencies (especially public) be able to compare these indicators with any they have obtained? Should the indicators be compatible on a geographic, temporal, or definitional basis? For example, in measuring personal income of the bus rider, one should use standard income categories. Similarly, trip purpose information should be measured according to standard categories. "Unless there is a direct link between a local department and a federal bureau little effort is made to coordinate and standardize data collection" (6).

Techniques

Some general techniques are suggested for the selection, measurement, collection, and storage of social indicators. These methods are by no means the only ones but are simply useful general approaches.

Selection—Several logical approaches have been suggested for the selection of social indicators: selection by their similarity in measurement, selection according to the level of decision-making, or selection from broadly defined areas.

Measurement—Next to the selection of indicators, the measurement of indicators is the hardest of the four stages to perform. In fact, many social indicators and phenomena are selected based on their ease of measurement rather than on their usefulness. One must first decide whether an indicator can be measured with or without a respondent. The latter case is easily handled. For example, one could ride a bus during a peak hour and easily count, by himself, the number of vacant seats.

When a respondent is needed, additional considerations are required. The indicators desired must be clearly defined. Assuming that the indicator selection procedure has been properly followed, much of the definition would already have been completed. Next, one would decide if structured or unstructured questions are to be given to the respondent (2). The former provides the respondent with fixed-response alternatives. Examples of this technique are two-choice and multiple-choice questions. Variations of these two types use specific ranking and scaling techniques to measure the response exactly. On the other hand, unstructured questions permit the respondent to talk freely and at length about the subject.

Collection—A first step in collecting social indicator information is to check existing data. Agencies that might have information useful to managers of a public transportation system would be (a) federal agencies and departments (e.g., Bureau of the Census, Bureau of Labor Statistics, Department of Transportation, and Department of Commerce), (b) local and regional authorities (e.g., transportation, housing, and welfare), and (c) other public and private institutions (e.g., universities and research centers).

Once these sources have been checked, the collection of new information would be considered. In so doing, the following three questions must be answered: Who will collect the needed information? How will it be collected? Where will it be collected? It may be decided to contract out the data collection, in which case results are presented as a package. On the other hand, if the data are collected in-house, the other two questions must be considered.

A useful method for collecting information is the sample survey. In the evaluation of a public transportation system, four survey techniques are possible: observation (on-board or bus stop) survey, mail-out survey, home interview survey, and destination survey.

The on-board survey would require only one or two persons to observe how the actual users of the public transportation system react to the service. A respondent may or may not be required.

In the mail-out survey, questionnaires would have to be prepared and given to the users of the system or sent to all residents within a specific area. Obviously, this preparation requires adequate knowledge of questionnaire development and sampling techniques and a listing of home addresses.

The home interview also requires proper questionnaire development, sampling, and, more importantly, interviewing. Home interviews are expensive, tedious, and time-consuming, but they do permit the collection of more information—attitudinal as well as factual.

All three techniques mentioned would require verification by telephone or return visit. In addition, editing of the collected data would be necessary to check for human errors.

The destination survey would be conducted at major destination points such as places of employment, shopping centers, and recreational centers.

Finally, when the collection is to be performed and how often it should be repeated must be determined exactly. These two determinations will be based on the previously mentioned factors concerning the condition at the time of collection (e.g., peak hour) and usefulness of the collected information (e.g., time series projection or monitoring a change).

Storage—Two plausible storage alternatives are available to the decision-maker. Data can be processed and stored in computer-compatible format, or data can be processed by hand. Except for small-scale surveys, computer storage would usually be the best selection. If computer storage is used, a few points should be considered. First, the data should be stored on files by each individual case. This technique permits aggregation at a later time. The data should not be grouped by user attributes or by level of aggregation before permanent storage inasmuch as this method restricts the decision-maker in his analysis.

AN APPROACH FOR SELECTING SOCIAL INDICATORS TO EVALUATE A PUBLIC TRANSPORTATION SYSTEM

The Approach

The approach comprises three steps. Eight general areas of concern are suggested and are given below. These represent specific performance criteria for a public transportation system. The second step further defines these areas by formulating detailed questions that represent the major question that the decision-maker would like to answer. The third step is to break down each question into the important components and the major factors related to these components.

1. Accessibility—This refers to the ability of the rider to travel from a selected initial location to a desired location. Where should the routes be located? The breakdown of this question is as follows:

Components	Factors
User origin	Number of people, percentage of elderly, percentage of one-car or no-car families, percentage of low-income residents, percentage of singles (25 to 35 years old), type and value of residential units
User destination	Office building, industry, retail center, supermarket, school, hospital, park

2. Comfort and Convenience—These refer to the quality of satisfaction and enjoyment or the physical ease in using the system. How can comfort and convenience be optimized? Some of the factors involved are as follows:

Components	Factors
Adequate seating	Number of riders per route, headways on route, number of packages (briefcases)
Comfortable air	Weather, time of day, operation of bus
Adequate design features	Handles, steps, doors, credit card, coins, paper tickets
Better bus driver	Training, skill, determination, physical limitations
Volume of buses	Origins, destinations, crowding policy, hours of operation

3. Economy—Economy refers to the efficient use of resources to provide an optimum and practical system. But how can the system's cost equal the cost of operation? Some of the items that should be considered follow:

Components	Factors
Fares	Costs, subsidies, ability to pay, charter revenues, off-peak fares, special fares (for children, the elderly, the disabled)
Variable costs	Labor, bus depreciation, maintenance, vandalism

4. Dependability—Dependability refers to the reliability of the system to perform properly. How can the system be made more dependable? Some items of interest here are as follows:

Components	Factors
Major delays	Bus stop location, speed, capacity, headways, railroad crossing, number and types of riders
Better bus driver	Training, skill, determination, physical limitations

5. Safety—This implies security and freedom from danger for both the passenger and the vehicle. It also refers to protecting the system and the passenger from undergoing injury or loss. How can the system be made safer? Items that might be germane to the answer follow:

Components	Factors
Cause of accidents	Poor driving, vehicle failure, signal failure, weather, personal accident on bus
Safety design features	Small steps, elevator, self-opening door, extra handles, reserved seats
Safety enforcement	Bus driver awareness, time of bus operation, presence of enforcement officer

6. Speed—Speed refers to the rate of performance of a system and implies swift or quick movement. How can the system's buses be made to operate at higher speeds? Items pertinent to the answer follow:

Components	Factors
Reduced delays	Number of riders, number of buses, route characteristics
Express route	Origin, destination, street linkage

7. Clarity—This addresses the ease in visibility, use, or understanding of a system and how it operates. How should the system be promoted? Items that may aid in the solution to the question follow:

Components	Factors
Communication media	Pamphlet, newspaper, radio, television, friend or relative, neighborhood organization
Understanding media	Percentage of population that is literate, blind, and knowledgeable of the system
Route identification	Overhead sign, bus number and color, street name, shelter

8. Flexibility—This final approach is that of flexibility, which refers to the capability of the system to respond to change or a new situation. How can the system be made more flexible? Items to be considered follow:

Components	Factors
Overloads and drop-offs	Weather, headways, rider habits, work hours
Prediction of overloads and drop-offs	Weather forecast, increased ridership, announced sales and sports events, staggered work hours, holidays
Route or schedule change	Origin, destination, volume

The Selection

Many indicators could have been selected, but the authors chose four samples. Those indicators selected are:

1. Origins, destinations, and number of female users of the system who are 16 and older;
2. Ability to pay (which equals weekly transportation cost divided by weekly income), presented as a frequency distribution for various income categories;
3. Number and time of daily work trips; and
4. Monthly vandalism cost.

The first indicator would contribute to two of the five main functions. It would help assess the performance of the public transportation system in terms of accessibility. The origins and destinations for these females would be compared to each existing route to determine the degree of accessibility.

The second function of this indicator is to anticipate future travel patterns. Comparing present travel patterns with past travel patterns would indicate changing trends and predict future travel patterns. Such trends as the growing female labor force and the increasing number of female heads-of-households would be typical examples.

The reason for selecting this particular group of users is twofold. First, females seem to be highly dependent on public transportation, constitute a large portion of the users, and have the most diverse travel patterns. Second, the age group was selected to include those females of employable age or who had a source of income.

The second sample indicator would have four functions. First, ability to pay would assess the present fare policy on an equal basis for all users. The indicator would determine if users were paying more than a certain percentage of their income on transportation costs. It would also aid in planning future fare policies by showing how many users would be helped or hurt by a fare increase or decrease. This indicator would also provide valuable information for supporting or refuting a pending sales tax or subsidy program.

The third function performed by ability to pay would be to improve an existing fare problem. The determination of which and how many users are paying a high percentage of their incomes for transportation would help in making a decision on subsidies or fare reductions.

Finally, ability to pay might point out further areas to be investigated. Some examples might be the following:

1. How many users ride the bus only for their work trips and drive automobiles for other trips?
2. What percentage of users with a high ability-to-pay ratio ride in the off-peak hours?

The third sample indicator would serve four functions. First, one could assess how a public transportation system competes with personal transportation (automobiles). This assessment would be done by comparing the total number of work trips to either (a) the potential number of work trips for a particular route or area or (b) the total number of automobile trips for a particular area (e.g., metropolitan area or CBD).

One could also use the comparison to assess how close the system is to a specific goal (e.g., to serve a minimum of 20 percent of a metropolitan population with public transportation).

Second, this comparison would indicate a possible source of new bus riders, e.g., workers who commute in automobiles. Third, if the decision-maker knew the time of these trips, he could estimate when to increase worker ridership. For example, attracting new riders in off-peak hours might be easier than in the peak hour because of present peak-hour crowding and the lack of capital to purchase more buses.

Finally, this indicator could suggest further areas to be investigated. For example, if the indicator showed a very low number of bus work trips compared to automobile work trips, the decision-maker could determine the origins and destinations of these automobile trips. He might then compare existing bus routes to these travel patterns to see how the routes might provide better access for the automobile driver.

The reasons for selecting this indicator are threefold. First, the work trip is the most important trip to the traveler. Second, the work trip is usually the most frequent and predictable trip for any traveler. Third, to increase ridership, the decision-maker would do better to attract new riders than to increase the frequency of trips for permanent riders.

Monthly vandalism cost would include damage occurring to the bus (e.g., torn seats) as well as physical injury to the driver or the passengers or both. This indicator would function in four ways. First, indicating a higher or lower estimated cost per month would effectively measure the system's performance. Second, when the present vandalism cost is compared to past costs, the decision-maker can determine whether the system is improving in terms of optimum economy, i.e., maximizing net revenue.

The third function relates to ameliorating the problem of vandalism. Vandalism costs would be listed by cause and location. This method of listing could remove much of the analysis normally performed on social indicators and place the decision-maker much closer to the solution. Bus drivers would report when and where actual vandalism occurred. In some cases the actual cost would be less important than the type or degree of vandalism. An increasing monthly vandalism cost would also suggest topics that should be further studied, e.g., unemployment of youths.

These, then, are the four indicators selected as typical samples for evaluating a public transportation system. The next sections set up a framework that explains how these indicators could be used to evaluate the system.

MONITORING THE PUBLIC TRANSPORTATION SYSTEM WITH SAMPLE INDICATORS

Monitoring usually implies periodic observation or regulation of a process or system. To monitor a public transportation system with selected social indicators requires first that indicators be measured and collected and preferably that they be stored. Consequently, this section discusses these three phases of the monitoring process as it applies to the four sample indicators.

Measurement of Sample Indicators

Measurement of the first social indicator, female bus users who are 16 and older, would require a structured questionnaire and a respondent. The origins and destinations could be recorded by full addresses or by nearest street intersections and could be coded later into census tract and block numbers or intersection numbers for computer storage. If additional information such as number of transfers, time of trip, frequency of trip, and purpose of trip is needed, the use of structured questions is suggested to facilitate coding and analysis. Furthermore, trip purpose categories should be standard.

The ability-to-pay indicator would require a respondent and questions structured for computer analysis. Secondary sources, such as the U.S. Bureau of the Census or a local welfare or planning department, would also provide income information. The indicator itself would be measured as a cost ratio. The exact number of weekly trips (including transfers) could be recorded, or a structured question could provide categories listing the number of trips in groups. The weekly transportation cost would then be calculated. For this measurement to be accurate, the respondent would also list whether she pays cash or a token or has a free pass for most of her trips. The type of fare payment could vary for different systems.

A structured question would be used to provide the respondent with a choice of recording either weekly, monthly, or yearly income. This would eliminate the problem of incorrectly converting a monthly or yearly salary to a weekly salary.

Once this ratio was calculated, it would be compared to a locally established standard on the percentage of income a user should have to pay for the cost of public transportation.

The third indicator, number and time of work trips per bus route, would require a respondent, structured questions, and some outside information source. The respondent would be used to ascertain the number and time of her daily work trips. An outside source would be needed to determine either of the following: the potential number of work trips for a particular route or area or the total number of automobile trips for a particular area (e.g., neighborhood, CBD, SMSA). The best source for this information would be an area-wide transportation study. This type of study would have origin trips recorded by purpose, mode, and zones. An example of such a study would be the Atlanta Area Tranpsortation Study (AATS) conducted in 1961.

Actual measurement of the indicator would result then from either of the following ratios:

1. Number of daily bus trips per route divided by number of potential bus trips per route or
2. Number of daily bus trips per system area divided by number of daily automobile trips per system area.

If the first ratio is used, each route could be evaluated. However, if the second is used, the measurement of daily trips should be expanded to include all routes.

The fourth indicator, monthly vandalism cost, would be measured in dollars and would have to be estimated because of the time lag between actual repair and billing. A normative standard would be established as a percentage of operating cost (e.g., not more than 1 percent). This standard would provide some value to the indicator and would also be a goal for the decision-maker.

A respondent would not be necessary to measure monthly vandalism cost. This information would normally be included in a regular budget analysis of most public transportation systems.

Collection of Sample Indicators

Collection of sample indicators would be directly dependent on how each is measured. As already mentioned, most of the required information would be collected from the sample questionnaire by means of an on-board survey.

The on-board survey would be conducted by three agents, one near each bus door and the third between the doors. The agents would distribute the questionnaire, answer questions, and scan the completed form for mistakes. The questionnaire would be short and simple to fill out inasmuch as the rider would have to complete it before leaving the bus.

The number, origins, and destinations of female riders (16 and over) would best be collected with an on-board survey, a simple and inexpensive technique. The data would be collected on a normal weekday for all bus hours and for each route.

The use of home interviews would be impractical for such a small amount of data. However, a metropolitan agency conducting an annual home interview survey could ask several additional questions on public transportation.

The information needed for the ability-to-pay indicator, i.e., frequency of trips, type of fare payment, and personal income, would be collected with a questionnaire in an on-board survey. The survey would be run all day on a representative sample of the routes. Collection could be repeated quarterly on different routes to ensure that the indicator presents a clear picture of the total system.

Not all of the required information for the third sample indicator would be gathered by an on-board survey. Only number and times of work trips for each route could be collected. Data on the number of automobile trips per area would have to be obtained from local public agencies or private consultants.

Monthly vandalism cost would not require surveys. The maintenance or finance department of the public transportation authority could keep a record of monthly or weekly expenditures due to vandalism. This record would be listed by route for comparative purposes.

A monthly record of vandalism cost is only a suggestion. The frequency would depend on the size of the cost and the system as well as the variation of cost by week, month, or year.

Storage of Sample Indicators

Except for very small public transportation systems, the first three indicators should be processed for computer storage. Information for the ability-to-pay and the daily work trip indicators could be coded by an optical scanner if the questionnaire is prepared properly. However, the number, origins, and destinations of female adult riders would probably be coded by hand before computer storage. Vandalism costs would not require computer storage but could be processed easily by hand.

EVALUATING THE PUBLIC TRANSPORTATION SYSTEM WITH SAMPLE INDICATORS

Analyzing the Sample Social Indicators

In general, analysis of social indicators would be performed on a continual basis with periodic input of new data. In addition, the decision-maker would have to keep in mind the basic functions and the qualitative or quantitative nature of the social indicators.

The female rider indicator might be best analyzed by cross tabulation and computer graphics. Cross tabulation would be easy and would produce simple tables on the similarities or differences in travel characteristics among females of various ages, races, and incomes.

The origins and destinations could be plotted on a map by the computer. This mapping would require an established grid system that used centroids of census tracts or street intersections. From these desire-line patterns, the network of existing routes could be analyzed. Finally, certain land use or simulation models might be used to analyze the residential mobility of these users. This analysis would be helpful in predicting future bus route locations. Examples of these models would be the San Francisco CRP Model, the Pittsburgh Urban Renewal Simulation Model, the Penn-Jersey Regional Growth Model, and the Chicago Area Transportation Model (3).

Analysis of the ability-to-pay indicator would also be conducive to computer summaries and cross tabulation. Values of the ratio could be grouped and summarized for each route and for the total system. Transportation cost could be cross tabulated with each income category or type of user. Computer graphics could be used to plot histograms by income category, transportation cost, or type of user. However, such graphics could also be easily done by hand.

Correlation and factor analysis could be used to determine those variables that are more indicative of users with a low ability to pay (i.e., a high transportation cost-income ratio). Based on this analysis, a regression equation that uses these variables to predict the number of users with a low ability to pay might be developed. A subsidy policy could then be established.

The number and time of work trips could be analyzed by running simple computer summaries. Typical summaries would be the number of work trips for various time intervals during the day. These summaries could be totaled for each route or the whole system or both. Each total could then be compared (by hand) to the number of potential work trips for the route or the number of automobile trips for the entire service area.

Analysis of monthly vandalism cost would involve periodic comparison with previous figures to determine possible fluctuations in total cost. Furthermore, the decision-maker would be interested in the causes of a high or increasing monthly vandalism cost. Neither computer nor statistical analysis would be necessary because of the small amount of data; however, these techniques could be used. A regression equation could be developed to predict future vandalism costs. Additional information such as the number of teen-agers per neighborhood, available recreational facilities, and the season of the year would be needed.

A more interesting approach would be to plot the locations in the service area where vandalism occurs. Computer mapping might be necessary depending on the number and frequency of acts of vandalism. Such a map would also be helpful to other agencies such as the urban renewal authority, the planning department, and the police department.

Formulating Alternative Recommendations

Alternative recommendations would be based on analysis of the social indicator. The analysis results would show how well the public transportation system is performing, how the system might be affected in the future, what should be done to improve the system, and what areas of the system need further study.

From analyzing the origins and destinations of female riders one might arrive at the following alternative recommendations:

1. Provide express routes for domestic workers,
2. Provide route modifications for more convenient medical-dental trips or shopping trips,
3. Extend routes to go past day-care centers in the morning and afternoon peaks,
4. Discontinue service in certain areas because of low ridership, and
5. Provide new routes to remove excessive transfers.

The ability-to-pay indicator would show the type and number of users who spend more than a locally set standard percentage of their income. From these results the following recommendations might be suggested:

1. Decrease or increase the fare for all riders,
2. Decrease the fare for all those paying more than the standard percentage of their income on travel costs (e.g., elderly, low-income Blacks, or disabled),
3. Decrease fare in off-peak hours and increase it in peak hours, and
4. Provide a subsidy to special groups of users.

Such subsidies might be provided with welfare checks.

Analysis of the number and time of work trips might produce the following recommendations:

1. Provide more air-conditioned buses in the peak hours to attract potential (automobile) work trips,
2. Provide express routes in peak hours on weekdays only for workers traveling to the same destination or area, and
3. Provide separate buses for workers and nonworkers in peak hours.

From the costs, types, and locations of monthly vandalism, one might arrive at several recommendations. Examples are presented later.

Evaluating and Selecting Alternatives

The decision-maker would have to evaluate each alternative by performing economic and social analyses. For the first sample indicator one might be faced with evaluating the social and economic benefits of providing an express bus route for domestics. The economic costs would be the use of the bus and driver for only a fixed number of riders. However, the return trip of the bus might be an express route for CBD-oriented workers and thus would provide an economic benefit. This reverse routing would depend on the origins and destinations of the user groups.

The social benefits would be numerous. The express transportation would make traveling easier for domestics. In addition, more domestics might be able to find jobs. Finally, the express route for the CBD worker could reduce the number of automobiles on freeways leading into the city.

The second sample indicator also provides challenging alternatives. Consider, for example, subsidization of trips made in off-peak hours by the elderly and disabled. The economic cost would be valued at the amount of subsidies given. The economic benefit would be increased ridership during the off peak and possible reduction in delays in peak hours. Social benefits would be obvious. Many of these users would have small fixed incomes (e.g., social security, pensions, and welfare) and would not be able to pay a large transportation cost.

Finally, evaluation of the vandalism recommendations would involve some important implications. For example, assume that the decision-maker is evaluating the idea of requesting more police protection in a specific neighborhood. He might see very small economic costs to his system for this alternative. However, if a civil disorder were to start because of this recently added police protection, the economic and social costs would encompass far more than those incurred by the public transportation system.

IMPROVING THE PUBLIC TRANSPORTATION SYSTEM WITH SAMPLE INDICATORS

Once he has selected the best recommendation, the decision-maker would attempt to improve the system. Consequently, this section presents one possible approach for the decision-maker to implement his selected improvement.

Establish a Public Information Campaign

A public information campaign would consist of pamphlets distributed on the bus, at ticket booths, or at bus terminals. Communications media would be used to reach nonusers and would also remind permanent users of an upcoming change. Finally, store owners could help distribute pamphlets to customers or possibly arrange special sales with reduced bus fares for shopping at their stores.

The value of a public information system would be threefold. First, the permanent users would be notified of a change beforehand, which would prevent inconvenience. Second, nonusers would be reached and possibly attracted as permanent riders. Finally, the campaign would provide continuing public relations with the general public.

Activate and Monitor Improvement

Once the public is informed, the decision-maker would activate the improvement. The improvement would then be monitored throughout a predetermined trial period. The monitoring process would attempt to answer the following questions: How many riders have been attracted and why? How many permanent riders have discontinued use of the system? How have other parts (other routes) of the system been affected? What is the reaction of the permanent riders to the improvement?

Continue Monitoring

Monitoring the public transportation system would be a continuing process. With it lies the key to observing sharp changes in the measured indicators, i.e., the use or performance of the system. It also provides a solid informational basis for predicting long-term trends for planning purposes, a prerequisite to calibration of the forecasting and simulation models. Finally, monitoring would provide the decision-maker with a clear picture of how the system is performing and thus would enable him to determine and provide the needed improvements.

APPLICATION OF VANDALISM INDICATORS TO MODEL CITIES SHUTTLE BUS SYSTEM, ATLANTA, GEORGIA

The Model Neighborhood Area (MNA) in Atlanta consists of six neighborhoods and approximately 45,000 residents. Of the households in the MNA, 56 percent have annual incomes of less than $4,000. Only about one-third of the MNA families own an automobile (4).

The Model Cities Shuttle Bus System was developed in June 1969 to provide intra-neighborhood transportation and to complement the regular Atlanta bus system. Model Cities buses are provided by the Atlanta Transit System, Inc. Fares are 10 cents per ride, and transfers worth 15 cents credit toward regular bus fares are available. Supplemental funds are provided by the Model Cities program to make up the difference between revenues and operating expenses.

Between the months of January and February 1971, a substantial variation in bus ridership occurred (5). An on-board survey was conducted, with a questionnaire, to determine the cause of this variation. The Model Cities staff discovered that one of the main reasons for this drop-off was a reduction in the evening ridership.

Through discussions with Atlanta Transit System officials and bus drivers, the staff discovered that 50 percent of the vandalism occurred after dark (8:00 p.m. to 12 midnight). The bus drivers reported that the vandals were youthful joyriders engaged in rock-throwing battles with youths of various neighborhoods as the bus proceeded along the route. In addition, numerous complaints were received by the Model Cities staff from the Atlanta Transit System concerning assaults on drivers and night riders. Thus, vandals were scaring off potential night riders as well as causing damage to the bus.

Several alternatives were possible for improving the system: increase the fare enough to make joyriding too expensive; place an armed guard on the bus from 8 p.m. to midnight; request more police protection at the locations of the rock fights; or discontinue bus service from 8 p.m. to 12 midnight. Each of these improvements would have obvious disadvantages. Increasing the fare would place a burden on the regular night riders. Placing an armed guard on the bus or extra policemen in the neighborhoods could have led to a riot and possible harm to innocent people. Finally, discontinuing service in the evening would reduce ridership and would inconvenience night riders.

Weighing all these points, the Model Cities staff selected to end bus service from 8:00 p.m. to 12 midnight and consequently lose 15 percent of their riders. In so doing, cost of the annual vandalism contract with the Atlanta Transit System was reduced from $8,000 to $4,000.

The staff then looked for an improvement to increase lost ridership by using the funds saved from vandalism cost. The solution was to provide a new north-south route connecting the Southside Comprehensive Medical Center in the MNA to Grady Hospital outside the MNA. The Center provides health services to many of the residents because there are no doctors in private practice in the MNA. The Center also refers many of its patients to Grady Hospital.

The new route complemented the existing loop system. Residents can transfer from the loop system to the north-south route and reduce their travel time by about half an hour. Furthermore, the additional Grady ridership more than made up for the 15 percent loss of night riders.

The Model Cities staff used an extensive public information campaign to inform riders of the discontinued night service and to promote the new Grady express route. Handouts were distributed in neighborhood stores, community group meetings, schools, and all Model Cities project offices. A total of 20,000 handouts were circulated.

Thirteen resident interviewers were placed on the buses for 2 weeks. During the first week the interviewers explained the changes that were to be made. In the second week, interviewers were positioned on the Grady and loop routes and acted as guides, pointing out various activities along the route and helping riders transfer.

Currently these improvements are being monitored. Vandalism costs are reported monthly and were only $30.45 and $37.34 for May and June. The Grady ridership increased from approximately 200 per day to 340 per day in May. During the month of June, the Grady ridership remained the same and an increase of about 2,200 riders was recorded for the loop system.

SUMMARY

In the past, social indicators were applied on a nationwide basis. Such approaches attempted to evaluate broad goals and policies or to predict long-term trends. Generally, these approaches have not investigated the use of social indicators for transportation planning or evaluation.

The framework developed in this paper lends itself more to an urban area and concentrates on public transportation systems. Specifically, the authors have shown how social indicators were used to reduce operating costs and increase ridership for the Atlanta Model Cities Shuttle Bus System.

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ECONOMICS OF TRANSPORTATION CORRIDORS: FURTHER EMPIRICAL ANALYSIS

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This paper poses the question: Do transportation corridors make economic sense? The answer yielded in earlier work and supported more rigorously here is No. A sample of 325 randomly selected properties were chosen from the assessment roles of the city of Burnaby, in the Vancouver, British Columbia, metropolitan region. Two relationships were explored. First, we examined the rate of increase of real property values during a 19-year period for which consistent assessment data were available. A deflated price index was developed for all 325 properties and for a smaller sample of some 24 properties within 0.2 mile of the Trans-Canada Highway. In both instances the rate of appreciation of the property fell considerably short of the 8 percent opportunity cost of purchasing and holding the property. Second, an estimate of the rental value of the acquired property was included in the previous calculations. Here again, when management and operating costs, foregone property and income taxes, and depreciation are taken into account, the net revenue resulting from leasing the property plus the appreciation of the property still does not cover the opportunity cost. From a strictly economic viewpoint, therefore, the corridor concept does not pay even when we allow for leasing of acquired property. These findings confirm the previous results and appear quite sound. However, I would not conclude that the corridor concept should not be applied to transportation planning. Particularly with the present concern for social and environmental factors, the concept has much to recommend itself. I would urge, however, that these strengths be noted and not its dubious economies.

• THIS is the last phase of a series of studies begun almost 3 years ago by the author and Heaver (1, 2). This paper builds directly on the previous work with two refinements. First, the economic framework developed in the first study and tested in the second is subjected to further empirical testing in a different area of the Vancouver region. This provides further support to the findings to date. The second refinement reported on relates to the inclusion of the rental value of property acquired in advance of need. This rental value was excluded in our earlier work and assumed to be balanced by lost tax revenues and the cost of operating rental property. The present paper probes this area more deeply inasmuch as data that allowed the calculation of rents and their relationship to assessed values were provided. The data base and the empirical work are described in more detail below.

The next two sections bring the reader up to date by summarizing the two previous papers and their findings. New data are presented to complement the earlier empirical work and to examine the inclusion of rents in the economic analysis of transportation corridors. The concluding section summarizes the progression of studies, gives conclusions, and points the way for further study and expansion of the corridor concept in the transportation planning process.

Sponsored by Committee on Social, Economic and Environmental Factors of Transportation.

ANALYTICAL FRAMEWORK

Transportation corridors and related ideas have been espoused over the past half century. By the 1960s urban freeway development was nearing its peak, and the high costs of acquisition, urban sprawl, and inadequate planning were becoming painfully apparent. It is against this background that the renewed interest in transportation corridors should be viewed.

Accordingly, the first task we undertook was to define the transportation corridor concept in a reasonably rigorous and operational manner. Having done this, our first paper went on to delineate an economic framework for the evaluation of corridor projects.

After reviewing existing literature, we identified three elements that differentiate, and therefore serve to define, transportation corridors from the standard right-of-way. These elements are as follows:

1. Buying early (advance acquisition of the right-of-way),
2. Buying more (more than short-run needs dictate), and
3. Designing for multipurpose use of the land.

The economic framework that evolved was that of cost-benefit analysis. We attempted to define the various kinds of costs encountered in such an analysis, including the following:

1. Economic costs—opportunity costs,
2. Financial costs—monetary outlays,
3. Direct costs—those incurred in acquiring and holding land,
4. Indirect costs—those costs that are induced in adjacent areas and activities, and
5. Tangible costs—costs that are easily measured in monetary terms (e.g., quality of environment and noise).

These costs provided a basis for analyzing the specific costs involved in acquiring more land than is needed immediately (i.e., corridors). There were two primary sets of costs involved: acquisition costs and holding costs. Each in turn was subjected to analysis. The benefits were treated in an entirely analogous manner.

The substance of the argument, and the conclusions, can easily be illustrated as shown in Figure 1. In the future there are two curves. The curve C_e represents the cumulative costs of buying the land at time t_A and holding it, thus incurring holding costs each year. The second and more curvilinear function, C_l, represents the cost of buying at some later date. This curve illustrates the great appreciation of rural fringe land as it is developed for urban uses, roughly near the point C. This curve depicts the progress of land values over time and represents the actual purchase price of property at any point of time.

The curves shown in Figure 1 demonstrate that it is not always economically wise to purchase land in advance of need. The early purchase plus holding cost curve is above the late purchase curve at all points to the left of B. To the right of B, land values accelerate to such an extent that early purchase plus holding cost represents an economic saving. It is doubtless that this situation is in most people's minds when they state that early purchase is a method of saving on acquisition costs. The more usual situation, in which a corridor is planned to stretch out into some as yet undeveloped suburb, is represented by the acquisition points to the left of B.

Employing the usual methods of microeconomic analysis shows that the optimum time to buy is where the slopes of the early and late purchase curves are parallel and where the late purchase curve is rising more rapidly for successive points to the right. Point C in Figure 1 is such a point and represents the maximum saving possible from buying early and the maximum vertical distance between the two curves. A straightforward proof of this proposition concludes our original argument.

INITIAL EMPIRICAL ANALYSIS AND FINDINGS

With the framework established, we next set out to investigate the economics of corridor acquisition (2). A sample of some 200 properties were selected from assessment rolls. We looked at real property values and land values. Real property values were selected as our focus inasmuch as acquisition costs are based on this figure and not simply land costs.

The area selected to test the corridor concept is typical of a zone in which property acquisition for a corridor might take place. Richmond, B.C., is a part of a rapidly growing metropolitan area. The municipality enjoys good access to the Vancouver CBD and satellite commercial cores, and its population is increasing rapidly.

Two characteristics of the area are likely to be particularly favorable to rapid increases in values. First, a freeway was completed through the area in 1959, which accelerated the process of development (3). Second, a significant amount of land is undeveloped, and it is land in this state that normally shows the greatest percentage of appreciation in value (4, 5).

However, data show that even the properties closest to the freeway only increased at a compound annual rate of 2.85 percent net inflation. Properties in Richmond as a whole only increased at a compound annual rate of 5.23 percent net inflation. Although the data have the usual problems characteristic of land and property value samples, the statistical reliability of the data is very good.

If it is supposed that holding costs are only 8 percent per annum, the results show that the increase in value of suburban properties is not sufficient to make advance acquisition attractive. The cost savings possible from buying very wide corridors in advance of expansion requirements also appear to be very limited. These results are consistent with the evidence available in other studies that have examined property values over time.

These studies all report average rates of increase in excess of those recorded in Richmond. It may be questioned, therefore, whether the experience in Richmond is typical of other rural-urban fringe areas. We think it is. The differences between our estimates and those of other studies can largely be accounted for by use of real property values and not simply land values. When land values are substituted for real property values, for all the properties in our Richmond sample, we get a regression equation of

$$V_L = 0.0740\, e^{0.0872t}_{0.0141} \quad R^2 = 0.7767 \quad F(1,11) = 38.3094$$

which implies a growth rate of 8.72 percent per annum and is significant at the 0.001 level.

To conclude that the rate of increase in suburban property values is modest is surprising at first sight. We are accustomed to reading of substantial changes over a number of years and certain cases of spectacular increases over a very short period. In reality, however, the effect of urbanization is gradual. Proportional changes in the radius of the city result in geometric increases in the supply of land (6). It takes considerable time, therefore, for a zone to experience an acceleration in the rate at which land values increase as urbanization approaches. The creeping process of urbanization consumes land lot by lot and results in gradual changes in the growth rate of wide bands.

To go several miles from the suburbs to acquire land for transportation corridors is not warranted on the basis of an analysis of tangible acquisition costs. Even as urbanization proceeds, the high level of holding costs demands that the rate of increase be in excess of 10 percent per annum before advance acquisition is warranted (7, 8). Drachman's rule (with the then prevailing interest rate of 7½ percent) was that land must double in value every 6 years to be a worthwhile investment. This implies a growth rate of 12 percent.

The high rate of appreciation necessary for an entrepreneur to make a profit by speculating in land was observed by Drachman (8). It should be noted that he assumed an interest rate of 7½ percent and an inflation rate of 4 percent. Current financial costs would run 2 percent above each figure, boosting Drachman's carrying charges to nearly 18 percent, which implies a doubling of land value every 4 years instead of the previous 6. It should be noted that Drachman is concerned (as are others who talk of speculation) with the appreciation of raw land. The question of speculation (and urban sprawl) is not posed in terms of real property appreciation (i.e., land plus improvements). This follows because land alone is cheaper and thus provides a lower base on which appreciation can accrue, as well as being easier to speculate in because of its lower price. Finally, raw land is more liquid because it is not constrained in use, nor by sunk capital costs, by the existence of improvements. Our results point this out: Raw land appreciates much more rapidly than does real property (8.76 versus 5.23 percent). The lack of liquidity depresses real property appreciation and thus makes the economics of corridors even more unattractive.

We observed that, although our conclusions were tentative and assumed away such things as rental value of acquired property, they did appear to reduce the apparent economic justifications for the concept. We went on to stress, however, that even a completely satisfactory economic repudiation of the corridor idea should not obviate it. There are doubtless substantial intangible benefits associated with corridors. Integrated land use and transportation planning and better treatment of environmental problems such as air and noise pollution would seem to be intangible benefits of corridors. We concluded therefore that too much stress on cost savings of advance acquisition may actually detract from the inherent strengths of the concept.

Our final observation was that additional empirical work should be undertaken to verify the initial findings. We noted (2) that "...time series studies of land values in other rural-urban fringe regions are desirable to substantiate the generality of the conclusions." This is the role of the present paper.

FURTHER EMPIRICAL ANALYSIS AND FINDINGS

To ensure comparability with the previous study, we again collected data for a suburban municipality in the Vancouver region (Table 1), this time from the municipality of Burnaby, the immediate eastern neighbor of Vancouver, as well as the location of the freeway in 1961 (Fig. 2). The present sample also comes from assessment records but is somewhat larger than the previous sample (325 properties compared with 200). Unlike the initial sample, which was random with respect to a preselected subarea of the study region (Richmond), the present one was completely randomly selected. The analysis begins with a test of the initial work; it then goes on to consider the rental value of acquired property and its effect on the economics of buying early.

Retesting the Economics of Corridors

Testing the economics of transportation corridors is at best hazardous. For purposes of comparability, this paper follows the same procedure, albeit imperfect, as the earlier one. First we need to derive what the actual deflated rate of real property appreciation in the test area is. Knowing this, we can then compare this rate of appreciation to the social opportunity cost of capital and determine whether the cost of capital was exceeded. If it was, then it pays in an economic sense to purchase early; otherwise, it does not.

Accordingly, a regression was fitted to the sample with time as the independent variable and real property value and land value as the dependent variables. The results are given in Eq. 1, real property, and Eq. 2, land values only. Figure 3 shows this information graphically.

$$V_P(t) = 1.00315\, e^{0.02513t}_{0.004506} \qquad R^2 = 0.6467,\quad F(1, 17) = 31.122,\quad \text{t-statistic} = 5.579 \tag{1}$$

$$V_L(t) = 1.07928\, e^{0.08510t}_{0.00525} \qquad R^2 = 0.9392,\quad F(1, 17) = 262.517,\quad \text{t-statistic} = 16.202 \tag{2}$$

where

$V_P(t)$ = assessed real property value,
$V_L(t)$ = assessed land value, and
t = time in years.

Figure 1. Acquisition, holding, and development costs.

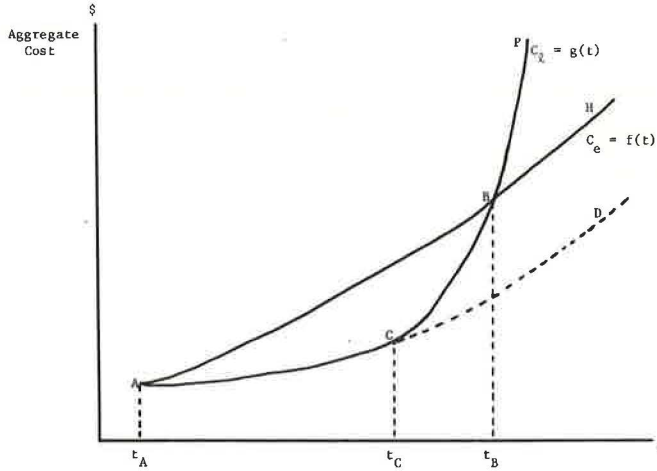
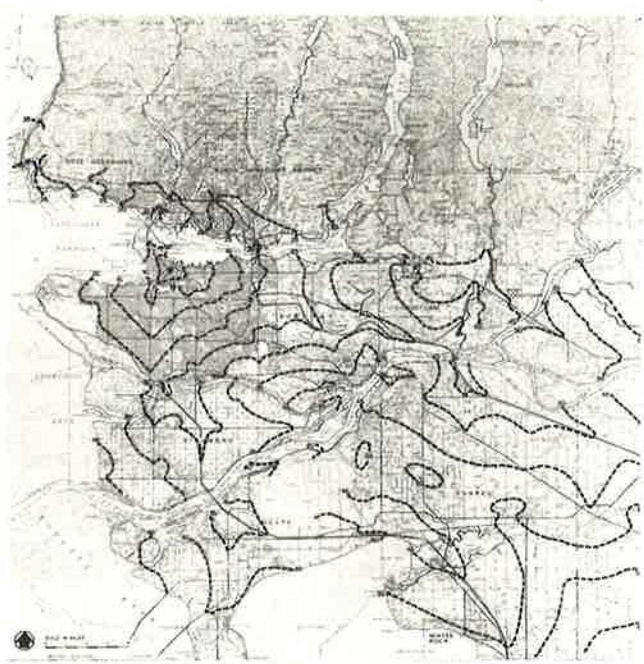


Table 1. Deflated price index of assessed land and property values.

Date	Land	Improvements	Land and Improvements	Fitted Values: Land and Improvements	Fitted Values: Land
1953	1.00	1.00	1.00	1.03	1.12
1954	1.08	0.96	0.98	1.05	1.24
1955	1.26	0.97	1.02	1.08	1.35
1956	1.39	1.00	1.06	1.11	1.47
1957	1.69	1.04	1.19	1.12	1.61
1958	2.21	1.06	1.28	1.17	1.75
1959	2.09	1.07	1.26	1.19	1.91
1960	2.20	1.05	1.27	1.21	2.09
1961	2.37	1.07	1.32	1.24	2.24
1962	2.97	1.05	1.32	1.27	2.48
1963	3.02	1.04	1.28	1.31	2.71
1964	2.99	1.03	1.51	1.34	2.97
1965	2.98	1.27	1.26	1.37	3.22
1966	3.05	0.85	1.35	1.41	3.51
1967	3.18	1.05	1.36	1.44	3.77
1968	3.99	0.87	1.43	1.48	4.18
1969	4.49	0.86	1.57	1.51	4.56
1970	5.18	0.87	1.61	1.54	4.97
1971	5.53	0.84	1.63	1.57	5.45

Source: Burnaby Assessor's Office.

Figure 2. Vancouver area.



SOURCE: GREATER VANCOUVER REGIONAL DISTRICT, 1970

From these equations we see that land alone appreciated at 8.51 percent annually compounded and real property at the much slower rate of 2.51 percent. In each instance the constant term of the regression is not significantly different from unity. Time, therefore, explains some 65 and 94 percent of the variance respectively. All the statistics are significant at the 0.001 level. Similar regression equations reducing both land and property values on a basis of square feet of land yielded the following:

$$V_p(t) = e^{0.02433t}_{0.00395} \qquad R^2 = 0.8001, \quad F(1, 17) = 68.04, \quad \text{t-statistic} = 8.25 \tag{1a}$$

$$V_L(t) = e^{0.08706t}_{0.00477} \qquad R^2 = 0.9514, \quad F(1, 17) = 333.09, \quad \text{t-statistic} = 18.25 \tag{2a}$$

These results are very similar to those in Eqs. 1 and 2.

The more modest increase in real property is accounted for by the depreciation of the improvements on the land relative to the land values inasmuch as acquisition costs cover real property and not just the land itself. The 2.51 percent rate of appreciation certainly does not warrant early purchase in light of an assumed 8 percent opportunity cost. We arrived at this 8 percent figure after reading over the various estimates of other authors and noting that their estimates fell in the 6 to 10 percent range. The mean of 8 percent seemed reasonable. However, even if the lower estimate is taken, early purchase is still not warranted in light of the low rate of property appreciation.

These results imply that, were a corridor purchased in 1953 for construction in 1971, society would suffer a net loss of from 3.5 to 7.5 percent per year on its investment. This is quite a strong finding statistically. (One question that has not been looked at is the relationship between assessed value and actual sales value. A sample of 225 record sales and assessment yielded a correlation coefficient equal to 0.4764, which is significant at the 0.001 level.) In addition, Burnaby is precisely the kind of suburban area that is ripe for such freeway development. In fact, to date there has already been one freeway constructed through the municipality (in 1961). To the extent that Burnaby has already received increased accessibility from the freeway, the growth rate of property values is in fact higher than it would have been had the land been purchased before such improvements were made in the transportation system.

It can be argued that taking an average property appreciation figure over the entire municipality avoids the question of expansion of an existing right-of-way, since to answer such a question one would be interested in those properties that fell within 0.1 or 0.2 mile of a freeway. It has been argued in the past that it is these properties that appreciate so greatly due to their access to the freeway. Such an assertion can be tested in Burnaby by looking at those properties falling within a band 0.1 or 0.2 mile of the Trans-Canada Highway. This effectively looks at the economics of buying more land as well as buying it early.

Regressions analogous to Eqs. 1 and 2 were fitted to properties falling within 0.2 mile of the Trans-Canada Highway. They are given in Table 2 as Eqs. 3 and 4. Equations 5 and 6 present the same information for properties falling between 0.1 and 0.2 mile of the freeway. They are all significant at the 0.001 level.

The results show that the effect of the freeway is very localized, a significantly higher rate of appreciation of both land and property values being within 0.1 mile of the freeway. However, as we move out to the next band between 0.1 and 0.2 mile we see that appreciation falls off sharply from 11.01 to 6.86 percent for land and from 4.11 to 2.98 percent for land plus improvements. Even the 4.11 percent growth rate falls below the lower range of the cost of capital of 6 percent.

From these findings, it seems not to be economically sensible to acquire excess land for right-of-way expansion. The evidence presented in Eqs. 1 through 6 supports the previous findings and presents no support for the assertion that buying more and buying early will result in economic savings.

Testing the Concept With Leasing of Acquired Property

In the preceding section, as well as in the previous empirical study, it was assumed that the only holding costs were opportunity costs of the social capital used to purchase the corridor. The assumption was made that renting the acquired property would be balanced by lost taxes (both property and income taxes), operating expenses, and maintenance costs.

Obtaining accurate information on the rental value of real property is very difficult. Even with data in hand it is trying to compare such information with the data on property appreciation. Accordingly, assessed rental value information was obtained. These data are consistent with the assessed value data on which the previous findings are based and have stood the test of time and consistency of assessment practice.

The goal of this section is to provide an estimate of the net annual addition to cost savings that results from leasing acquired property. Equation 7 sets out the cost savings calculation.

$$S = GAR - OE - DEP - LIT - LPT \qquad (7)$$

where

S = addition to cost savings (as a percentage of acquisition cost, i.e., assessed value),
GAR = gross assessed rental value,
OE = operating expenses excluding property taxes,
DEP = physical depreciation,
LIT = lost income taxes from developer, and
LPT = lost property taxes.

Data were collected to estimate each of the terms in Eq. 7. Thus, GAR was found to be equal to roughly 7 percent of the assessed value of the property. A regression between GAR and AV (assessed value) yielded

$$\underset{}{GAR} = \underset{(419.0)}{1{,}492.7} + \underset{(0.0039)}{0.0675AV} \qquad R^2 = 0.6507,\quad F(1, 159) = 296.17,\quad t\text{-statistic} = 17.21$$

Information from the Greater Vancouver Real Estate Board (9) established that operating expenses net of property taxes constituted from 21.8 to 34.1 percent of gross rent for frame buildings depending on age. Property taxes varied from 11.2 to 13.5 percent of gross rent for these structures. For office buildings the operating expenses were 23.5 percent of gross rent, whereas property taxes represented 13.0 percent.

To estimate depreciation of the improvements required an estimate of improvements as a percentage of assessed value. Using the assessment information yielded improvements equal to 52 percent of the property value. A regression showed

$$\text{Improvements} = \underset{(0.026)}{0.521AV} \qquad R^2 = 0.7065,\quad F(1, 159) = 382.75,\quad t\text{-statistic} = 19.56$$

Assuming a 50-year life and straight-line physical depreciation yields annual depreciation equal to 1 percent of the assessed value.

Finally, lost income taxes were calculated from information on the average return on investment in real property (10). The average return was 5.5 percent after taxes. This implies a before-tax return of 10.0 percent, which further implies lost income taxes roughly equal to 4.5 percent of the capitalized value of the property (assessed value in our terms).

With this information we can then calculate S as follows:

$$\begin{aligned} S &= 0.07AV - 0.20(0.07AV) - 0.01AV - 0.045AV - 0.010AV \\ &= 0.07AV - 0.014AV - 0.01AV - 0.045AV - 0.010AV \\ &= -0.010AV \end{aligned} \qquad (8)$$

Upon closer scrutiny, it appears that our assumption was correct and that costs of holding, maintaining, and renting the property do offset the rental income. The calculation given in Eq. 8, rough as it is, shows in fact that the saving is negative. Even if we assume away depreciation on the argument that the structures will be demolished for the corridor, the saving is still -0.009AV.

Even if we acknowledge the weakness of data and the assumptions made in the calculation of S, it still appears that allowing for leasing of acquired property does not improve the economics of transportation corridors.

CONCLUSIONS

The present study confirms the findings of the previous one. Moreover, the statistical results being more conclusive and the sample being more complete allow stronger conclusions to be drawn.

Under the assumption that rental revenue will be offset by holding costs and lost taxes, the findings show clearly that there is no economic justification for early acquisition of large corridors. Calculating the likely effect of rental income showed that there would be little effect, thus validating the previous assumption.

One might draw the conclusion therefore that both corridor planning and leasing until need should be discouraged. Quite the contrary. Previous papers by the author and others have pointed out the need for flexibility in transportation planning as well as integrating transportation planning with land use and more recently environmental planning. Wide transportation corridors (up to ½ mile in width) would seem to be very effective in achieving such integration and flexibility. We would not like to see these strengths ignored by discrediting corridors because of overly enthusiastic claims of economic savings. One point should be stressed. This relates to interinstitutional differences between British Columbia and the rest of Canada and the United States. One of the significant elements in the land development process in British Columbia is the absence of large-scale builders. There are currently no builders who construct more than 100 private single-family homes a year. Thus, the average developer is small, and the development process proceeds in a checkerboard but relatively small incremental pattern. Urban sprawl has taken place, but it has been the result of the development of a large number of very small subdivisions. The absence of large-scale community builders in British Columbia means that growth takes place in a reasonably smooth way.

Land prices tend to rise continuously over time rather than by large discrete jumps, which would correspond to large discrete developments. Thus, one of the claims of proponents of the corridor concepts—that corridors save large amounts of capital by preventing large-scale subdivisions—does not apply in British Columbia inasmuch as there are no large-scale subdivisions. The situation is likely to be quite different in the United States, and it is entirely conceivable that significant savings might result from advance acquisition by preventing the large-scale builder from building in the path of a corridor. Related questions were touched on in our earliest paper.

It is hoped that future studies of the corridor concept will cloak that concept in a broader context, where it can be viewed as one of a small variety of tools available to the regional planner, tools that have social, environmental, transportation, and land use implications on a large scale. It is my strong feeling, therefore, that corridors should be brought into the family of planning tools. They do make sense but not cents.

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DISCUSSION

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I do not disagree with Goldberg's conclusions, only with his method of arriving at them. I refer here to his implicit definition of "benefits" as the difference between the costs of acquisition when the corridor is identified and the costs of acquisition when the land is actually needed. If he were considering private investment he would be correct, but highway corridors are public investments that require consideration of total societal welfare. When viewed from this broader perspective it becomes quite clear that, without knowledge of the gainers and the losers, we can say only that a transfer results. We cannot say we have increased economic benefits and thus societal welfare.

Indeed, the "benefits" derived from a program like advance acquisition of corridors considered in Goldberg's context meet neither the Pareto criteria nor the less stringent Hicks-Kaldor criteria for optimal resource allocation. [The Pareto criterion says that the welfare of society is increased if one is made better off, given no one else is made worse off. The Hicks-Kaldor criterion extends this by saying that societal welfare is increased if the gainers of a resource reallocation gain more than the losers lose (11).]

Unless we can identify and are willing to make utility decisions concerning the landholders from whom the windfall gains will be taken we can make no pronouncements either positive or negative about the economic desirability of such redistributive programs. We may be quite willing to do so, but I dare say our decisions may be quite different in each case. (Consider the poor farmer's widow whose only asset is land, whose income is $5,000 a year below the median income of the gasoline taxpayer, and whose farm happens to lie adjacent to a new highway. Then consider the moneyed land speculator whose business it is to foreclose on mortgages of poor old farmers' widows, knowing full well where the location of the new highway corridor is.) We can say, however, that there are considerably more efficient programs for causing redistributions if that be our objective.

Having made this unequivocal statement, let me elaborate slightly. If we know the appropriate social rate of discount, the rate of return of the landholders in their best alternative investment (other than in the land), and if we assume the utility of money to be constant, we can determine under the Hicks-Kaldor criterion whether the social welfare has increased. But those are a lot of ifs.

However, let us assume for a moment that we do know all these things. Then social welfare has increased by

$$W = Po\left[(1 + b)^n - (1 + r)^n\right]$$

where

Po = cost of a specific piece of property when the corridor is identified,
b = private rate of return on best alternative investment,
r = government's rate of discount, and
n = number of years until property is needed.

Notice first that this function does not depend on the rate at which land is appreciating in value and second that it is positive when $b > r$. However, without a case-by-case comparison of r with b, we still cannot make a categorical statement about welfare, for if $r > b$, which is not unlikely (although Goldberg's work shows that this is so; i.e., he shows that $r > a$, but $a > b$ to cause the landholder to invest in land instead of his alternative investment; therefore, $r > b$), welfare is decreased.

I must admit that the foregoing analysis does not consider improvements to the land made during the period between corridor identification and purchase. But neither does Goldberg's. That is a broader question for which we would need to examine the economics of such in-between alternatives as land use controls.

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The purpose of this discussion is to raise some questions about the approach proposed by Goldberg for the economic evaluation of transportation corridors. It is suggested that the following questions be carefully considered before the approach is used in making decisions on transportation corridors.

IS AN ECONOMIC OR A FINANCIAL APPROACH PREFERRED?

The paper purports to deal with "the economics of transportation corridors," "measuring the impact of transportation corridors," and "testing the economics of transportation corridors." From such captions, one might expect to find evaluations that could be used as a guide if one wished to make decisions from the point of view of the overall economic good of the community. The information presented by Goldberg, however, establishes only that, if an agency desired to acquire a corridor traversing the entire municipality of Richmond, B.C., it would be farther ahead financially to acquire near the end of the 1958-1969 period rather than earlier in that period. In reaching this conclusion, it is assumed that (a) money costs more than 5 to 6 percent, (b) the agency is able to purchase land at the assessed value at any time, and (c) land values increase gradually under the impact of urban development.

What perspective is required for an economic assessment in the broad interest of the whole community? Should it be the point of view of an agency, assumed to hold all of the land, wishing to maximize the economic good of the community?

SHOULD ONE CONSIDER THE WAVE OF RESOURCE INVESTMENT DURING DEVELOPMENT?

One of the most significant characteristics of the data given in Table 1 and shown in Figure 3 is the jump. Goldberg explains this by saying that the completion of several large developments account for a jump in the value of land and completions. One must ask, however, if such jumps are important to the economics of corridors. Urban development occurs when raw land is subdivided and serviced and when improvements are constructed. This phenomenon is reflected in property prices by a jump. This price jump reflects the investment of real resources such as the labor and materials for the construction of services. The amount of the jump is some indication of the quantity of resources consumed and thus of the economic value.

For any particular radial corridor extending through the zone of land development, the price jump will tend to move outward from the center like a wave. The obvious time for corridor acquisition, or reservation, at each particular point is just before the price wave hits that point. Therefore, should not any analysis aimed at determining the optimal time of corridor acquisition, or reservation (whether economic or financial), of necessity be an analysis of this wave propagation?

Possibly the surprising conclusion that "the rate of increase in suburban property value is modest" is a result of the author's curve-fitting methodology, which obscures the jump. Goldberg states that "the creeping process of urbanization consumes land lot by lot and results in gradual changes in the growth rate of wide bands." It should be clear that the rate of the price change depends directly on the width of the band selected. A narrow, CBD-concentric band will show an abrupt jump, whereas a wide band will show a gradual increase. If the band is chosen wide enough, let's say to include the entire nation, then the rate of increase may only be the rate of inflation plus appreciation due to population growth.

IS MARKET PRICE A USEFUL INDICATOR OF "THE VALUE OF REAL PROPERTY"?

For an economic evaluation of corridors from the community viewpoint, it is important to penetrate the meaning of the value of real property. The author uses assessed value to quantify the value of real property. He defends this by showing a correlation with actual sale price. The linearity of this correlation is not surprising because assessed values are usually established to bear some consistent relationship to market price. The question remains, therefore, whether market prices are a good indicator of the economic value of the real property used for corridors.

The importance and difficulty of this question are underlined by the fact that there is really no market for corridor land. Land price is related to zoned use. The market price varies greatly when the zoning is changed, as, for example, if single-family land is rezoned to multiple-family land. There is a market price for residential land of a particular type and location, but how can one determine a market price for street land that the developer is required to dedicate to the municipality when the land is subdivided? What is the market price for corridor land?

Market price is of doubtful usefulness, not only because of the absence of a suitable market but also because, for an economic evaluation from a community point of view, we should be interested in the entire community. If a city with corridors were better or worse than a city without corridors, this theoretically might be determined in a marketplace where cities were bought and sold. Inasmuch as there is no such market, the market price approach seems a blind alley.

Consider a theory of the relationship between land price and the quality of the transportation, a theory stating that "the sum of the land price of all parcels in an urbanized region, less the replacement cost of useful services and improvements, is an inverse measure of the quality of the transportation system." At least one extreme of this theory seems valid: If transportation were perfect, i.e., speed infinite and cost zero, then the total land price less improvements is likely to be low. At the other extreme, the theory also checks because the highest land prices in the world come at the center of cities, such as Hong Kong, with very poor transportation systems. This theory has not been proved, but it cannot easily be disproved. The very difficulty of disproving such a theory demonstrates that it is dangerous and possibly misleading to sum up micro land prices determined in the market and to use the result to draw macrolevel conclusions concerning the benefit of corridors to a metropolitan region.

SHOULD REAL PROPERTY VALUE BE APPROACHED THROUGH MEASURING OUTPUT?

Economic value may, in general, be thought of as the present worth of future production potential. In the case of rural agricultural land remote from urban development, the market price gives some indication of productive potential. Land that is more productive agriculturally and better located with respect to markets sells at a higher price, representing the benefit bestowed on the owner because he will be able to produce more agricultural products and to sell them at a better price. Under these conditions, one might consider using market prices for agricultural land as a measure of economic value.

The market conditions are much different, however, within urbanized areas and close to urbanized areas where land speculation occurs. Urban land prices are responsive to governmental and community actions that do not change the community's productivity, at least not in the way the land price changes it. Indeed, the land price may even vary inversely with the productivity. In each urban area there is a unique market for each category of land, e.g., desirable, easily accessible, or high-rise apartment land. Such land is a scarce commodity. The price is some indication of the degree of scarcity. The scarcity is increased by poor planning, zoning, and supply of transport facilities. If the planning is poor and the transport poor, such land might be very scarce indeed and thus very expensive. Comparing two similar cities that differ in the average price for high-rise land, we might expect the one with the higher land prices to have the inferior transport system and thus the inferior efficiency and productivity.

Urban land prices, therefore, cannot be used as a measure of production potential, and we must seek elsewhere for such a measure. In searching for such a measure, we must bear in mind the object. This can be illustrated as shown in Figures 4 and 5. We are not concerned so much with the production of particular parcels of land within these cities as with the productivity of the total city region and its variation between the two cases, without the corridors and with them. In both cases, the total area that we are considering is exactly the same, that is, πR^2. We are interested in some measure that would determine whether city A or city B is better, that is to say, which has a higher production potential. Market prices could mislead us, but how else can we get an indication?

One might suggest that the arrangement that gives the ability to produce a given output at a lower cost (i.e., at a lower consumption of resources) will also be the arrangement that gives the higher output. This assumes that there is some positive elasticity of output to price. If the city can produce television sets at a lower price, it will be able to sell more of them.

If the use of transportation corridors results in some rearrangement of the activities of a community on the land available to it, then the crucial question of the economics of corridors appears to be "What effect will this rearrangement of activities have on the cost of production?"

The net benefit from transportation corridors might thus be expressed in the following equation:

$$\text{Net benefit} = S - A - T_c + T_1$$

where

- S = present worth of saving in the cost of services, buildings, and roads, which results from the avoidance of reconstruction and of inefficiency that would be caused by rearrangement sometime after construction;
- A = loss of agricultural production, inasmuch as it is more difficult to use the corridor land, which is represented in Figure 5 by LW, for agricultural production than it is to use an equivalent amount of land at the perimeter of the city;
- T_c = present worth of the increased transportation cost necessitated because all trips crossing a corridor are made longer by the amount that the corridor is wider than necessary for the facility; and
- T_1 = present worth of reductions in transport costs throughout the metropolitan region, which occur because of improved transportation facilities that are implemented when the corridors are available and that would not be implemented without them.

Figure 3. Actual versus predicted values, 1953-1971.

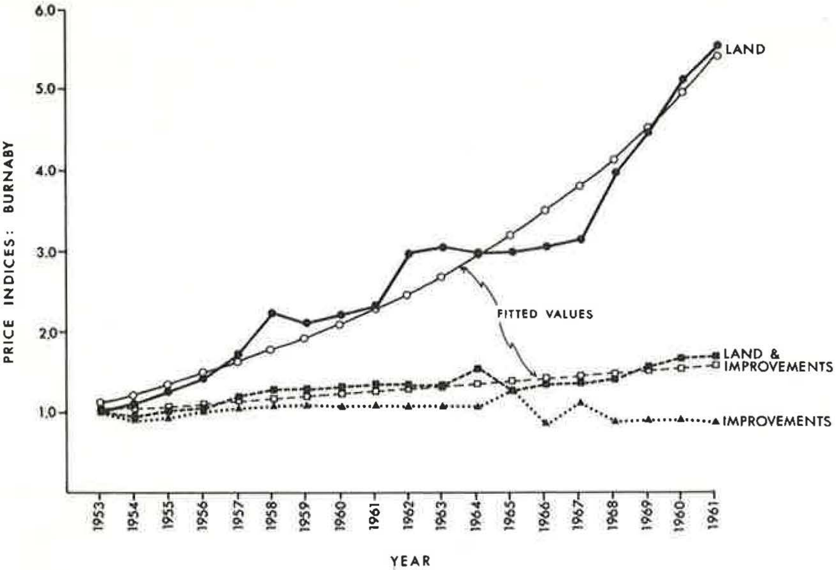


Table 2. Regression equations fitted to property within 0.2 mile of Trans-Canada Highway.

No.	Equation	R^2	F(1, 17)	t-Statistic
3	$V_L(t) = e^{0.11013t}_{0.02729}$	0.4893	16.291	4.036
4	$V_p(t) = e^{0.04106t}_{0.00328}$	0.9024	157.266	12.541
5	$V_L(t) = e^{0.06855t}_{0.01884}$	0.4377	13.233	3.638
6	$V_p(t) = e^{0.02975t}_{0.00354}$	0.8060	70.643	8.405

Figure 4. City "A" without corridors.

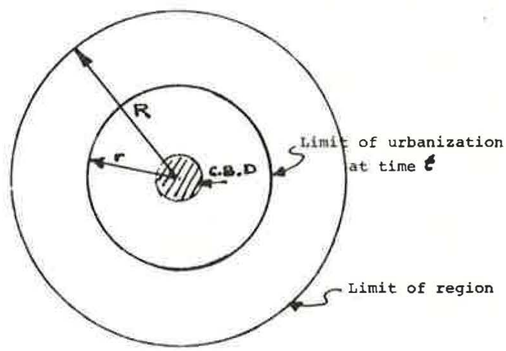
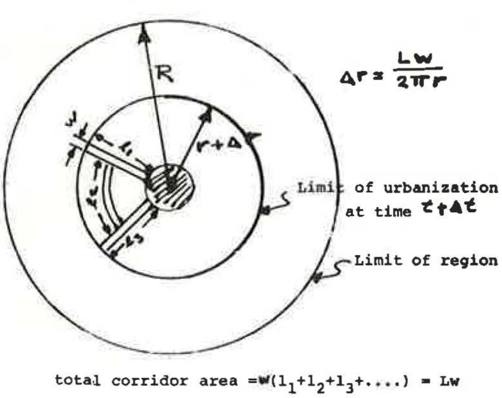


Figure 5. City "B" with corridors.



The approach to assessing the value of the various elements in this net benefit equation would be through a transport analysis for elements T_1 and T_c and through an analysis of the cost of services for S. It is only A that might be evaluated through land prices and could be taken as the unit price of agricultural land times the land area put out of agricultural production because of the use of corridors. In his paper, Goldberg appears to recognize S and T_1 as potential benefits of corridors, but he refers to them as "intangible benefits." I suggest that they are both real and tangible and that they have been quantified.

IS IT IMPORTANT WHO HOLDS THE CORRIDOR LAND?

Goldberg has formulated an economic analysis of transportation corridors in such a way that who holds the land appears to be an important question. This bias is introduced by the definition of corridors as relating to acquisition. This concept is also introduced by his idea of "holding costs," which is a term drawn from commercial real estate practice and which may not have any usefulness for purposes of economic evaluation. When we consider the options (with and without corridors, Figs. 4 and 5), it seems clear that the same amount of land is held in both cases. Would it not be desirable to have the methodology of economic analysis applicable to the case where all of the land is held by one agency? Many of those who have studied the question of transportation corridors have suggested procedures for achieving the benefits of corridors without acquisition. Thus, should not a valid method of economic analysis of transport corridors be required to give the same answer irrespective of how the land is held and by whom?

HOW SHOULD WE TREAT TAXES AND SHADOW PRICES?

In an economic analysis of a public enterprise, it is important to handle taxes carefully and to give consideration to the applicability of shadow prices.

The only place in which Goldberg refers to taxes is as follows: "Lacking evidence on possible annual revenues from property ownership, we have chosen to ignore lost taxes and maintenance costs. If the revenue exceeds the latter, we are understating the attractiveness of early purchase." The concept here seems to be that it might be possible to gain some revenue by renting the corridor land but that this will be balanced by taxes that the municipality will not receive and by maintenance costs; therefore, all three items are ignored. Is this an adequate method of considering taxes?

There are a number of interesting and significant tax questions relating to transport corridors. In the first place, consider whether municipal tax revenues are likely to be increased or decreased. If one considers the total municipal tax revenue of the metropolitan region as shown in Figures 4 and 5, then the tax revenues would decrease if the total assessed value of land and improvements in the metropolitan region were to decrease. There is no easy way of determining whether the total land values would, in fact, increase or decrease. Quite possibly, they would stay more or less the same, and, therefore, the total municipal revenue should be about the same, although it might be differently distributed to the several municipalities within the total region.

A more significant question perhaps is whether the ratio of municipal tax revenues to the cost of providing municipal services would be improved. If the corridor scheme does, indeed, improve the efficiency of providing services, then there could be a substantial benefit to the municipalities in terms of the relationship between tax revenue and the cost of services.

Another question is whether the costs are, indeed, net of taxes. This raises the question of the effect of taxes on land price, if one is to use land price in the analysis. Taxes and land prices could be related in a chicken-and-egg fashion, which would make it very difficult to analyze the net of taxes, unless one takes the approach of quantifying the costs of production.

Shadow pricing is another way of considering land price. Indeed, many of the questions we have asked can be rephrased as shadow price questions. Is the market price of land a valid price to use in the analysis, or should a shadow land price be used?

WHAT TYPE OF RESEARCH THRUST IS REQUIRED?

The research thrust suggested by Goldberg is based on the assumption that land price is a useful indicator of economic value. This assumption should be proved before research of the type proposed is likely to be useful. If, on the other hand, the line of thought suggested in this discussion is valid, then research on transportation corridors would take an entirely different thrust. Little confidence would be placed in land prices as an indicator of the economic value of corridors, and research would be directed more to the evaluation of total city efficiency for different transport and land use arrangements.

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VISUAL QUALITY FOR THE HIGHWAY USER: A STUDY OF THE RELATION OF FACTORS OF VISUAL QUALITY TO ROUTE DESIGN

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This paper, the product of a 4-year study, defines and illustrates how visual and aesthetic values for the highway user can be incorporated into the highway development process. Visual characteristics of the highway environment are described in terms of important performance characteristics and in terms of their functional use to the driver. In the problem-solving process developed here, all information is organized as specific guidelines and criteria for implementation during the standard phases of work in highway planning and design. Guidelines and criteria that are applicable during design are supplied, and the tools and techniques for implementation are described. The paper presents a compilation of material in the form of a case study and a step-by-step manual that illustrates how quality values for improved driver performance may be obtained in highway planning and design. Though many of the guidelines would be useful, this work is primarily applicable to rural highways and not to urban or highly developed areas. It should be most applicable in right-of-way design work because many of the factors described are utilized then. The information has not been field tested. This is a repeatable process. The guidelines and criteria are definitive and lead to specific decisions; they do not exclude good design judgments for many choices and tradeoffs. The process provides the highway planner a framework that can take advantage of the backgrounds and skills of design teams in the field.

• THE PROCESS as we have developed it parallels the current highway design process, with the following few modifications:

1. It relates directly to current methods of highway planning and design practice and parallels other highway planning design considerations such as engineering, geometrics, community values, and natural systems as a part of the "complete highway" concept as defined by the Highway Research Board and AASHO;
2. It is efficient and is illustrated step by step, linking each problem with its opportunities for solution, and it is objective and repeatable;
3. It provides guidelines and procedures, rather than specific and rigid operations, in order to take advantage of available choices that distinguish priorities and good design judgment; and
4. It is useful both for planning new highways and for evaluating existing locations.

IDENTIFYING ISSUES AND PROBLEMS

Our work in previous years investigated the total range of the needs of the driver as well as the necessary association of environmental and highway factors to meet his

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needs. Our approach assumes that attention must be given to the total experience of the driver, resulting in the accommodation of his needs. To do this we must identify a range of critical issues and their associated problems as they relate to driver experience and then develop a method for solving these problems while relating them to the design process. Consideration of the issues and the solution of their related problems lead to a better highway in terms of the visual and aesthetic aspects of the driving experience. These issues are as follows:

1. Visual exposure allows the driver to see, experience, and understand the visual environment through which he is traveling, to meet his travel expectations. He needs to have an appropriate image of the visual characteristics of the highway environment in and beyond the right-of-way; e.g., he may expect to see a major landmark.
2. Orientation information fulfills the driver's way-finding and orientational needs within the right-of-way and the visual highway environment. This is the need to know where he is and to find his way during travel; e.g., local roadside views illustrate travel progress.
3. Aesthetic experience, potentially available from the visual factors in the highway environment, provides interest and pleasure for the driver. This involves the particular elements and characteristics of the environment as well as their grouping as landscape composition, all as visually experienced during travel, e.g., a scenic view of high appeal.
4. Stimulation provides an adequate range of interest, arousal, and stimulation from the total driving experience, at each point in time and as it accumulates over time. Adequate stimulation eliminates fatigue and boredom during travel.

To deal with these issues specifically requires that each be divided into a series of definitive problems and operational needs relating to specific driving functions and experiences and visual factors.

If these problems are accommodated and resolved in highway planning and design, visual and aesthetic values enabling comprehensive travel experience will result. Each relies, for its resolution, on appropriate visual data from the environment and on the use of guidelines and criteria developed and applied at each phase of the highway design. Data and techniques to use them are illustrated later. An example follows.

One of the problems when we consider issue 3, aesthetic experience, for example, is defining the components of aesthetic visual quality. This is the need to experience qualitative and significant visual components in the highway landscape during travel. These compose the particular elements and characteristics of the environment such as seeing particular objects or experiencing a scenic view. The designer has to design for qualitative elements, natural or man-made objects or elements in the environment on their own merit (e.g., a lighthouse on a rockbound coast), and for qualitative settings, views (usually of large areas) that are capable of being seen and experienced by the driver.

Another problem is designing a sequential experience. This is the need for qualitative experience in relation to the sequential and dynamic visual characteristics of the right-of-way and beyond it. This represents the value of the cumulative effects of the experience. This need may be satisfied by the right-of-way design or by components of the landscape. The designer must design for landscape organization, the arrangement in a dynamic sense of the available elements, settings, and views with their locations and interrelationships. This includes the arrangement of visual enclosure, which focuses views, screens unsightly areas, and provides speed reference, and sets of visual areas that provide visual contrast, interest, and continuity to the travel experience. He must also design for the sensual form of the highway, which is the dynamic experience of movement, determined by the careful arrangement of horizontal and vertical alignment in harmony with the form of the landscape.

PROBLEM-SOLVING PROCEDURES

The interactions among all identified problems and the phases of work create opportunities in the environment and the highway for solution of these problems. To link all problems through all the phases of work to planning and design decisions on the ground requires that the following three activities be undertaken:

1. Inventory identifies and locates data types important for the solution of the problem (what in the general environment will be useful in solving the problem?);
2. Application of guidelines determines how and when the data types are to be used in the decision-making process; and
3. Application of criteria implements the guidelines in direct, on-the-ground decisions for physical location and design.

The procedures for accomplishing these functions are general enough to be useful for any physical location or highway type (allowing for differing goals) and are specific enough to aid in decision-making and tradeoffs.

Although the solution of each problem is of prime necessity, the phase-by-phase planning and design process is the controlling factor in application. Thus, in the normal process the procedures are used to solve each problem relevant to each phase of work by making the appropriate decisions and tradeoffs. Then the procedures are applied to the next phase of work. For instance, at the corridor selection phase, all problems and decisions for selecting a corridor are dealt with and made. Then, the route or alternate routes are selected, considering all problems again as they are relevant.

Study Area Maps

We organized the work by giving it a format that is useful in application and deals directly with problems in context with the planning and design process. Therefore, a series of maps that applies the procedures and aids problem-solving for an actual site is developed.

Each phase of work requires, as a resource, a base map containing all of the raw data that are important at that phase available from the environment, irrespective of the problem. These maps are consistent in scale with other work being done at that phase. The following three maps are used for the solution of one problem at one phase of work:

1. Inventory map, which is a map of all the pertinent data and their location as defined by the data types available in the study area, required by the problem;
2. Guideline application map, which shows the application of guidelines and their criteria, as they relate to the study area and to the available data; and
3. Resolution map, which shows the areas of decisions, adjustments, and refinements of the highway and the landscape design based on the judgments, decisions, and tradeoffs made.

Guidelines and Criteria

To implement decisions made on the basis of particular problems requires that guidelines and criteria be established. They are included here in the form of operations charts. They will mostly concern the reader interested in the details of decisions, but a general understanding of the process does not depend on their use. They contain the following information:

1. Data types that are important for solving the problem at each phase of work;
2. Guidelines that outline the nature of the decisions to be made, based on the problem and on the data type involved; and
3. Criteria that create the basis for decision-making, e.g., locating where events occur and determining their duration.

METHODS AND TECHNIQUES

In developing and applying the work of this paper, we used many methods and techniques. They include inventory, notation and ranking (or rating systems), and evaluation techniques, and they may be accomplished by manual methods, computer processing, computer graphics, or simulation. Many of the methods were developed by others, but we have, in previous work, developed and used methods of our own that were appropriate to the study.

Although it is vital to a useful process to employ the appropriate techniques, often several different methods can be used to achieve the correct result. The important thing is to select or develop the most appropriate techniques for solving the problem.

The following case study will demonstrate the application of the prototypical process outlined by using the procedures for the solution of two illustrative problems in a rural situation.

CASE STUDY DEMONSTRATION

To demonstrate the solution of highway development problems by employing the procedures described as they would be applied in practice, we have used a case study approach. We picked Cape Cod, Massachusetts, with the existing Mid-Cape Highway (US-6) as the location for our study area and concentrated on the northern end, near Provincetown, to illustrate prototypical procedures that can be applied to other highways (Fig. 1). This site is ideal because it is an interesting and appealing area with many diverse visual characteristics. This allows us to demonstrate, in a relatively small area, many of the problems and examples for their solution in the clearest and most concise way. Also, the existing highway has relatively clear objectives (e.g., destination and arrival at Provincetown and scenic and recreational uses), which could be used as an "evaluation" base for our work.

The case study demonstration should not be seen as a proposal for a new highway for the Cape nor as an evaluation of the existing highway but solely as a vehicle for describing the solution of problems and a demonstration of procedures for doing so. The visual values—"view from the road" needs—represented parallel, but do not include, the other values that make up the complete highway. We will demonstrate only one of the problems that need to be considered in the design of the complete highway, and we are concentrating on just the alignment and right-of-way design phases. It is also important to note that, for ease and clarity of description, we are studying only one travel direction, that toward Provincetown. Because of these limitations, the work of this report would not be complete enough to use in the planning process for a proposed highway, but it is, of course, very useful for demonstrating the points we want to make here.

The location of the demonstration on Cape Cod is shown in Figure 1. The problem will be carried out for corridor and route selection, alignment, and right-of-way design and for selected smaller areas. Determination of highway purpose and completion of prior phases of work will be assumed.

Format

To clearly describe the solution of problems and the process for their solution, we will demonstrate one of the problems mentioned earlier. This problem is diverse enough to cover the kinds of solutions that can be developed: What are the components of aesthetic visual quality? The problem is qualitative and deals with the interest and pleasure of the driver while he is traveling.

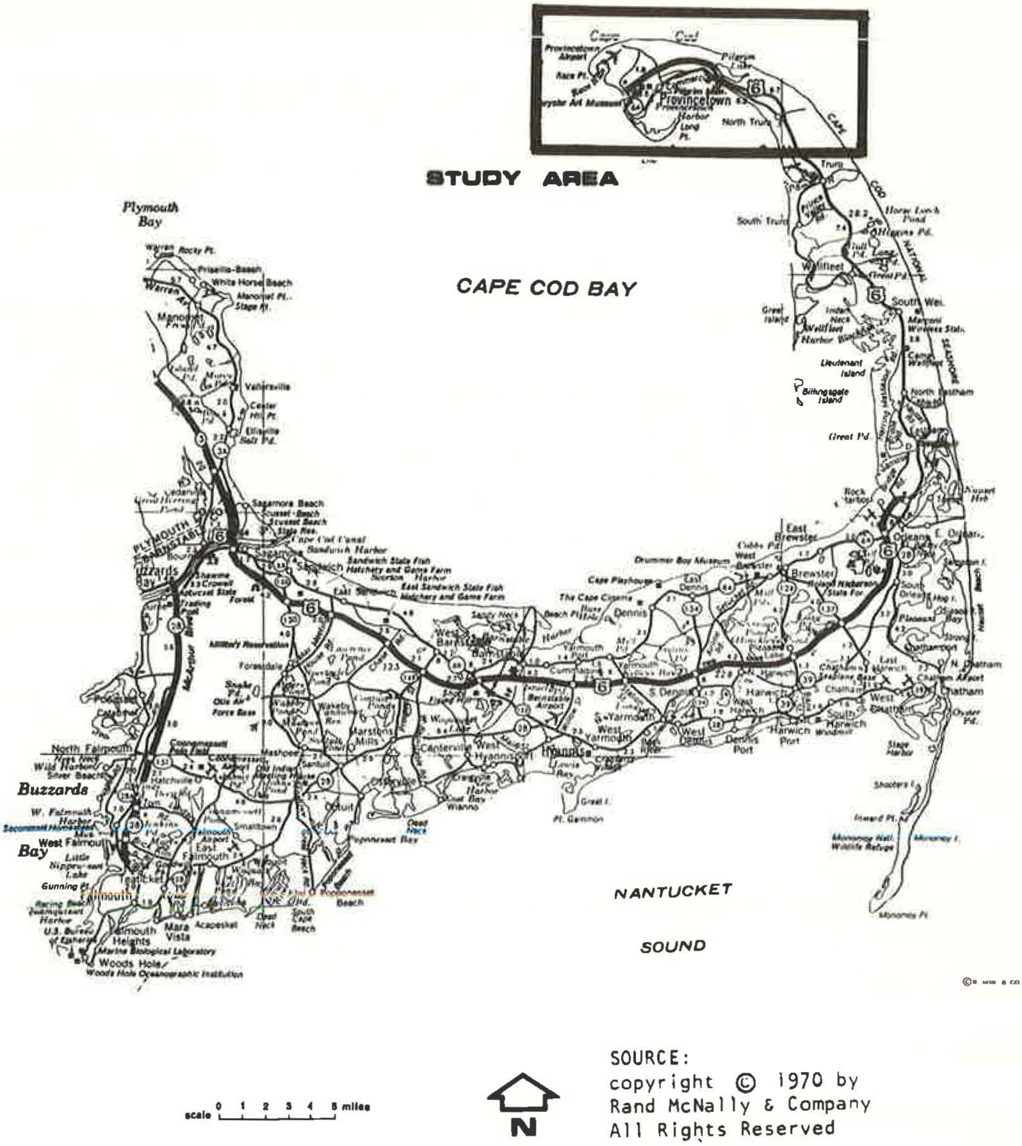
Procedures

The tools for decision-making, the operations charts and study area maps, will be used to demonstrate the problem solution. The charts provide prototypical guidelines and criteria for solving problems in general; the maps, related to particular highway location areas, are the basis for application of the guidelines and criteria.

For each problem, the charts spell out the types of data important to each problem. A base map, taken from a U. S. Geological Survey quadrangle of the north end of Cape Cod, represents the basic data available from the environment.

The process implies manipulation of the highway alignment and of what can be seen from the highway, taking advantage of the relation of the highway to its location in the landscape. Broader decisions are made at the corridor and route selection phases;

Figure 1. Location map.



more detailed and refined decisions are made at alignment and right-of-way design phases.

PROBLEM DEMONSTRATION: COMPONENTS OF AESTHETIC VISUAL QUALITY

The problem to be demonstrated is the first of the two problems of issue 3, components of aesthetic visual quality. This issue is aesthetic experience or the need for a qualitative experience, potentially available from the highway environment, to provide interest and pleasure for the driver. This involves the particular elements and characteristics of the environment, as well as their grouping as landscape composition, all as experienced during travel.

The components of aesthetic visual quality constitute particular elements and characteristics of the environment, such as seeing particular objects or experiencing a

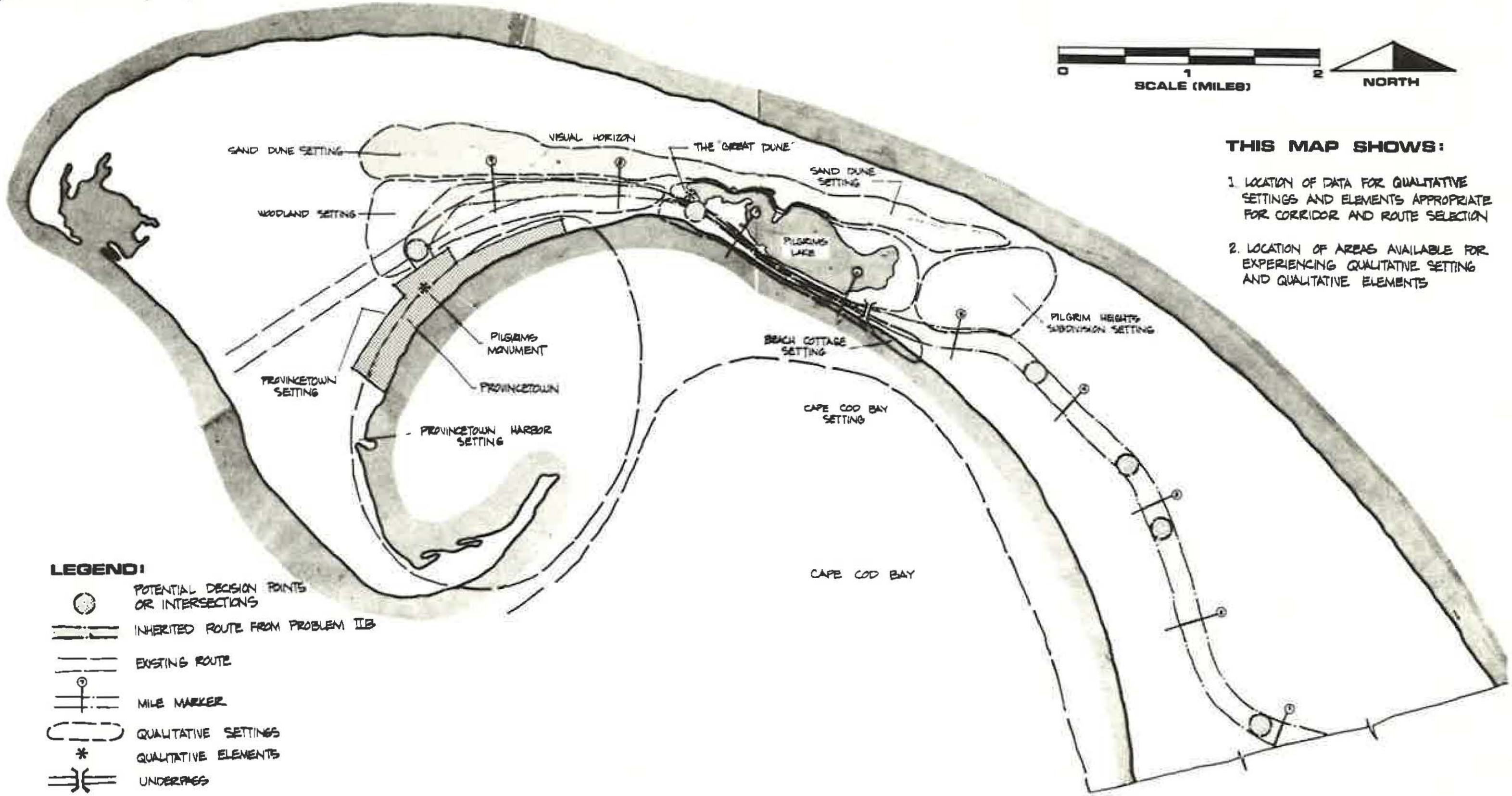


Figure 2. Inventory map.

scenic view. Solve for qualitative elements, the qualitative significance of particular natural or man-made objects or elements in the environment on their own merit, and qualitative settings, the qualitative significance of settings as they are capable of being seen and experienced by the driver on their own merit (these are often "views"). The operations charts and illustrative study area maps for this problem follow each phase of work.

The problem involves the potential appreciation of particular things or events of quality and interest in the environment and areas of landscape quality that give the driver pleasure. Clearly, the scenic aspects of travel are important to the driver, as indicated by the increased use of the automobile for recreation purposes. Therefore, one should take full advantage of all opportunities available in the landscape to provide this amenity, and this is particularly true when one of the major purposes of the highway is scenic, as is the situation in this case study.

The driver's operational needs are to experience qualitative elements (objects significant in themselves in the environment) and qualitative settings (groups of objects or areas with common characteristics). The elements and settings that constitute the driver's operational needs for this problem range from large (mountains and cities) to small (houses and fields). It is, of course, important that they be considered at each phase of work as they are appropriate. Thus, the value of the larger elements and settings will be considered at the corridor and route selection phases and the value of the smaller at the alignment and right-of-way design phases. It is also important to measure the impact of the various settings and elements as they occur in the environment in order to know their relative values to the driver and to aid in setting priorities and making tradeoffs. We did this in some detail in previous work by using several appropriate techniques. For the demonstration of this problem, such techniques are not shown in detail, but the appropriate techniques are available for use in determining the relative values.

Corridor and Route Selection

Inventory Step—The inventory step identifies and locates those qualitative settings and elements that will, potentially, be seen from the route area. Areas beyond the visual horizon are not considered because they are not visible to the driver. The inventory map (Fig. 2) shows the route and location of interchanges as selected in corridor and route selection; revisions and adjustments to that route will be made on the basis of the driver's operational needs in relation to this problem. The operations chart (Table 1) will provide guidelines and criteria for the decisions to be made. The data for this problem at this phase are given in Table 2.

Guideline Application Step—The guideline application map (Fig. 3) identifies those zones within the route that are best for viewing the qualitative settings located during inventory. The potential views within these zones were analyzed for the operational needs of the driver (i.e., providing an appropriate view to the selected visual elements and settings). The needs were accommodated by associating them with view types, i.e., panoramic views, enclosed views, and focal views. The guidelines describing these views and stating the best conditions for the driver are listed in the operations chart. For purposes of selecting or adjusting a route location, the guidelines establish the time limitations that are best for driver perception and experience; e.g., panoramic view, 30 to 120 sec, and focal view, 5 sec minimum. The guidelines also aid in identifying conflicts between driver view needs and conditions of the landscape. We will identify and solve two conflicts shown on the guideline application map, basing our solutions on the driver's needs and the guidelines for meeting them. These solutions will be shown on the problem resolution map (Fig. 4).

Conflict One—Cape Cod Bay, which is an important qualitative setting, is not seen adequately along the route. Inasmuch as major settings are best experienced by the driver as a panoramic view, that is, as a wide expanse seen for a long period of time, opportunities were looked for that would provide this. Two opportunities were found: a view to the bay at mile 5 and an adjustment to the route at mile 1. This adjustment takes place on a high area and creates little physical disruption.

Figure 3. Guideline application map.

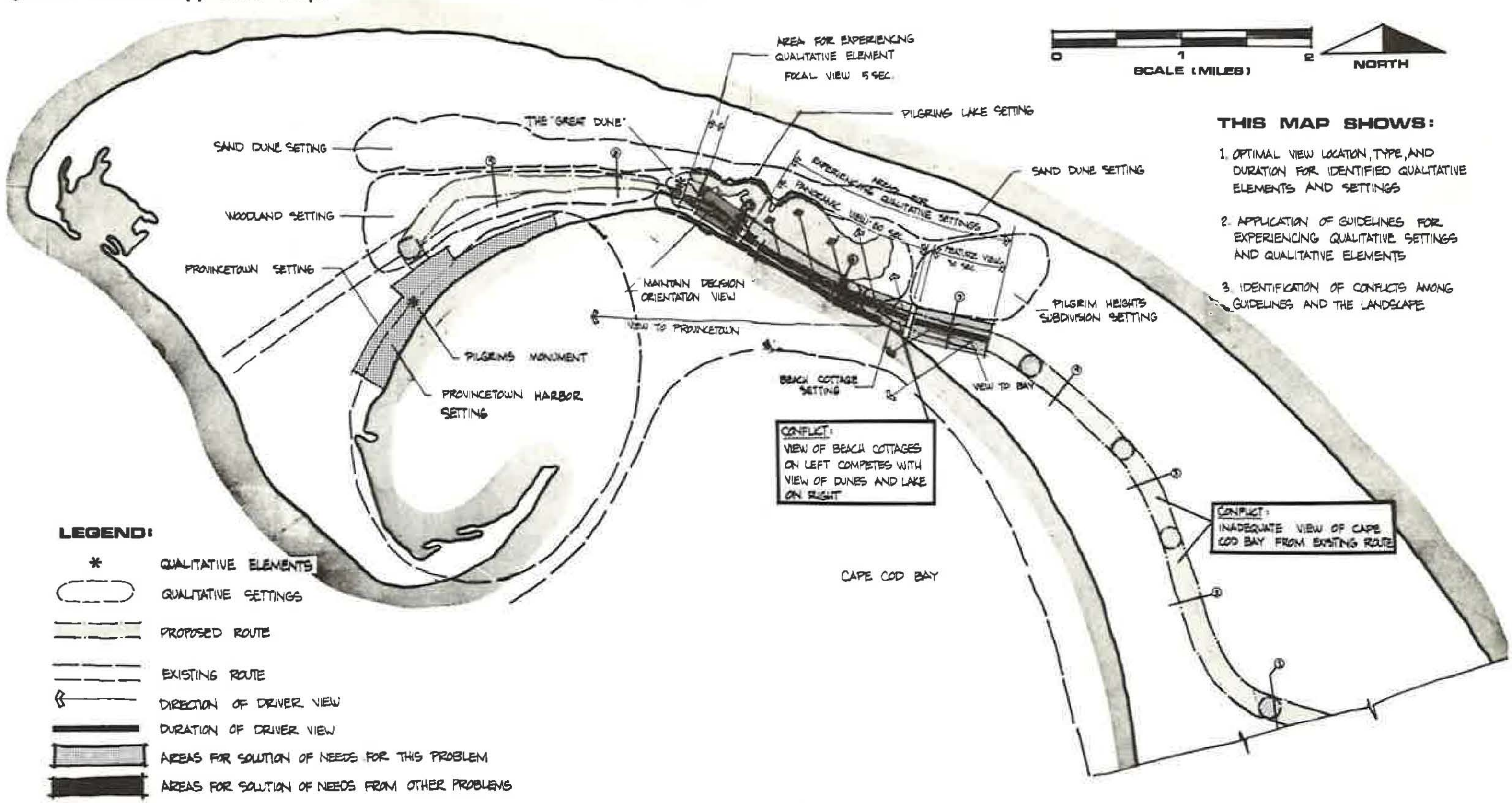


Figure 4. Problem resolution map.

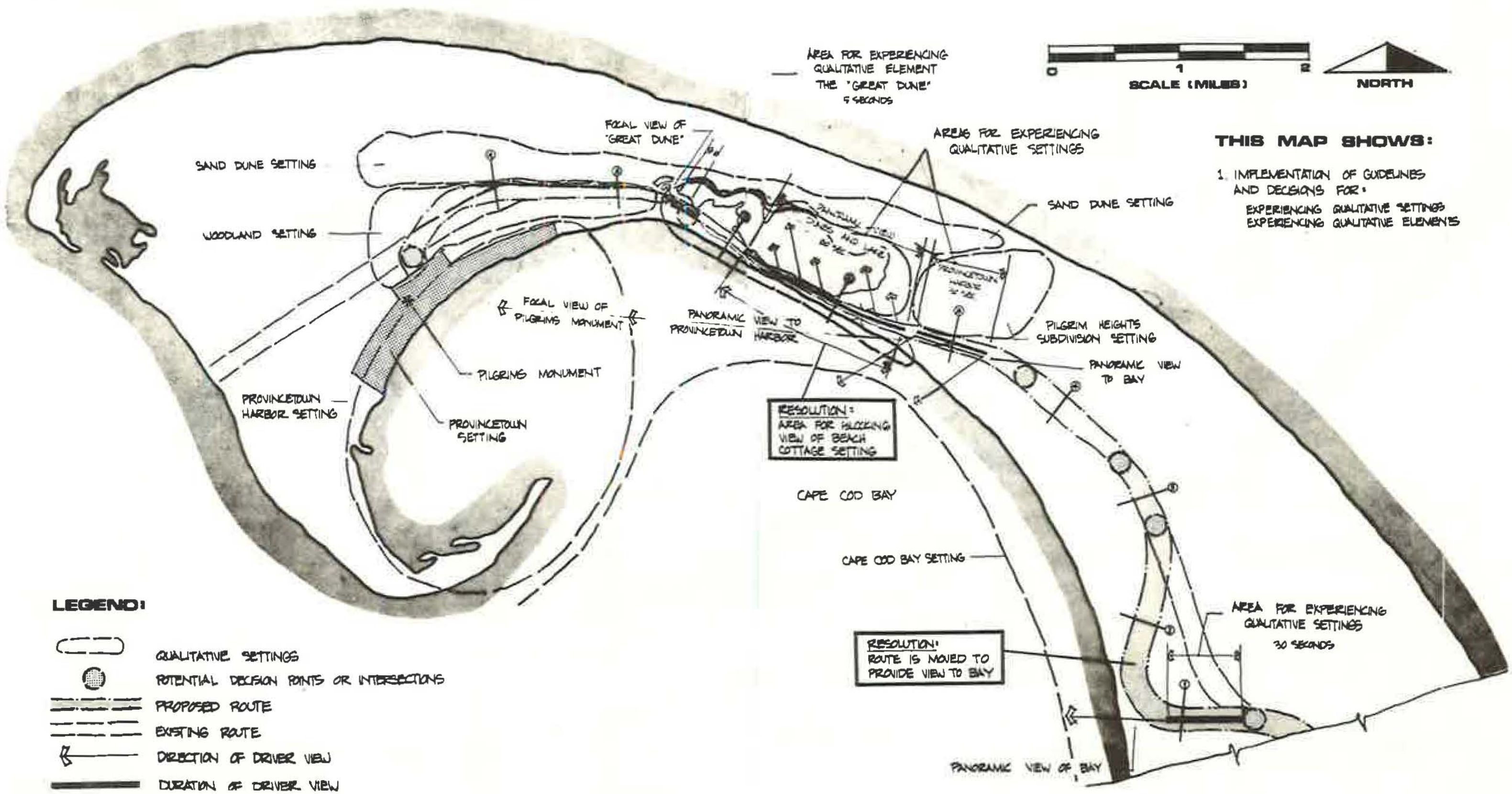


Table 1. Operations chart.

View	Criteria	Qualitative Elements and Settings	Guidelines
Panoramic	See continuously for minimum of 30 sec and maximum of 120 sec; minimum cone of vision of view of 45 deg; view occurring within 90 deg of driver view to center of road	Areas primarily made up of settings and general characteristics, usually mostly background with horizontal form	
Feature	Total exposure of not less than 30 sec; see continuously in minimum of 15-sec intervals; view occurring during elapsed time of maximum of 120 sec	Areas primarily focused around a particular element in landscape, mostly background	Provide adequate exposure to important elements and settings of visual quality
Enclosed	See view for minimum of 5 sec (view not significant if less than 5 sec)	Areas primarily defined with enclosure of space, usually middleground; may also include settings or elements or both	Provide visual contact and information contact
Focal	Axis of view within driver's focal area determined by design speed; minimum of 5-sec exposure of focal view; no interchanges; minimum hills and curves during view duration; direct alignment of road (vertically and horizontally) toward view	Areas primarily directional and convergent, focusing on elements; should include spatial edge in incidence of view	If area cannot be seen, provide information on its existence and its location; minimize interference of decision points with view areas; minimize effect of functional demand of curve and hills on view areas; manipulate curves and hills to take advantage of view types

Conflict Two—The view of the beach cottage area between miles 5.5 and 7 interferes with the more important panoramic view to the dunes and Pilgrim Lake. A solution would be to block the view to the beach cottage area. This would provide an uninterrupted view of the dunes and lake. Upon examining other views on the site in relation to their needs, we found no conflicts between the existing environment and the needs. The feature view to Provincetown and Provincetown Harbor at mile 5 is well accommodated by the route as it stands, for its location coincides with a previously established view of Provincetown needed for destination-orientation purposes and conforms with the guidelines for this problem. The other need, for a focal view to Pilgrim's Monument and Provincetown, is also satisfied, inasmuch as its criterion for duration of view is shorter than that for the feature view that occurs simultaneously.

Table 2. Elements, settings, and views in case study.

Environmental Data	Case Study Examples
Elements	The Great Dune Pilgrim's Monument Water tower in dunes
Settings	Cape Code Bay Provincetown Provincetown Harbor Sand dunes Pilgrim Lake Pilgrim Heights subdivision Beach cottages
View areas	
Panoramic view	To dunes area To Pilgrim Lake To Cape Code Bay
Feature view	To Provincetown To Provincetown Harbor
Enclosed view	The Great Dune
Focal view	To Pilgrim's Monument

Problem Resolution Step—The problem resolution map (Fig. 4) shows the decisions made for solution of the two conflicts noted. The first conflict, inadequate opportunities for seeing Cape Cod Bay, was solved in two ways. First, it was found that the duration of the previously provided view is adequate to meet the needs of a panoramic view. Second, by realignment of the route, a view of 30-sec duration was created, which provides an adequate panoramic view to the Bay. These two views together create an exposure to the Bay adequate to the driver's needs.

There are three alternatives for solving the second conflict, interference of the beach cottage area with the lake and dunes: (a) move the route, possibly to the other side of the lake; (b) lower or raise the vertical alignment to eliminate the competing view; or (c) rely on an alignment phase decision, such as use of visual edge for screening. The first two are unrealistic because major changes, resulting in physical disruption and high costs, would be necessary. The third alternative is the most reasonable because there will be several possibilities for application of visual edge during the alignment phase. The map shows the area and duration where blocking of the view is needed and where attention should be given at the alignment phase.

By noting the procedures of this problem, one can see that some decisions and solutions are internal to each problem, whereas other decisions interrelate among several problems. The judgments and priorities necessary to make these decisions point up the great importance of having a clearly established purpose of the highway at the outset. Knowing what the highway should do in the broadest sense is the basis from which the priorities are set and the decisions made, which provide the best highway and the one most closely matched to the needs of the driving experience.

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ADEQUACY OF THE SPATIAL ORGANIZATION OF RESIDENTIAL NEIGHBORHOODS: THE RESIDENTS' POINT OF VIEW

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ABRIDGMENT

•IN earlier papers (1, 2) a model of accessibility acceptance was developed. This model emerged as a by-product of an effort to describe people's preferences for accessibility to selected neighborhood services. Briefly, the basic concepts of the model are based on the notion that accessibility preference is a function of two competing preference processes: (a) desire for access and (b) aversion to proximity. This notion was used to develop disutility functions, including rejection thresholds that are hypothesized to be probabilistically distributed over a given population. The threshold distribution functions were used to develop joint distribution functions that were intended to describe the probability that a specified level of accessibility to a given neighborhood service would be acceptable to a member of the population. It is suggested that a model of this sort might be useful in the design and evaluation of residential environments as well as in evaluating the impacts of transportation facilities.

In a more recent study (3), preference data that generally supported the model's assumptions and hypotheses were collected. The following results are significant:

1. The concept of "rejection threshold" is psychologically meaningful. Reliable measurements of the distribution of perceived rejection thresholds can be obtained. Whether these distributions are behaviorally meaningful remains untested.
2. The perceived thresholds are log-normally distributed.
3. The "aversion-to-proximity" threshold is statistically independent of the "desire-for-access" threshold, which supports the hypothesis that these two preference processes are independent.
4. There is a weak tendency for the perceived thresholds for one facility to be sensitive to the position of other facilities. However, the magnitudes involved are not significant.
5. For a given person it is more important to avoid violating some thresholds than others.
6. Population groups with different requirements can be identified.
7. Based on the concepts developed in the model, a utility theory that allows the exploration of trade-offs among locations of various neighborhood services relative to the place of residence can be developed. This theory can be developed either in terms of individual (or aggregate average) dissatisfaction or in terms of the probability that a given combination of locations will be rejected by any member of a homogeneous population. For example, based on the data collected in this study, it can be shown that, for a unique population group (married couples with children in elementary school), the level of dissatisfaction is low when a park and playground is located three blocks and a shopping center six blocks from the residence. However, the dissatisfaction level rises significantly if the park and playground is moved out to six blocks and the shopping center is moved in to three blocks.

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We suggest that the approach is useful for application to various problems concerning the quality of the residential environment. One important application is in the evaluation of the effect of transportation routes, such as freeways, on adjacent neighborhoods. When properly calibrated, the model allows the adequacy of a neighborhood's spatial organization to be measured directly from the point of view of the residents. Thus, the impact of alternative route locations on the perceived adequacy of a neighborhood's spatial pattern can be compared in terms of the numbers of residents who find the resulting spatial patterns to be adequate. When developed further, the utility theory notions may allow comparisons to be made in terms of actual levels of satisfaction.

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THE END OF THE ROAD?

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•ONE of the games that anthropologists and philosophers love to play is trying to identify that characteristic that clearly separates the boys from the beasts. Verbal communication, recognition of the significance of death, and the ability to laugh are among the contenders for this distinction.

Surely, the concept of aesthetics must be considered a clearly distinguishing characteristic of homo sapiens. It is true that many of our fellow creatures developed characteristics that we humans term "beautiful," but, to the best of my limited knowledge, the significance of a bird's plumage is, to another bird, solely of an aphrodisiac nature. The bird's "beauty" lies in the eye of the beholding man rather than in that of the bird friend.

I hope it is safe to assume that for the purpose of this effort in communication no definition of beauty is necessary. This is almost imperative, in fact, because I am not at all certain that I would be able to do this. Recognition of beauty is more visceral than cerebral. The philosophers and art critics, at best, rationalize what is intuitively felt by the average man who boasts that he knows what he likes.

Man had barely emerged from the cave before he decided, or felt, that he was not going to live by bread alone, that sheer survival was not enough for him, and that he would establish values over, above, and beyond that of simple utility. Thus, since the dawn of history, men have incorporated an element that we term beauty into the design of that that they require to sustain their existence. They clothed themselves not only so that they were protected from cold, heat, rain, or snow but also so that they presented a pleasing appearance to their fellow men. The earliest weapons were not only designed to kill or maim effectively but also shaped or ornamented so that they were pleasing to handle and to behold. Food was seasoned, combined, and cooked in ways such that it not only sustained life but also made eating an agreeable experience. The bowls and other artifacts in which or with which food was prepared and served were shaped and decorated to please the user. Houses were designed to do far more than shelter men from the elements.

In fact, before very long, as history goes, the aesthetic significance began, in many areas, to transcend the functional in terms of the amount of effort expended in the production of clothes, food, buildings, and the many other basic needs of man; far more was expended developing the aesthetic characteristics than the functional. Some philosphers hold that what is not beautiful cannot be functional, but I am still not inclined to spend too much aesthetic consideration on the design of the inside of a sewer.

At an early point, man started producing a multitude of objects that had no function whatsoever other than that of attracting attention or symbolizing power or wealth. Surely, the mass of the Great Pyramid was redundant in terms of its function of sheltering and protecting through eternity only one or a few human bodies no matter how sacred. In the applied arts, however, functional satisfaction was an obvious imperative, and the aesthetic character was properly derived from and inextricably related to the functional.

Before very long, some men, at least, found that they had a vast surplus of mental and physical energy over that needed to sustain life. The concept of recreation, which is functionally aesthetic in character, was born.

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Although man's recreation was designed to serve fun rather than function, because it provided mental and physical exercise, it indirectly and unintentionally improved his ability to function effectively. Like gourmet cooking, fashionable couture, and monumental architecture, his recreational activities stem largely from what were originally utilitarian pursuits. Many of the most popular forms of recreation are still, at least in part or at times, functional as well, e.g., walking or bicycling. Others such as swimming, mountain climbing and horseback riding are functionally archaic; swordsmanship and archery for other than fun are as vestigial as the vermiform appendix. Still other recreational pursuits, most of which are largely concerned with throwing, hitting, kicking, or pushing a ball or smaller object about, are probably a ritualization of personal combat or warfare.

The earliest motor cars bore to the horse and buggy the same sort of relationship that any form of recreation does to its functional antecedent. Initially, the automobile was less than an improved means of transportation, but, like some of the fruits of pure research, it was considered sufficient unto itself. People bought motor cars out of curiosity and drove them for the fun of it.

As roads and automotive technology improved and the functional significance of the automobile grew, it never lost its popularity as a recreational device. We still identify a passenger vehicle as a pleasure car. Our society spends more of its hours driving for pleasure than it does eating, buying clothes, or sitting in the shelter of its living rooms.

Roads that served our earliest motor cars turned out to be, with little conscious intent, surprisingly satisfying aesthetically. They were unobtrusive and fitted into a landscape that was still largely an ingratiating one. The occasional structure that bridged a stream or railroad was a thing unto itself, a work of engineering or architecture that was not looked on as an element in the highway.

Before very long, as the highway developed into a more significant element in our environment, the application of man's unvarying instinct toward conscious beautification was reflected in the development of the parkway concept, an artery with expanded and landscaped rights-of-way with alignment and gradients consciously developed for safe and efficient transport and also incorporating a sculptural beauty. The roadway was a slender ribbon with a sinuous beauty. Bridges and other related structures were conceived of as integral elements in the whole design and treated as works of architecture.

Recognition that the highway, like any other of man's works, should be a thing of beauty was by no means universal, but there were enough capable craftsmen around to ensure a continuation of the tradition of the highway as an appropriate subject for careful aesthetic design.

Following the war, the parkway concept began to make itself felt in the development of mixed traffic arteries, and much of our Interstate system, both rural and urban, has benefited from thoughtful, coherent design. In the better portions of the rural elements of the system, highway design showed a respect for terrain, logical line and grade, and exploitation of natural vistas and other features. In urban design, a dramatic and dynamic relationship between the highway and its urban environment was frequently achieved. Although it is true that a considerable amount of urban highway design was insensitively conceived and ended as a blight on the cityscape, there are enough examples of good design to demonstrate clearly that a highway can be a good neighbor as well as an efficient means of transportation.

In the last few years, however, a combination of circumstances that would seem to make the development of an aesthetically satisfying highway more and more difficult to achieve has become apparent. I refer to the unrestrained reflection of traffic demand, which has resulted in highways of Gargantuan and overwhelming cross section.

To combine in one restricted right-of-way, eight, 10, and even 12 or more parallel lanes of traffic, even on multiple roadways, presents a design problem that from an aesthetic viewpoint becomes nearly insoluble. At the very best, by expanding the right-of-way or by architectural treatment, we make the best of a bad thing, but few of these giants seem capable of being developed as truly handsome examples of either urban or rural engineering design. The once sinuous beauty is now layered with obscene fat, and our roads have all the grace of a slug.

Now by all the rules of the game, this should not be the case. The history of architecture shows us innumerable examples of the fact that scale itself is no impediment to architectural mastery. Great cathedrals, towering office structures, vast palaces, and public buildings are among our most distinguished architectural achievements. The Gardens of Versailles hardly suffer aesthetically because of their vast scale. The urbanism of Haussmann's Paris may not have the intimate quaintness of the medieval city that it in part displaced, but it is undeniably handsome withal. Our musical monuments consist of great symphonies and grand operas.

Why then should we have any more difficulty designing a beautiful large highway than we had designing those arteries of much more modest capacity? Faced with this problem on a number of projects with which I am involved, I have sought long and hard both for an explanation of why bigness seems in many cases to exclude the possibility of beauty and for some answer to a problem that I insist demands a solution if we are not to throw up our hands, give up, and admit that we have come to a dead end in the art of highway design.

I spoke earlier of the inextricability of beauty and function. The beauty of any useful object springs from a clear and coherent development of the functional characteristics of the object to be designed. If, in designing a tool, a garment, a plate, or a building, the function is subordinated too greatly to aesthetic demands, the result is likely to be decadent and superficial; similarly, if the functional character of the object of design is not rational, the design is no longer rational, and beauty of the design becomes meaningless or, rather, nonexistent.

Successful, applied design comes in large part from a logical and articulate expression of the function of what is to be designed. This principle is, of course, most clearly seen in the design of a bridge in which each part of the structure must express its function simply and clearly and in which the interrelationship of each part to the others must be clear and harmonious. Keats said, "Beauty is truth, truth beauty." Today we might put it "Tell it like it is." It is true that aesthetic achievement is not limited to the design of objects for physical use. Great paintings, plays, and music represent an entirely different area of artistic endeavor: the function of art in the communication of ideas. But just as the so-called pure arts are successful only to the extent that the idea behind them is imparted to the viewer or listener, so in the applied arts success is only achieved to the extent that function is expressed. The house, which does not reflect the way of life of the society for which it is designed, is meaningless. If an artifact does not function effectively, its beauty is overpriced.

Now with respect to our super superhighways, is it possible that the trouble we are having in achieving a satisfactory aesthetic solution to the problem derives from the fact that there is no valid and effective functional solution? Are we trying to find an answer to the unanswerable? Are we enhancing the fat lady by putting her in a miniskirt when we should be hiding her under a tent? Are we trying to make a silk purse out of a sow's ear? I guess that what I am asking is whether the highway is suffering from some sort of identity crisis.

Each of man's creations or contrivances must have, if it is to gain lasting acceptance, what the philosophers call an "essential property," i.e., a special distinguishing characteristic that sets it apart from other devices and one that is not possessed by the others or not possessed to the same degree.

Darwin's concept of natural selection had to do with the evolution of flora and fauna but is applicable generally if not invariably to the works of man. By a sort of reverse Gresham's law, efficient devices ultimately drive out the less efficient. In the competition of the marketplace, a better mousetrap will, on the whole, sell.

Railroads enjoyed their enormous popularity and growth because they had an essential property possessed by nothing theretofore devised. Despite the gross mismanagement and corruption from which they have suffered, they have survived and will probably ultimately improve because we have not yet found any potentially superior or even comparable means for moving masses of people and goods along relatively limited and defined routes economically, comfortably, and safely.

The essential property of the motor car on the other hand is a flexibility not offered by rail transport. It offers freedom from the limitations of fixed schedules and predetermined routes. The dune buggy is its ultimate personification.

When we use a knife blade as a screw driver, the results are often less than wholly satisfactory if not possibly disastrous. Are our efforts to make motor cars work as trains introducing a functional inefficiency that will inevitably be reflected in aesthetic decadence?

We know that lane efficiency diminishes as a roadway is widened above two lanes. In other words, there is a diminution in effective functioning. Is it unreasonable, then, that this should be reflected in a diminution of aesthetic achievement? Again, we come back to Keats's dictum that beauty is truth. As the lanes multiply and efficiency lessens, are we facing a law of diminishing aesthetic returns? Does aesthetic as well as functional good sense require that, as apparent traffic demand in a corridor approaches proportions that are unmanageable by conventional standards, we must reexamine our approach to seeking a solution?

One very obvious, almost cliché, answer is that, if automobiles are trying to do what trains can do better, it is time to turn back to trains. I will not labor this point here; enough is being said by others.

Another answer that lies more directly within our sphere of influence is to divide up the load into more efficient and, therefore, presumably more aesthetically manageable elements.

One of the most justifiably famous pieces of urban transport architecture is the three-level cantilever section of the Brooklyn-Queens Expressway in New York. Ten lanes of traffic are so subdivided that no driver is uncomfortably aware of the total traffic being carried. The highway's neighbors are effectively shielded from what might be an otherwise excessive impact.

On the other hand, a current proposal for a waterfront expressway in another large urban area would put eight moving lanes of traffic plus four shoulders and a median divider on one level, roofed and walled on the shore side. The innermost lane would be about 130 ft from a slit that is supposed to afford the driver a river view.

Like putting the tent over the fat lady, simply hiding the roadway is a less than happy solution although there are many who would put all urban and suburban vehicular traffic in tunnels. I for one cannot forget that drivers are also people. To consign them to the underground like a race of troglodytes seems less than humane. Tunnels are fine solutions to special transportation design problems, but one can get too much of a good thing.

Our best hope lies in bringing the highway back to manageable proportions. By either vertical or horizontal separation of roadway elements the impact of each element can be measurably reduced, and I am referring here to effective visual separation, not just a broad paved area striated with New Jersey type of barriers.

Obtaining adequate space, whether in terms of right-of-way or air space, has obvious economic and social costs, but the environmental game is worth the candle. Our potential solution lies in deliberately splitting our corridors horizontally. There are cases where two can do the job more efficiently than one.

A few years ago any suggestion that trust fund moneys might properly be used for public transit was considered heresy and constituted grounds for being drummed out of the regiment. Times have changed! Are we ready to reexamine the need to accommodate trucks and truck trians on all of our roads? Theirs is, of course, the major influence on highway size and structure. The parkway concept is not obsolete. Perhaps, if we all gave a little push, we could change the pendulum's direction.

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