On March 11, 1974, the Southern California Rapid Transit District (SCRTD) engaged Arthur D. Little, Inc., (ADL) to make a community impact study of a proposed rapid transit program. The assignment was to develop a series of position papers which would be essentially non-evaluative: not to attempt an assignment of dollar values to specific impacts which were essentially non-economic, but rather to identify key impacts on transportation users and to quantify or describe these impacts in meaningful terms for the average citizen.

Six separate impact statements presented in Chapter III cover the areas of development policy; travel time, convenience, and opportunity; access to work opportunities; traffic congestion and ease of auto travel; private automobile operating costs; and economic activity. It is expected that these statements will be used as a basis for the SCRTD Public Information Program which will address the concept of rapid transit for Los Angeles and the effect of the specific rapid transit proposals. The Public Information Program will focus on critical transit-related issues: individual mobility of residents and access to opportunity, viability of the Los Angeles economy, balance in transportation facilities, quality of the regional environment (e.g., air quality, community identity, activity centers, and livability), and the Los Angeles life-style.

The specific impacts described in this report are based on the program described in the March 26, 1974 report, "A Public Transportation Improvement Program." Service level assumptions, route alignment, and modal mix described in that report, which is essentially a summary of the Phase III consultant findings, comprise the assumptions behind our impact statements. Much of the current data used was obtained from the recent SCAG reports and some of the data are based on primary research conducted by ADL during the past eight weeks.

Among the significant findings and conclusions of our work are the following:

Automobile-related

- The average automobile driver in Los Angeles who switched to public transit for his daily work commute would save, on a conservative estimate basis, $1,100 per year.

- Those drivers who commute 30-40 miles per day (round trip) could save more than $1,500 per year.

- A one-car family could save up to $1,900 per year by choosing mass rapid transit instead of buying a second car.

- Parking in downtown Los Angeles has risen to a cost of between $2.75 and $4 per eight-hour day.

- In terms of family expenditures and income, the average Los Angeles household is spending approximately twice as much per year on automobiles as on clothing.

- The average cost of highway construction built since 1938 is $3.3 million per linear mile. The most expensive link in the 485-mile Los Angeles freeway system is the proposed Beverly Hills Freeway which would cost $80 million per mile. The estimated cost of a fixed guide rail rapid transit system for Los Angeles is $30 million per mile.

- The average annual operating cost for automobiles in Los Angeles County is $1,400.

Development-related

- The so-called "centers" policy which has been adopted by both the City and County of Los Angeles and by the Southern California Association of Governments (SCAG) is to a large extent supported by the planned SCRTD program. The program appears to provide the catalyst for the revitalization of older centers, the high capacity for people movement into and out of the centers, and the accessibility deemed appropriate in the SCAG report for the specialized centers.

- The proposed rapid transit system is likely to encourage clustering of multi-family and medium- to high-density residential development around station locations.

- By increasing higher-density residential development in the central Los Angeles area, the system would increase the number of residents living within a reasonable distance of employment opportunities which are found in the central area.

- One of the greatest potential contributions of the rapid transit program to land use and development policy would be the acceleration of recycling of older, unstable urban areas in and near the regional core and near older urban centers such as Pasadena, Long Beach, Compton, Santa Monica, and El Monte.

- In station locations where the greatest patronage is expected there would be significant incentives for investment in new residential, commercial, and office development.

- The rapid transit system should serve to reduce the pressure for new development in the fringe areas, and promote the SCAG plan to preserve open space.

Related to Travel Convenience

- The most significant benefits of the transit program would accrue to those who, by choice or necessity, now use the existing transit system. The most dramatic effects of the transit system would be the reduced travel times by public transit.

- For many potential travelers, a rapid transit system would offer substantial cost and time savings over travel by automobile.

- The automobile will continue to be the primary source of mobility in Los Angeles. But for some, the availability of rapid transit would preclude the need for a second or a third car.

- For many, the rapid transit system will offer the ability to go more distant places in the same amount of time – rather than reduce travel time – by bringing within the same time-distance greater opportunities for work, shopping, recreation, and entertainment.

- The effect of the rapid transit system will be similar to the past effects of the freeway system in Los Angeles: it will increase accessibility within the area. For those who prefer to live closer to their place of work and near activity centers, the system will make it possible to get there faster and more conveniently.

Related to Access to Opportunity and Commuting

- Various employment impacts would result from mass rapid transit in Los Angeles. Some communities would have improved access to job opportunities; others, because of lack of job skills compatible with job opportunities, would benefit only by direct employment with SCRTD at facilities located in the community.

- Twenty-two percent of the South Central community now uses public transportation for job-related commuting. Two percent of the Van Nuys community relies on public transit.

- The majority (52%) of the work trips generated by residents in the South Central area are made within that area.

- Seventeen percent of the households in Los Angeles County have no automobile; 31% have one automobile. Contrary to general impressions, auto availability in Los Angeles is not much higher than in other metropolitan areas and is lower than in several.

Related to Area Growth in Los Angeles County

- With improved access to the CBD provided by the proposed transit system, finance, insurance, real estate, and related professional and business service sectors of the economy probably will continue to concentrate in the major centers of activity. Thus, a growth rate higher than the anticipated rate of 5% in the CBD is likely.

- Increased retail activity is likely to occur in the CBD resulting from both place of employment in these areas and the improved access for shoppers that will be provided by the transit system.

- In terms of residential location and redistribution, it is anticipated that conversion to higher densities will occur near the corridors of the transit system, resulting in population growth in these areas in excess of that anticipated by the first round of population forecasts. This growth may be at the expense of residential development in outlying areas.

- From a regional standpoint, the development of a rapid transit system will not reduce the overall trip activity as measured in passenger-miles. The proposed line-haul transit system will improve access between centers of development, and therefore a dramatic increase in movement between and among centers will probably dictate that no decreases will occur in overall regional trips.

Related to Traffic Congestion and Ease of Automobile Travel

- The proposed rapid transit system with both fixed guide and feeder systems can directly affect the sources of congestion in Los Angeles: first, by making it possible to move to, within, and out of high activity centers by a mode which requires far less space than the automobile for the volume of travel desired to be served; and second, by providing an alternative, more space-saving means of movement among non-core areas which reduces the amount of traffic that must pass through core areas to specific destinations.

- To the extent that people choose to travel by mass rapid transit in a highly traveled corridor or to an activity center, congestion on the freeways and on the street can be reduced out of proportion to the number of persons diverted to transit.

- Rapid transit has a potential capacity to carry 40,000 people per hour from one place to another on the equivalent of less than one lane on the freeway; to achieve the same capacity for auto travel would require almost 20 lanes of freeway.

- The greatest effects of rapid transit on reducing traffic congestion will occur where rapid transit is provided on separate rights-of-way from automobile traffic.

- By 1990, the number of daily person-trips made in the region is expected to increase by 18 million to 45 million (an increase of 65%) while the population will increase by 2.7 million, according to the latest forecasts. Although a greater proportion of total traffic will occur outside of Los Angeles County in the more rapidly developing areas, the population of the urbanized areas of Los Angeles County will account for an increase of 5 million daily trips (a 30% increase over today's level). Many of those trips will have destinations requiring passage through the regional core, due to the structure of the freeway system and of the region.

- The primary impacts of the diversion of trips from automobile to mass rapid transit will be felt on the freeways connecting large residential areas and major employment centers and within the high activity centers of southern Los Angeles County, especially downtown Los Angeles, the Wilshire corridor, Commerce, and Long Beach central business districts – areas which are currently the most congested in the region and which are served by the most congested freeways.

- The reduction of traffic on the now crowded freeways will probably cause a substantial diversion of traffic from arterial streets parallel to the freeway, easing local traffic congestion, and improving local circulation.

- The rapid transit system will have two major effects: it will provide an alternative mode of transportation to the automobile, and it will increase the total capacity of the transportation system to handle the increased travel demands from the existing population and new growth in the area.

THE SCRTD POSITION CONCERNING COST-BENEFIT ANALYSIS AND RAPID TRANSIT FOR LOS ANGELES

A. INTRODUCTION

It has become common in the past few years to attempt to perform cost-benefit or cost-effectiveness analyses for major governmental programs, projects, and investments. To date, the results of those analyses which have been performed have been unsatisfactory, both from a technical point of view and in terms of meaningful advice either to policy makers or to the general public. The Secretary of the U.S. Department of Transportation has given an indication to the Southern California Rapid Transit District that he desires to see such an analysis performed for the district's proposed rapid transit program before committing federal grants in support of that program. The purpose of this chapter is to describe briefly the nature of and expected results from cost-benefit analysis as it is generally applied and the reasons why such an analysis is unlikely to yield useful results for consumption either by policy makers or the public. Suggestions will also be made for types of analysis which would be more productive.

B. THE COST-BENEFIT ANALYSIS FRAMEWORK

Cost-benefit analysis is conceptually quite simple: its purpose is to measure all of the benefits and all of the costs associated with a particular program or project and to determine on the basis of such measurement whether or not the benefits would exceed the costs. So stated, there is little doubt that such an approach to the evaluation of programs, policies, and projects is desirable. Since virtually all decisions made by public policy makers imply a sense of what the benefits and the costs of a particular decision will be, it would be useful if those benefits and costs would be made more precise.

Despite the rather simple conceptual foundation and the apparent desirability of performing cost-benefit analysis, the results of such analyses cast considerable doubt upon the reliability of results which can be obtained. There are also serious doubts as to the applicability of a quantitative approach where the expected benefits and costs are either intangible or susceptible to varying evaluations according to the individual's perceptions as to what are costs and what are benefits. The difficulties and defects of cost-benefit analysis can be grouped, somewhat artificially but usefully, into technical problems and policy problems. Although the two classes of problems are related, it is useful to distinguish between the technical difficulties associated with carrying out cost-benefit analysis and the policy problems inherently associated with a method of analysis which attempts to quantify and encompass different kinds of impacts.

1. Technical Problems Associated with Cost-Benefit Analysis

A host of technical difficulties confronts the analyst in attempting to perform a cost-benefit study for a rapid transit program or any other complex program having potentially widespread benefits and significant implications for the welfare of citizens within an area. These problems may be grouped into: problems of definition, problems of measurement, problems of valuation, problems of tracing, and problems of uncertainty.

a. Problems of Definition

Perhaps the most neglected problem confronting cost-benefit analysis is the problem of defining what is a benefit and what is a cost. Although not recognized as a serious problem in early cost-benefit analysis, it is becoming increasingly evident that the mere classification of impacts into costs and benefits implies value judgments which affect the results of the analysis and its acceptability. In theory this problem can be avoided if the analysis focuses on measuring the changes in well-being for every individual affected by a proposed project (assuming that problems of valuation can be overcome). However, as a practical matter it has proved impossible either to identify every individual affected by a project, to identify the nature of the impacts on him, to identify his preferences as a means of classifying the change in his well-being, or to devise an acceptable means for aggregating individuals into groups in order to make conclusions about overall social benefits or costs.

Since this is the case, a practical approach requires assumptions as to the perceptions of a relevant population regarding what are benefits and what are costs. While in some cases these assumptions may have general validity, in others the assumptions predetermine the nature of the conclusions. For instance, almost everyone would agree that a reduction in loss of life is a benefit. On more controversial subjects involved in rapid transit planning there is far less agreement. For instance, what assumption is to be made about the effects of rapid transit on land use patterns? If rapid transit increases densities of development in one area, is that a benefit or a cost? If rapid transit expands the total area of settlement within a region by making it possible for households to locate farther from their place of work or have a wider choice of residential and job locations, is that a benefit or a cost? More obviously, if a rapid transit program is expected to increase economic growth and population growth within a region, is that a benefit or a cost, and from whose point of view?

In all of the above cases, defining an expected impact as a benefit or a cost requires an assumption regarding the perceptions and desires of a relevant population, which in turn requires a definition of the relevant population. For those in Los Angeles County or the Southern California Association of Governments (SCAG) region who are opposed to any additional growth in the area or in the region, any program which may have such an impact produces a cost equivalent to the growth induced. For those who desire growth, such an impact would be a benefit of the project. And, if one varies the population deemed to be relevant, the answers may change. Residents of the Los Angeles area may decide that growth itself should be classified as a cost because of a perception that growth itself produces more costs than benefits; on the other hand, residents of the region, of Santa Barbara County, of the state, or of the United States may feel that minimization of

growth in that area will cause adverse effects in other areas and therefore consider growth within the area to be beneficial. Since federal, state, and local dollars and decisions are usually involved in a transportation program, the attitudes of populations outside the area directly affected cannot be ignored as irrelevant and the question of benefit definition is further clouded.

This is also true on the cost side. Virtually all cost-benefit studies performed for local or regional projects ignore project costs funded from nonlocal sources, such as federal grants. The rationale for doing so is that the relevant decision population is local and that these costs do not fall on the decision population except very indirectly through federal taxation. A more important reason for failing to include such costs is the practical inability to determine the benefits and costs of a local program for the entire country. Therefore, federal decisions as to available financing must be accepted as representative of a decision already made by policy makers at the federal level as to the benefit-cost ratio for a certain type of investment. Given that this assumption is required, the rationale for performing a cost-benefit analysis for a local project in order to justify the federal grant is completely undercut.

In addition, local decision makers simply do not have the assigned responsibility or ability to make judgments as to the benefits to be obtained for the nation as a whole.

The results of a benefit-cost analysis must necessarily be fairly artificial for purposes of consumption by federal officials if performed to produce results in the least bit useful for local officials. This technical problem thus translates into a policy difficulty inherent in cost-benefit analysis to be discussed later, involving the question of the respective roles of government in making decisions regarding allocation of resources.

b. Problems of Measurement

Measuring benefits and costs and translating them into dollar values has constantly plagued cost-benefit analysis. Generally, it is assumed that costs are fairly well defined and that benefits present the measurement problem. Although measurement of benefits has certainly been the major problem, in actuality the same problem exists for costs, if all relevant costs are properly included. They rarely are, for the same reasons that not all benefits are included and measured: namely, that they can barely be identified, much less measured.

The first step in measurement is identification of the benefit or cost, on the assumption that agreement has been reached on what is a benefit and what is a cost. Identifying benefits implicitly requires identifying beneficiaries. Thus, conventional cost-benefit analysis for transit programs (or highway programs) typically classifies benefits into traveler or user benefits and secondary benefits, such as benefits to the unemployed, to businesses, to property owners. It is more rare to see an attempt to identify the nonbeneficiaries, or the losers. For instance, a transit improvement program may reasonably be expected to increase transit patronage and thereby reduce potential automobile sales. As a result, on the cost side, one should look at the impacts on automobile dealers and salesmen. This is never done, for the simple reason that those who would lose the sales cannot really be identified and even if

they could it would be virtually impossible to identify the costs associated with such losses and aggregate them in any meaningful way. Most of them are potential or opportunity costs, rather than actual costs.

Similarly, impacts on those who may be benefited are difficult, if not impossible, to identify and measure. Some who live near a proposed transit station and own property may be expected to realize enhanced property values. On the other hand, those who live in the same area but do not own property may be forced out by increasing rents. Measuring these impacts can be considered infeasible for any "system" because of uncertainties regarding the overall effect of the system on property value shifts and impacts on any particular individual or groups of individuals.

Even more conventional problems addressed by cost-benefit studies are not capable of acceptable resolutions. For those who use it, a rapid transit system will offer time-savings in making trips which are now made by another mode or will make it possible to reach more distant destinations in the same amount of time. Generally cost-benefit analysis assumes that the user population will take advantage of the time-savings and then proceeds to place a value on the time-savings and cumulate the values for the entire user population affected. In the more sophisticated analyses, the nonuser population which might benefit from shifts from currently congested modes is also identified. However, the potential time-savings can only be accurately measured if it is assumed that the user will continue to make the same trip in order to shorten his travel time. He may well make a different choice, such as to travel farther. If he does so, the time-savings measurement becomes irrelevant and there is another impact to measure, the benefit to him of being able to travel farther.

Even more challenging are the attempts to measure nonquantifiable aspects of convenience associated with transit: the ability to use the time on the train or bus for reading, for sightseeing, for uninterrupted conversation, for completing a task; or the comfort which may be offered by the ride; or fear associated with particular modes, such as subways; the degree to which trips can be made without prior planning because of the presence or absence of a reliable mode of travel; or the number of accidents avoided or lives saved.

More importantly, all transportation systems, and particular transit, have widespread effects on the qualitative aspects of life in an urban area and on the service environment. Since transportation is an essential service, there is no conceivable situation in which it would be completely done without. Each system and each component of it have widely ranging impacts on economic productivity of an entire region, individual productivity, access to opportunities for education, cultural enrichment, and recreation, and on the shape of the urban environment. While these impacts can generally be identified and classified, and while theory and experience offer a basis for estimating the probable nature or direction of the impacts of a particular program, neither theory nor methodology is available to measure these impacts with any degree of reliability.

Generally, the approach of cost-benefit analysis is to attempt to make aggregate measurements of changes caused by a program or project, with some changes labeled as benefits and some labeled as costs. One method is to take various impact components, such as effects on time-savings by transit users, savings in parking construction costs by businesses, and reduced unemployment compensation costs, and to aggregate all of these "benefits" to arrive at an aggregate effect of the project. The implicit assumption in this procedure is that there is a base from which impacts are identified and measurements are based, and the base is almost always the status quo.

Sometimes, and this is true of the evaluative procedure followed by SCRTD consultants, an attempt is made to identify effects not in terms of the status quo but in terms of the alternative situation likely to exist at a future time produced by some other program or set of programs assumed to be followed. While this increases the sophistication of the analysis, it does not change the fact that effects are identified and must be measured against some situation assumed to exist. This approach is usually called the "with-without" approach. It attempts to isolate and measure impacts produced by a project by identifying probable conditions without the project and with the project. The difficulty with this approach, also commonly used in environmental impact assessment, is that it is very difficult to say what conditions might exist, particularly in the future, or what alternatives might exist; or it relegates the analyst to the use of the status quo as the only known. It is particularly difficult, even in after-the-fact analysis, to determine the degree to which certain impacts, such as a downtown office building boom, resulted from a transit program or from other factors and the degree to which they can be accounted for by one or another cause. At present, this type of analysis is being performed on the Bay Area Rapid Transit System and it is apparently almost as difficult to measure the impacts of a transit program after it has gone into operation as it is to predict what those impacts will be.

Predictive impact analysis and cost-benefit analysis are obviously even more difficult since, if measurement of known occurrence is difficult, measurement of unknown effects is all the more so.

c. Problems of Valuation

Closely related to problems of definition and measurement in cost-benefit analysis is the problem of valuation. The cost-benefit framework itself calls for a common denominator of value to be attached to every effect which can be identified and measured. The intended result is to be able to compare all effects and to arrive at a net answer or a measurable ratio, expressed in dollars. The aim is comparable to quantification of all effects.

It is obvious to all analysts today that, however worthwhile the effort to improve upon methods of measurement and valuation, we can expect little progress in reducing different kinds of benefits and costs to quantified values. Aesthetic, social, and many environmental impacts cannot successfully be converted into dollar amounts because there are no markets which establish their dollar value to either an individual or to a community. As a result all analyses produce results only for some of the benefits and some of the costs of a project,

leaving the remainder to be judged qualitatively. Since the nonquantifiable benefits may be the most significant and are almost always the most controversial, this means that the analysis cannot deal adequately with the *central* issues. Due to the greater value typically attached to quantification, the analysis also has the misleading effect of attaching greater importance to those benefits and those costs which can be quantified. The effect is that no conclusion can be drawn about *net* benefits or *net* costs. This is particularly the case in analysis of transportation programs because of the inability to measure adequately the overall effects of transportation programs on other areas of concern, such as land use patterns, location of economic activities, social relationships, and public services, and the required focus on transportation as a uniquely identified good without regard to its function relative to other activities and services.

Although ingenious methods have been devised to attach dollar values to particular effects, such as travel time-savings, the values which are chosen are of necessity averages and it must be assumed that every individual affected attaches the same value to the variable. In practice, it is well known that this is not the case. Clearly, some individuals would value their time very highly and travel time-savings effected by transit would be worth a great deal. They would, we assume, be willing to pay a certain amount to save a certain amount of time in travel, and the use of air travel by businessmen is some indication of the importance of time to them. On the other hand, time is worth less to others and its value to anyone will depend on the particular activity in which he is engaged at any particular time. Even if it were possible to disaggregate effects on different people and to attach different values to something like time based on incomes or wage levels, this would require the implicit value judgment that one person's time is worth more than another person's time. Whether such a judgment should be made by decision makers as a matter of public policy in the choice of a transportation system is dubious, since that judgment expresses a conclusion about the social productivity of different citizens' time or at minimum an acceptance of current patterns of job and income distribution.

Beyond this theoretical level, there are even more serious practical problems of valuation facing cost-benefit analysis. What is generally required, if all benefits and all costs are to be taken into account, are assumptions regarding the benefit-cost ratios involved in other projects, activities, and decisions which will be influenced by the particular transportation decision. For example, a rapid transit system in Los Angeles may be designed and expected to enhance the possibilities for renewal and redevelopment of central city areas which have been abandoned in favor of outlying areas. Assuming that we can predict that such renewal will occur and in particular amounts, the question arises as to how to value such an impact. If one believes that renewal of such areas is itself economically or socially beneficial, then there is a benefit and it must be measured and valued somehow. However, one may not believe that such an impact will be beneficial in terms of the overall metropolitan economy. To resolve the question would in fact require an analysis of the benefits and costs associated with different locational patterns in the entire metropolitan economy and of the impacts of those patterns on the functioning of that economy, a task that is clearly beyond current analytical capabilities. This leads to the tracing problem discussed below.

As another example, assume that it is known that a particular project will increase the number of jobs available and that there will be a net reduction in unemployment. How does one value the reduced unemployment? A common approach is to determine the net savings in welfare or unemployment compensation payments. However, these payments only represent the value which society has determined a man's unproductive time to be worth; they do not represent the value which he attaches to his time or the effects of unemployment on his ability to feed his family and engage in a satisfying life.

In the case of other impacts, such as the disruption of a community caused by freeway or transit construction, causing increased traffic congestion, perhaps the loss of open space, or the creation of a physical and social barrier between different areas, there are no acceptable means to attach a value to the effects.

Normally, in our system of government, the valuation of different actions is performed by voters and their representatives as a political act. The political decision substitutes in collective decision making for the individual market decision to buy or not to buy. To the extent that benefit-cost analysis attempts to arrive at a "technical" assignment and aggregation of values to discrete effects, it bypasses political decision making as the accepted method of arbitrating among competing values.

d. Problems of Tracing

Already mentioned in other contexts is the problem of where to draw the line in cost-benefit analysis. Such analysis takes place in an institutional and economic context which is essentially open-ended. There are no boundaries which provide given limits for the analysis. This is seen in the definitional problems associated with choosing the relevant population for which to identify benefits and costs, and in the problem of valuation where assumptions must be made as to the overall character of expected secondary effects. It is also a problem of measurement since the more indirect an effect, the more difficult it is to measure.

The decision about where to terminate analysis of benefits and costs is essentially arbitrary. Assumptions must be made on the basis of established policy, personal value judgments, institutional constraints, and technical limits on the degree to which analysis can be conducted. Generally, if a proposed rapid transit system is likely to promote successful conclusion of an ongoing or planned urban renewal project, the analyst does not investigate the benefits or costs of the urban renewal project. He simply accepts the project as having some net benefit. This means that he stops tracing through costs and benefits at that point. Similarly, a transit system may save tourists to an area time and money during their vacation. These savings are usually not included because of the difficulty of measuring them. If they were measurable, one might attempt to determine the degree to which those savings would cause a channeling of more money into the purchase of local goods and services and then the extent to which that would increase local employment. Or one might attempt to determine the degree to which such savings would permit that individual to take longer vacations. The effects could be traced indefinitely if adequate knowledge were available. Since it is not, the tracing process must stop at some point.

Of critical concern in the evaluation of projects such as rapid transit is that fact that many of the effects will occur over a long period of time, are likely to be very subtle, and will not be encountered in an analysis of direct effects. They are usually termed secondary effects and they present the greatest measurement and identification problems. However, if the secondary effects are likely to be more important in the end than the direct effects, then the inability to trace the secondary effects is a significant weakness of the analysis and may well produce inaccurate results regarding the costs and benefits of the project. Transportation projects are particularly good examples of the types of projects which may have secondary costs and benefits more significant than the direct effects. On the basis of economic theory, the second-round effects over a long period of time of transportation investments on land use patterns may well be identified in general. Yet they are not easily traced in cost-benefit analysis because of inadequacies of methodology in economic and social analysis. That freeway construction in the Los Angeles area has had substantial effects on patterns of land use and environmental conditions seems undeniable. Whether such effects can even today be measured and valued is questionable.

e. Problems of Uncertainty

A problem common not only to cost-benefit analysis but also to all policy making is uncertainty regarding the future, particularly with respect to those factors which interact with policy decisions in one field to produce certain outcomes. In transportation planning the types of uncertainties which tend to receive the most treatment involve possible technological changes in transportation system developments. Often, however, the concern with premature commitment to a particular system or mode choice on grounds of expected technological advances is translated into nothing more than a fear of action and a commitment to the status quo. Although technological breakthroughs are almost always anticipated, history seems to indicate that, at least in the case of ground transportation, they are few and far between and less can be expected than was once thought. However, to the extent that cost-benefit analysis must make assumptions about a base situation for comparative purposes, uncertainty regarding technological changes presents a serious technical problem. For example, if one assumes that a solution will be found to the polluting qualities of the internal combustion engine, vastly different results may occur in a cost-benefit analysis for transit than if one assumes that no solution will be forthcoming.

Perhaps even more difficult and more pervasive are uncertainties regarding changes in the social, economic, and institutional environments which shape transportation demands and responses to them. In the late 1940s few could have predicted that the primary impetus for construction of a massive, national highway network would have arisen out of a concern for national defense and a "cold war" which shaped decisions to funnel massive amounts of funds into that network. The institutional environment had changed and a particular "actor" in that environment – the federal government – changed the entire scope of transportation system evaluation and ultimately the nature of travel patterns. If rapid transit projects had been evaluated before those decisions in terms of their benefits, the conclusions would certainly not have taken account of the benefits associated with transit or highway contributions to national defense. Yet national defense benefits were implicitly a primary benefit attributed to freeway construction.

Cost-benefit analysis requires predictions to be made about a host of future factors which are unknown: probable work patterns, including staggering of work hours and the four-day or three-day week; attitudes toward time spent in commuting and residential location preferences; levels of employment or unemployment; prices of gasoline and electricity and available supplies; probability of major earthquakes or other natural disasters; and demographic variables. Of particular concern is uncertainty with regard to population and economic growth because of the history of inaccurate predictions. At present, projections of future population growth are based on very recent, and atypical, trends in birth rates in the United States. Not more than two years ago, population projections indicated potential increases in the SCAG region's population of almost four million people by 1990. Today, the estimate is 2.7 million. In fact, there is little certainty as to the increases which are likely to occur over the next 20 years. On the other hand, decisions must be made about transit systems or parts of them to be operational from 5-15 years from now. Estimating the benefits of a project requires assumptions regarding the changes to occur in the economy, in population, and in various institutional factors affecting the impact of the project on travel demand satisfaction and on land use patterns, with little certainty as to the nature of the environment within which the transit system will be functioning in the future.

2. Policy Problems Associated with Cost-Benefit Analysis

The various technical difficulties explored above suggest serious policy implications associated with the concept of cost-benefit analysis as it can actually be applied. In effect, such an approach assumes that technical methods are available to evaluate complex trade-offs and distributions of costs and benefits among various individuals, groups, and governments. This assumption is implied in the attempt to obtain measurable values in common terms for each effect and to aggregate differing effects on individuals and groups into a net "community" benefit or cost expressed in dollar values. Such an approach raises serious questions regarding its value in assisting those who must make the decision. Some of the additional policy-related problems are discussed below.

a. Failure to Consider Alternatives

Because cost-benefit analysis is so time-consuming and so expensive, the conventional approach is to analyze a particular proposal without regard to other alternatives and to specify *absolute*, rather than *relative*, benefits and costs. Normally, the base used implicitly for purposes of measuring change is the status quo. Sometimes it is an assumed future. Thus, this type of analysis inevitably leads to conclusions regarding the benefits and costs of a particular project without regard to the possible benefits and costs of all other alternative projects or situations and without regard to the opportunity costs or benefits associated with not undertaking the project.

From the point of view of policy making, this is a serious defect in cost-benefit analysis and generally means that such analysis does not contribute anything to knowledge regarding a project's worth if alternatives have already been analyzed in terms of their relative ability

to achieve certain desired effects (benefits) and to minimize undesired effects (costs). This is the case, for instance, where an elaborate and sophisticated planning process has been utilized in arriving at the choice of a rapid transit program, as is the case in Los Angeles. The planning process has itself involved a comparative evaluation of the relative costs and benefits of alternative solutions to a particular problem and alternative means of achieving certain goals. If this process has been conducted conscientiously and expertly, the final choice of a project is a result of an implicit relative cost-benefit analysis which has involved prior analysis of many alternatives. To the extent that conventional cost-benefit analysis is then applied simply to estimate the absolute effects of the project, it contributes far less to understanding of the choices available and their relative desirability than the original analysis which resulted in the choice. Since, indeed, it does not consider alternatives, it is far less illuminating and virtually worthless to the serious decision maker concerned with choosing the best alternative available to meet a need. At its best, it simply indicates the likely effects of his choice without regard to the other alternatives which were or are available. Such an exercise is hardly useful in making decisions though it might be used for certain limited purposes (such as identifying means of recouping special benefits for overall public gains or in taking advantage of expected impacts through other public policy decisions).

b. Bypassing the Citizens' and the Decision Makers' Role in Establishing Values

To the extent that cost-benefit analysis succeeds technically in defining and valuing benefits and costs, it effectively erodes the role of individual voters and their representatives in making their own value judgments as to what is good or bad with respect to a particular project. The analysis is by its nature evaluative since it involves classification of expected effects into benefits and costs and assignment of values to both according to a common measurement system. Thus, it consists essentially in an attempt to package all effects into a final conclusion as to the positive or negative quality of the project. Aspects of cost-benefit analysis involve value judgments by the analyst which may be at odds with value judgments which would be made by all or segments of the particular community or communities for which the project is proposed.

The purpose of such analysis should be to assist citizens and policy makers in assigning their own values to the impacts of a project, thereby setting their own goals and policies as to the desired qualities of their communities. While cost-benefit analysis can attempt to incorporate these values into the analysis by basing the classification of costs and benefits on adopted policies and goals for a community, there will remain substantial disagreements even within the community as to the meaning of a particular goal or policy statement in any particular instance. For example, while there may be general agreement on the desirability of concentrating future growth in Los Angeles in established centers, there is probably not yet agreement on the allocation to each and the degree to which existing land uses should be disrupted in pursuance of that goal. Thus, at the individual level, some residents may favor the general concept of increasing densities at particular locations and yet oppose the same policy if applied where they live. Although these issues must be and are dealt with at the political level, they cannot be dealt with technically in cost-benefit analysis, nor should they.

By its nature, cost-benefit analysis must also use common values for application to different people, despite the fact that different people will have different perceptions regarding the importance of a particular benefit or a particular cost. Reconciliation of these conflicts and differences can only be accomplished in the political arena and not by technical means which assume the absence of such conflicts. There is simply no means by which to determine each individual's benefit or to aggregate those benefits for an entire community. The same may be said as to indirect costs.

c. The Fallacy of the *Net* Benefit and *Net* Cost Approach

Conventional cost-benefit analysis generally arrives at either an estimate of the benefit-to-cost ratio or identification of the net benefits or costs in dollar terms.

In the first case, a ratio is shown in order to avoid the difficult proposition that there is actually an identifiable net dollar effect. In the second this additional leap is made. In actuality, the two are only variations on a similar theme: each proposes to indicate an aggregate relationship between benefits and costs which is expected to have some social or economic significance. If the benefit-cost ratio exceeds 1.1 to 1.0 or if the *net* effect is positive, then it is assumed that the project is desirable.

The effect of this emphasis on aggregation of differential effects is to obscure the probably more significant impacts on discrete individuals and groups. Underlying the approach is an assumption that someone's loss can be valued against someone else's gain and if those who gain, gain more than those who pay, then the project is desirable. This approach is not accepted in either the theory of welfare economics or in democratic political theory. The danger of the approach is that the discrete underlying effects on different groups and individuals may be ignored and thereby exacerbated. This is particularly critical if those who stand to bear a cost are much less well off than those who stand to reap a gain from a particular project, which is a strong possibility in choosing among alternative transportation projects.

Generally, it seems wiser to do the best possible job at estimating impacts and evaluating alternatives and let elected representatives and citizens who have varying interests and will be affected differently indicate how they feel about and value the prospective changes. In this way trade-offs can be made which tend to even out the distribution of gains and losses. The misleading character of conventional cost-benefit analysis is to suggest that there is some mechanism which provides for the transfer of benefits and costs among persons so as to arrive at a net social benefit. This is in fact not the case, except through political bargaining.

d. The Role of the Decision-Making Body and the Central Role of Policy

Comprehensive cost-benefit analysis would deal with the effects of any proposed action and its assigned value on all those who may benefit from it or bear its costs. Thus, as indicated above in the discussion of problems of definition, ideally a cost-benefit analysis of a

rapid transit program in Los Angeles, if a program is to be financed in part by the federal government, should address the question of the costs and benefits of the program to the entire population of the United States. Since this is obviously impractical as a technical matter and useless from the viewpoint of local policy makers, it is never done. As a result, no cost-benefit analysis performed for the purposes of informing the decisions of local officials can provide useful instruction for federal officials in the matter of whether or not to commit federal funds to the project. They might as well accept the decisions of local policy makers that the proposed program is the proper and desired approach for the area.

In addition, every governing body or set of decision makers necessarily operates within substantial constraints with respect to the kinds of action it can effect and the territory within which those effects can be realized. This obviously leads to potential conflicts with other jurisdictions and other governing bodies in some cases. Cost-benefit analysis has to be undertaken at some scale and has to include a definition of the relevant area and population affected; the rest of the world is automatically excluded. For the policy makers there is no other alternative, for this is the universe in which they are assigned responsibilities to act and they must decide as best they can. As a result, the cost-benefit analysis will be shaped in terms of the values and goals of that particular universe, to the extent it is shaped by any goals or values other than those of the analysts. The effect of the analysis therefore will generally be to elaborate upon the rationale for a choice by those decision makers rather than to provide wholly new information for their use. When this is the case, it provides no substantial guidance to those who must make the decision.

It has become increasingly apparent in modern planning and public policy formulation that established objectives and policies should be the bases for public investment decisions. Alternatives must be weighed in terms of their ability to achieve an adopted set of policies, whether they relate to reduction of unemployment, increased mobility, enhancement of environmental quality, stabilization of social structures, promotion of reduction of growth, or centralization or decentralization of jobs.

Projects in any particular field – such as transportation – must be weighed and evaluated in terms of their contribution to a coherent set of overall policies for an area. Cost-benefit analysis, in its conventional form, provides little assistance in undertaking this evaluative process, although versions of cost-effectiveness analysis may. Generally, the technical support required is to determine, to the degree possible, how a particular action or project may or may not contribute to the attainment of given objectives. This can be achieved through impact analysis, applied to several alternatives, and such analysis is generally embodied in the very kind of planning process which leads to the identification of a "project."

Conventional cost-benefit analysis may divert attention from the proper conduct of such a planning process and the appropriate methods by which desirable actions are identified in furtherance of such policies, by focusing attention on methods of analysis and techniques of quantification rather than on policy formulation.