# State of the Practice: Travel Analysis Methods in Long-Range and Strategic Planning

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In response to the shifting issues and context for urban transportation planning, particularly the reduced capability of most regions to finance major highway and transit capital improvements, less emphasis is now being given to long-range planning than in the 1970s. Long-range planning, to be sure, will continue, and past plans will be refined and updated. However, the greater priorities are now being placed on shorter-range questions of transportation systems management and efficiency--obtaining increased capacity and service from existing facilities. Without the prospect of major capital investment as a tool for guiding urban growth, development, and redevelopment, less interest also is currently being shown in strategic or policy planning, with even longer time frames (beyond 20 years) than traditional long-range transportation planning.

In this paper, two case studies--Milwaukee and Dallas-Fort Worth--are used to examine travel analysis and long-range and strategic planning methods now in use within this context of changing planning requirements.

In general, current work of the North Central Texas Council of Governments (NCTCOG) is regarded as representative of most medium-sized and larger urban regions (1,2). NCTCOG is updating its 1975 regional transportation plan with only modest technical effort and with relatively little innovation in the application of travel-demand models or the analysis of strategic planning options. State-of-the-art disaggregate demand-analysis models were installed in 1979 and offer considerable flexibility in application at regional or subarea levels. However, these models are not being used in any extensive or thorough way to explore a wide range of regional transportation alternatives nor are multiple scenarios or alternative futures for the region being examined. This, in turn, is consistent with the perceptions of the COG Regional Transportation Council with regard to transportation planning and programming priorities in the region.

The Southeastern Wisconsin Regional Planning Commission (SEWRPC) has been one of the stronger metropolitan planning organizations (MPOs) for a number of years in terms of both local political support and technical capability. Staff of the agency has been given sufficient freedom to test new analytic methods and has recently completed an update of the transit component of the 1974 regional transportation and land use plan, which offers some measure of leadership and innovation in long-range and strategic transportation planning (3,4). Both alternative socioeconomic futures and accompanying land use plans were explored. A wide range of alternative transportation systems (highway and transit), which support each of these alternative futures, was also defined and analyzed in detail by applying state-of-the-art demand-modeling methods. This example consequently provides something of a benchmark or target for improved analytic support of long-range and strategic planning but not without important technical difficulties.

In the remainder of the paper, these two case studies are contrasted in three ways:

1. Evolving methods for strategic planning (or at least the forecasting, assumption setting, or both associated with socioeconomic or land use contexts for travel demand analysis) as well as long-range transportation planning and demand modeling are briefly reviewed. Seven different methodological topics are investigated, covering such aspects as the role of alternative land use plans, the management of information overload for participating decisionmakers, or the importance of corridor or subarea planning to regional-level decisionmaking.
2. In support of the overall conclusion that the state of the practice in this area is relatively weak, reasons for this lack of attention or focus are given. Several different reasons are suggested, ranging from the information absorption limits of decisionmakers to the technical and communication difficulties associated with delineating complex socioeconomic and environmental scenarios and the increasing short-range implementation focus of many decisionmakers.
3. Several suggestions are outlined for closing the apparent gap between the state of the art and the state of the practice in travel analysis methods that support long-range and strategic planning.

## EVOLVING METHODS

Several general areas of transportation and land use planning strategy and travel analysis methodology merit examination. These include the extent to which alternative futures are utilized; the extent to which travel demand models are employed (and their associated degree of complexity) in relation to alternative futures and in general; the extent to which corridor or subarea transportation planning and travel analyses are conducted or required to make decisions; and the extent to which the often extensive information output of travel analysis is effectively managed.

The evolving methods investigated here and their treatment by the two case-study areas, Milwaukee (SEWRPC) and Dallas-Fort Worth (NCTCOG), are summarized in Table 1.

**Table 1. Summary of evolving methods: SEWRPC and NCTCOG.**

| | Case-Study Treatment | |
|---|---|---|
| Evolving Method | SEWRPC | NCTCOG |
| Alternative futures and scenarios | Two socioeconomic scenarios | Concept not used |
| Alternative land use plans | Two land use plans for each scenario | Urban development model used for single projection |
| Long-range transportation alternatives | Six modal options matched against four scenario and land use plan combinations to yield 24 basic alternatives | Eleven modal options matched against single, eight-corridor transportation and land use system |
| Travel-demand analysis | UTPS-based computerized demand modeling | Manual sensitivity analyses |
| Policy and strategic options | Focus on intangible benefits of rail alternatives | Focus on influencing future land development patterns |
| Management of evaluative information | Three-stage, narrowing down evaluation process | Not an issue |
| Decisionmaker informational needs | Ten; 40 summary measures used | Five; 10 key indices desired |

Alternative Futures or Scenarios

Few regions have successfully employed the notion of alternative futures as a background for regional transportation and land use planning. One of the immediate dangers is, of course, doubling or quadrupling (or worse) the amount of work necessary to carry forward any competent analysis of alternatives, given the time and budget constraints associated with typical planning agency staffs. Keeping the number of alternatives under control and structuring them so that they represent a high or low assumption along key parameters are important guidelines.

SEWRPC defined two basic alternative futures for updating its regional transportation and land use plan--a moderate-growth scenario and a stable or declining-growth scenario (3). As indicated in Figure 1 (3, p. 155), each scenario was tied to a series of assumptions regarding basic external factors affecting regional growth, such as energy availability and price, automobile fuel efficiency, household size, female labor force participation, household income growth (real dollars), and population and employment growth. Figure 2 (3, p. 141) indicates how each scenario was assumed to follow a high or low growth rate through the year 2000 for the various key factors. The scenarios are consequently used as a way to bound the future of the region in terms of pessimistic or optimistic growth and economic prospects.

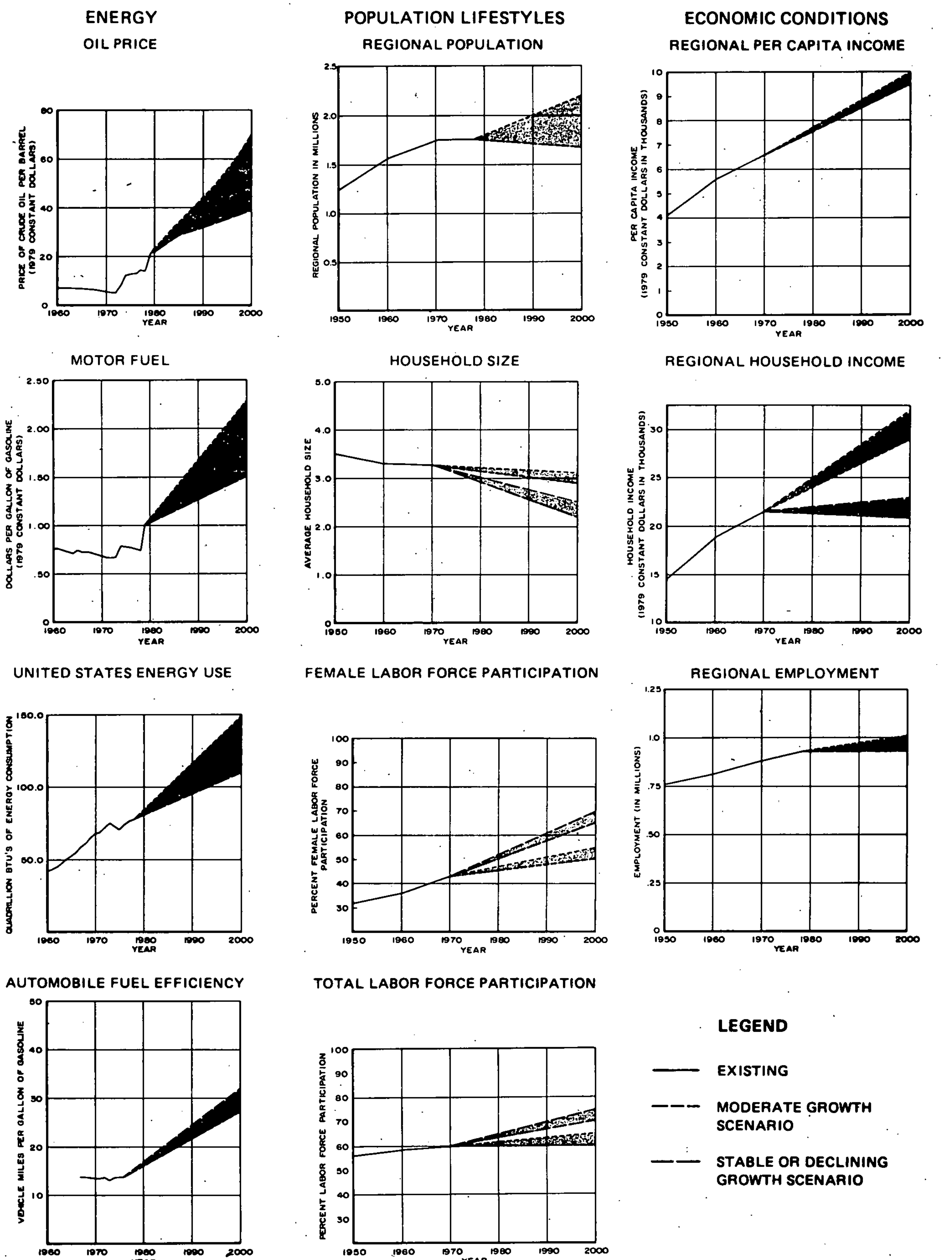
In updating its regional transportation and land

Figure 1. Alternative futures.

| Key External Factor | Moderate Growth Scenario | Stable or Declining Growth Scenario |
|---|---|---|
| Energy<br>The future cost and availability of energy, particularly of petroleum | Oil price to converge with world oil price, which will increase at 5 percent annual rate to $72 per barrel in the year 2000 (1979 dollars)<br>Petroleum-based motor fuel to increase to $2.30 per gallon by the year 2000 (1979 dollars)<br>Assumes some potential for major and continuing disruptions in oil supply | Oil price to converge with world oil price, which will increase at 2 percent annual rate to $39 per barrel in the year 2000 (1979 dollars)<br>Petroleum-based motor fuel to increase to $1.50 per gallon by the year 2000 (1979 dollars)<br>Assumes no major or continued disruptions in oil supply |
| The degree to which energy conservation measures are implemented, particularly with respect to the automobile | Low degree of conservation in all sectors, resulting in increase in energy use of 3 percent<br>Automobile fuel efficiency of 27.5 miles per gallon | High degree of conservation in all sectors, resulting in increase in energy use of 2 percent or less<br>Automobile fuel efficiency of 32 miles per gallon |
| Population Lifestyles<br>The degree to which the changing role of women affects the composition of the labor force | Female labor force increases to 50 to 55 percent and total labor force participation is 60 to 65 percent | Female labor force increases to 65 to 70 percent and total labor force participation is 70 to 75 percent |
| The future change in fertility rates | A continuation of below-replacement-level fertility rates during the next decade, followed by an increase to replacement level by the year 2000 | A continuation of below-replacement-level fertility rates to the year 2000 |
| The future change in household sizes | Average household size stabilizes | Average household size continues to decline |
| Economic Conditions<br>The degree to which the Region will be able to compete with other areas of the nation for the preservation and expansion of its economic base | Region is considered to have relatively high attractiveness and competitiveness | Region is considered to have relatively low attractiveness and competitiveness |
| The future change of real income | Per capita and household income increase envisioned as a result of the attractiveness and competitiveness of Region, an increased proportion of the population being of work force age, and increased population labor force participation | Per capita increase likely but no household income increase envisioned as a result of the lack of attractiveness and competitiveness of Region, but increased proportion of the population is of work force age, and there is increased population labor force participation |

| Attendant Regional Change | Moderate Growth Scenario | Stable or Declining Growth Scenario |
|---|---|---|
| Population of the Region in Year 2000<br>Size | 2,219,300 persons | 1,688,400 persons |
| Age Distribution | 29.2 percent—0-19 years of age<br>58.5 percent—20-64 years of age<br>12.3 percent—65 years of age or older | 26.8 percent—0-19 years of age<br>60.6 percent—20-64 years of age<br>12.6 percent—65 years of age or older |
| Number of Households | 681,100 to 739,400 | 673,600 to 750,600 |
| Household Size | Average of 2.9 to 3.1 persons | Average of 2.2 to 2.5 persons |
| Economic Activity of Region in Year 2000<br>Employment | 1,016,000 jobs | 887,000 jobs |
| Structure | Manufacturing. . . . 32 percent<br>Services. . . . . . . . 40 percent<br>Other . . . . . . . . . 28 percent | Manufacturing. . . . 30 percent<br>Services. . . . . . . . 41 percent<br>Other . . . . . . . . . 29 percent |
| Personal Income | $29,600 to $32,000 per household in 1979 dollars (38 to 50 percent increase over 1970, or a 1.1 to 1.4 percent annual rate of increase)<br>$10,000 per capita in 1979 dollars (54 percent increase over 1970, or a 1.4 percent annual rate of increase) | $21,400 to $23,700 per household in 1979 dollars (0 to 11 percent increase over 1970, or a 0.0 to 0.3 percent annual rate of increase)<br>$9,500 per capita in 1979 dollars (46 percent increase over 1970, or a 1.3 percent annual rate of increase) |

**Figure 2. Ranges of external factors considered in alternative-future scenarios.**



use plan, NCTCOG has followed a more traditional approach of single-valued forecasts of demographic, employment, and development characteristics of the region, based on an examination of past trends in the region and in other regions across the country (2,5). Conventional population and employment forecasting models were utilized to derive single-valued year-2000 forecasts. In deriving these forecasts, however, extensive consideration also was given, as in the Milwaukee region, to the availability and price of transportation energy and to socioeconomic trends regarding age distribution, residential density, sunbelt-snowbelt population shifts, and central city versus suburban population and employment shifts.

## Alternative Land Use Plans

Each of the SEWRPC growth scenarios was accompanied by two corresponding land use plans. These land use development assumptions also tend to represent density and distributional extremes. The centralized land use plan assumed that virtually all new urban development would occur at medium residential densities adjacent to existing urban centers [see Figure 3 (3, p. 145)]. Considerably less land would be consumed for urban uses compared with the decentralized land use plan, which reflects historic development trends in the region since 1963--low densities, urban scatteration, and inefficient provision of accompanying urban services [Figure 4 (3, p. 147)]. For both scenarios, distributional assumptions by land use category and location were made for the two land use plans accompanying each scenario. A total of four basic alternatives (two scenarios and two land use plans each) resulted as the framework for defining transportation alternatives.

In contrast, NCTCOG exercised an urban development model to project a single-valued allocation of urban land uses among the region's subareas. This model requires as input the accessibility provided by assumed highway service levels, since accessibility is one of the factors influencing the distribution of residential population. The land use allocation is also constrained by local zoning policies and holding capacity. Since only a relatively small number of regions have opted for the utilization of computerized urban development models, this use in Dallas-Fort Worth may be atypical. (No land use model was employed in Milwaukee.) There has been pressure from some rapidly growing suburbs in Dallas to consider the effect of increased growth rates for their jurisdictions on area transportation alternatives, which represents, in effect, a higher-growth scenario.

## Matching Long-Range Transportation Alternatives to Alternative Futures

It is at this stage of a long-range transportation planning process that the dangers of information overload become evident. In Milwaukee, it was felt that a thorough analysis required five modal options in addition to a base-case plan. These options included express bus-on-freeway (base case), expanded bus-on-freeway, busway, commuter rail, light rail, and heavy rail rapid transit. As a first cut, so-called maximum extent systems for each of these modes were matched against each of the four scenario and land use combinations, which resulted in 24 basic alternatives. A three-level process of evaluation involved an initial testing of these 24 alternatives, a truncating of the five primary transit systems to their highest performance corridor components (followed by a subsequent round of analysis and evaluation), and a more detailed evaluation of two finalist, composite alternatives.

In Dallas-Fort Worth, a less structured planning process has been followed, and emphasis has been given to the relatively rapid definition and analysis of express transit alternatives for the Dallas portion of the region. For the single population/employment land use projection, a series of 11 different modal systems alternatives was defined for Dallas at a sketch-planning level of detail. For ease of analysis, the same basic eight-corridor network was assumed for each alternative, and levels of service (average speed, station spacing, headway, etc.) were assumed to vary for each mode (6). In effect, the selection of a single land use plan permitted a larger number of modes to be analyzed, although the total number of alternative transportation systems examined was still considerably less (about one-half) than in Milwaukee.

## Extent of Travel Demand Analysis

Major differences between SEWRPC and NCTCOG emerge here, reflecting in large part the time frame and budget allocated for analysis. The SEWRPC long-range plan update was set within a multiyear regional transportation planning program and accomplished within a well-thought-out planning process. Computer-based travel demand modeling was applied to each of the 24 maximum extent alternatives as well as to the most promising of the remaining truncated alternatives; this involved a major expenditure of funding and staff effort.

In the Dallas region, on the other hand, analysis of express transit alternatives was initially conducted for the Interim Regional Transportation Authority (IRTA), established within a relatively short time frame and modest budget to select a viable transit alternative for the region with a mandate not fully integrated with the ongoing regional transportation planning program. While NCTCOG staff participated in the resultant planning effort, it was not possible to fully utilize the recently developed and improved travel demand modeling package (6). Preliminary travel demand analyses for the express transit alternatives were consequently derived by using manual sensitivity analyses of demand forecasts before 1975, in turn based on the somewhat outdated demand modeling package of that time. Much less effort was devoted to travel demand analysis in Dallas-Fort Worth than in Milwaukee. NCTCOG does plan to apply its computerized travel demand modeling package to a single selected express transit alternative or service plan, to more completely detail its operational and demand characteristics. This transit plan will then be combined with a companion, separately developed highway plan to form the overall updated regional transportation plan.

## Policy and Strategic Options Versus Facility-Oriented Options

Although one of the conclusions of a recent conference on urban transportation planning involves the reorientation of long-range transportation planning more toward policy and strategic options and less toward facility-oriented options (7), this dimension is a difficult one to characterize for the two case studies.

In general, the SEWRPC planning process was quite specifically facility oriented in the sense of detailed definition of transit alternatives regarding route alignment and station location and corridor-by-corridor service-level differences (all required as input to the computerized travel demand model-

**Figure 3. Existing and proposed land use in region: 1970 and 2000 centralized land use plan for moderate-growth scenario.**

| Land Use Category | Existing 1970 | | Planned Increment | | Total 2000 | |
|---|---|---|---|---|---|---|
| | Acres | Percent of Major Category | Acres | Percent Change | Acres | Percent of Major Category |
| Urban Land Use | | | | | | |
| Residential | | | | | | |
| Urban High Density | 24,389 | 7.4 | 371 | 1.5 | 24,760 | 6.2 |
| Urban Medium Density | 37,092 | 11.3 | 41,046 | 110.7 | 78,138 | 19.5 |
| Urban Low Density | 72,701 | 22.2 | -7,689 | -10.6 | 65,012 | 16.2 |
| Suburban Density | 22,079 | 6.7 | 4,862 | 22.0 | 26,941 | 6.7 |
| Subtotal | 156,261 | 47.6 | 38,590 | 24.7 | 194,851 | 48.6 |
| Commercial | 6,517 | 2.0 | 698 | 10.7 | 7,215 | 1.8 |
| Industrial | 10,038 | 3.1 | 6,672 | 66.5 | 16,710 | 4.2 |
| Governmental and Institutional | 16,628 | 5.1 | 951 | 5.7 | 17,579 | 4.4 |
| Transportation, Communication, and Utilities[a] | 109,430 | 33.4 | 21,441 | 19.6 | 130,871 | 32.7 |
| Recreation | 28,982[b] | 8.8 | 4,166[c] | 14.4 | 33,148 | 8.3 |
| Urban Land Use Subtotal | 327,856 | 100.0 | 72,518 | 22.1 | 400,374 | 100.0 |
| Rural Land Use | | | | | | |
| Residential | - -[d] | - - | 22,306 | - - | 22,306 | 1.7 |
| Agriculture | 1,040,119 | 74.7 | -79,779 | -7.7 | 960,340 | 72.7 |
| Other Open Lands[e] | 353,125 | 25.3 | -15,045 | -4.3 | 338,080 | 25.6 |
| Rural Land Use Subtotal | 1,393,244 | 100.0 | -72,518 | -5.2 | 1,320,726 | 100.0 |
| Total | 1,721,100 | - - | - - | - - | 1,721,100 | - - |

[a] *Includes off-street parking uses.*

[b] *Includes net site area of public and nonpublic recreation sites.*

[c] *Includes only that net site area recommended for public recreation use.*

[d] *Included in land use inventory as part of urban residential land use.*

[e] *Includes woodlands, water, wetlands, unused lands, and quarries.*

**Figure 4. Existing and proposed land use in region: 1970 and 2000 decentralized land use plan for moderate-growth scenario.**

| Land Use Category | Existing 1970 | | Planned Increment | | Total 2000 | |
|---|---|---|---|---|---|---|
| | Acres | Percent of Major Category | Acres | Percent Change | Acres | Percent of Major Category |
| Urban Land Use | | | | | | |
| Residential | | | | | | |
| Urban High Density | 24,389 | 7.4 | -2,548 | -10.4 | 21,841 | 4.6 |
| Urban Medium Density | 37,092 | 11.3 | 43,888 | 118.3 | 80,980 | 16.9 |
| Urban Low Density | 72,701 | 22.2 | -2,423 | -3.3 | 70,278 | 14.7 |
| Suburban Density | 22,084 | 6.7 | 64,889 | 293.8 | 86,973 | 18.2 |
| Subtotal | 156,266 | 47.6 | 103,806 | 66.4 | 260,072 | 54.4 |
| Commercial | 6,517 | 2.0 | 385 | 5.9 | 6,902 | 1.4 |
| Industrial | 10,039 | 3.1 | 3,847 | 38.3 | 13,886 | 2.9 |
| Governmental and Institutional | 16,617 | 5.1 | 2,735 | 16.5 | 19,352 | 4.0 |
| Transportation, Communication, and Utilities[a] | 109,407 | 33.4 | 33,788 | 30.9 | 143,195 | 30.0 |
| Recreation | 28,996[b] | 8.8 | 5,738[c] | 19.8 | 34,734 | 7.3 |
| Urban Land Use Subtotal | 327,842 | 100.0 | 150,299 | 45.8 | 478,141 | 100.0 |
| Rural Land Use | | | | | | |
| Residential | - -[d] | - - | 4,782 | - - | 4,782 | 0.4 |
| Agriculture | 1,040,122 | 74.7 | -141,070 | -13.6 | 899,052 | 72.3 |
| Other Open Lands[e] | 353,136 | 25.3 | - 14,011 | - 4.0 | 339,125 | 27.3 |
| Rural Land Use Subtotal | 1,393,258 | 100.0 | -150,299 | -10.8 | 1,242,959 | 100.0 |
| Total | 1,721,100 | - - | - - | - - | 1,721,100 | - - |

[a] *Includes off-street parking uses.*

[b] *Includes net site area of public and nonpublic recreation sites.*

[c] *Includes only that net site area recommended for public recreation use.*

[d] *Included in land use inventory as part of urban residential land use.*

[e] *Includes woodlands, water, wetlands, unused lands, and quarries.*

ing). Key policy issues were, however, also addressed as a part of the overall evaluation of alternatives. A basic policy issue raised by the Commission was the judgmental trade-off regarding the measureable and more certain advantages of the bus-on-metered freeway alternative and the intangible advantages of the light rail transit alternative and of commuter rail facilities and services. A detailed and thorough technological and policy evaluation of modal alternatives was also prepared as background material for the Commission, again reflecting a significant expenditure of staff and budget resources.

At NCTCOG, on the other hand, although it would appear that the comparative lack of modal specificity would allow a greater focus on policy issues--specific alignments and station locations were not a part of the express transit alternatives defined--there was also a danger that too many policy issues might in the end be only superficially addressed. One major issue raised by IRTA broad members involved the extent to which investment in high-capacity, grade-separated rail transit could or could not significantly influence future land use development in the long term. The extent to which this should be a desired regional objective, addressed by land use policies and controls as well, was also raised. Insufficient time and budget were available to adequately examine such weighty policy issues as these.

### Management of Evaluative Information

As indicated above, the SEWRPC alternative-scenarios planning process generated a considerable amount of information regarding 24 basic maximum-extent transportation alternatives. In order to sift through the information generated on these initial alternatives as well as on subsequent versions of them, it was necessary to devise a three-stage evaluation process for narrowing down to the final two alternatives, which were more carefully compared.

Following review of the maximum-extent alternatives, a series of truncated alternatives was also defined, with a reduction of the total number of alternatives under consideration to 10 (some alternatives were assumed to appropriately serve two or more of the scenario and land use combinations). Under the third evaluation stage, the two most promising alternatives--bus-on-metered freeway and a two-tier or two-stage light rail system--were more fully evaluated, including a more careful consideration of intangible or indirect impacts.

In Figures 5, 6, and 7 a partial summarization of this sequence of evaluative efforts is given, and some idea of the volume of evaluative information that required the concentrated attention of Commission members as they proceeded through the process is indicated. This information flow was regarded as unwieldy and cumbersome by some participants (8).

### Decisionmaker Informational Needs

The NCTCOG planning process was not so thoroughly structured as that followed in Milwaukee, so that the dangers of information overload were much less. It simply was not possible to generate the quantity of network performance and cost data, at a considerable level of detail, as that carried forward in Milwaukee. Emphasis in the evaluative stages of the planning process consequently shifted from management of potential information overloads to meeting the key informational needs of decisionmakers. This, in effect, involved zeroing in on 5-10 key indices for assessing express transit alternatives without devoting time and effort to additional supporting information, which, although valuable in providing a more thorough understanding and background on important similarities and differences among transit alternatives, is only supportive.

The bottom-line indices--peak-link, peak-hour, and peak-direction passenger volume; daily ridership volume; capital cost per passenger; operating and maintenance cost per passenger; total capital cost; operating subsidy per passenger required; and related effectiveness or efficiency measures--remain the key desired outputs of the planning process. In the Dallas-Fort Worth example, however, additional information was desired by IRTA members regarding the related scenario-type variables that might affect potential transit demand--energy cost, residential density, highway congestion levels, etc. In fact, although these key requested sensitivity analyses could perhaps have been better addressed by a more thorough alternative-futures component of the planning process, such an approach was precluded by the short time frame under which the IRTA transit planning process was inaugurated (six months).

## LIMITED STATE OF THE PRACTICE

A number of important contrasts between the SEWRPC and NCTCOG examples are now evident--prior commitment to thorough and systematic regional planning processes (SEWRPC), political mandate for and urgency of reaching express transit investment decisions in a short time frame (NCTCOG), major differences in the level of staff effort and funding devoted to the long-range and strategic planning process, associated time and funding availability for the exercising of computerized travel demand models, and the extent to which varying assumptions (high versus low) regarding key external factors have been reflected in travel demand and supply relationships for different modal alternatives. In general, although several aspects of the SEWRPC case study are both noteworthy and commendable, the NCTCOG case study is nevertheless representative of the majority of the MPOs across the country. It is consequently necessary to use both case studies to investigate a number of reasons for the relatively limited state of the practice in long-range and strategic planning and supporting travel analysis methodology.

The following preliminary reasons are offered.

### Decisionmakers Have Information Limits

The NCTCOG example in particular illustrates how the underlying decisionmaking and political or community context can place real limits on the ability (and even desire) of decisionmakers to absorb extensive evaluative information regarding transportation alternatives.

In general, at least two levels of decision can be distinguished, and many decisionmakers focus on the simpler, less demanding level, namely, can any sort of capital-intensive transportation investment (such as fixed guideway, grade-separated transit) be justified and in how many corridors? Given this go or no-go decision, the additional information required to discriminate among technology options calls for a second decisionmaking level and places greater demands on decisionmakers for the understanding of impact differences and trade-offs among them. As experience in most other regions shows (and certainly in Milwaukee as well), many decisionmakers at either level search for those 5-10 key criteria for which a straightforward choice among alternatives can be made. This desire for simplicity reflects limited time available for in-depth analysis as well as a pragmatic search for the essentials (9).

**Figure 5. Summary of evaluation of base system plan and alternative maximum-extent primary transit system plans under each scenario land use plan.**

| | Alternative | | | | | |
|---|---|---|---|---|---|---|
| Scenario | Base Plan | Bus-on-Freeway Plan | Commuter Rail Plan | Light Rail Transit Plan | Busway Plan | Heavy Rail Rapid Transit Plan |
| **Moderate Growth Scenario-Centralized Land Use Plan** | | | | | | |
| Public Transit Ridership | | | | | | |
| Passenger Trips per Average Weekday | 326,800 | 387,900 | 372,100 | 357,800 | 353,500 | 346,600 |
| Cost | | | | | | |
| Total Cost | | | | | | |
| Total Cost to Design Year | $579,742,000 | $832,269,800 | $868,415,300 | $1,120,900,000 | $938,394,490 | $2,048,414,900 |
| Capital Cost | | | | | | |
| Total Capital Cost to Design Year | 148,842,000 | 221,249,800 | 210,245,300 | 628,160,000 | 442,054,490 | 1,572,378,300 |
| Total Capital Investment to Design Year | 233,328,700 | 356,443,700 | 401,852,100 | 1,231,138,000 | 771,162,200 | 2,930,538,000 |
| Net Operating and Maintenance Cost (deficit) | | | | | | |
| Total Deficit in Design Year | 23,198,300 | 45,713,000 | 51,607,600 | 30,928,100 | 31,378,700 | 28,840,500 |
| Total Deficit to Design Year | 430,900,000 | 611,020,000 | 658,170,000 | 492,740,000 | 496,340,000 | 476,036,600 |
| Cost-Effectiveness | | | | | | |
| Cost to Design Year per Passenger | | | | | | |
| Total Cost to Design Year per Passenger | 0.39 | 0.52 | 0.54 | 0.73 | 0.62 | 1.35 |
| Capital Cost to Design Year per Passenger | 0.10 | 0.14 | 0.13 | 0.41 | 0.29 | 1.04 |
| Operating Deficit to Design Year per Passenger | 0.29 | 0.38 | 0.41 | 0.32 | 0.33 | 0.31 |
| Percent of Operating and Maintenance Cost Met by Farebox Revenue in the Design Year | | | | | | |
| Total Transit System | 62 | 53 | 49 | 59 | 58 | 60 |
| Primary Element | 56 | 54 | 41 | 88 | 86 | 74 |
| **Moderate Growth Scenario-Decentralized Land Use Plan** | | | | | | |
| Public Transit Ridership | | | | | | |
| Passenger Trips per Average Weekday | 217,400 | 256,700 | 245,100 | 234,700 | 231,600 | -- |
| Cost | | | | | | |
| Total Cost | | | | | | |
| Total Cost to Design Year | $542,926,370 | $770,816,100 | $785,265,880 | $1,040,607,700 | $ 900,128,990 | -- |
| Capital Cost | | | | | | |
| Total Capital Cost to Design Year | 124,606,570 | 180,135,500 | 182,522,880 | 583,822,300 | 407,051,590 | -- |
| Total Capital Investment to Design Year | 186,198,500 | 286,385,500 | 334,665,700 | 1,127,632,600 | 733,648,700 | -- |
| Net Operating and Maintenance Cost (deficit) | | | | | | |
| Total Deficit in Design Year | 21,625,900 | 43,171,000 | 44,678,800 | 26,434,100 | 30,970,600 | -- |
| Total Deficit to Design Year | 418,319,800 | 590,680,600 | 602,743,000 | 456,785,400 | 493,077,400 | -- |
| Cost-Effectiveness | | | | | | |
| Cost to Design Year per Passenger | | | | | | |
| Total Cost to Design Year per Passenger | 0.44 | 0.59 | 0.60 | 0.84 | 0.73 | -- |
| Capital Cost to Design Year per Passenger | 0.10 | 0.14 | 0.14 | 0.47 | 0.33 | -- |
| Operating Deficit to Design Year per Passenger | 0.34 | 0.45 | 0.46 | 0.37 | 0.40 | -- |
| Percent of Operating and Maintenance Cost Met by Farebox Revenue in the Design Year | | | | | | |
| Total Transit System | 53 | 43 | 42 | 56 | 48 | -- |
| Primary Element | 45 | 48 | 35 | 82 | 80 | -- |
| **Stable or Declining Growth Scenario-Centralized Land Use Plan** | | | | | | |
| Public Transit Ridership | | | | | | |
| Passenger Trips per Average Weekday | 215,900 | 241,700 | 230,500 | 227,200 | 224,800 | -- |
| Cost | | | | | | |
| Total Cost | | | | | | |
| Total Cost to Design Year | $493,042,100 | $708,108,800 | $777,644,100 | $1,019,763,000 | $ 845,224,700 | -- |
| Capital Cost | | | | | | |
| Total Capital Cost to Design Year | 119,819,100 | 173,830,600 | 260,209,900 | 577,865,600 | 399,377,700 | -- |
| Total Capital Investment to Design Year | 180,851,300 | 273,722,800 | 305,467,100 | 1,106,884,700 | 719,773,600 | -- |
| Net Operating and Maintenance Cost (deficit) | | | | | | |
| Total Deficit in Design Year | 15,988,800 | 36,120,700 | 34,015,200 | 24,573,100 | 25,066,800 | -- |
| Total Deficit to Design Year | 373,223,000 | 534,278,200 | 517,434,200 | 441,897,400 | 445,847,000 | -- |
| Cost-Effectiveness | | | | | | |
| Cost to Design Year per Passenger | | | | | | |
| Total Cost to Design Year per Passenger | 0.40 | 0.56 | 0.62 | 0.83 | 0.68 | -- |
| Capital Cost to Design Year per Passenger | 0.10 | 0.14 | 0.21 | 0.47 | 0.32 | -- |
| Operating Deficit to Design Year per Passenger | 0.30 | 0.42 | 0.41 | 0.36 | 0.36 | -- |
| Percent of Operating and Maintenance Cost Met by Farebox Revenue in the Design Year | | | | | | |
| Total Transit System | 61 | 45 | 45 | 53 | 52 | -- |
| Primary Element | 49 | 35 | 22 | 82 | 77 | -- |
| **Stable or Declining Growth Scenario-Decentralized Land Use Plan** | | | | | | |
| Public Transit Ridership | | | | | | |
| Passenger Trips per Average Weekday | 169,400 | 193,100 | 183,200 | 180,000 | 178,300 | -- |
| Cost | | | | | | |
| Total Cost | | | | | | |
| Total Cost to Design Year | $483,703,200 | $688,398,600 | $679,440,000 | $1,016,911,000 | $ 855,484,300 | -- |
| Capital Cost | | | | | | |
| Total Capital Cost to Design Year | 107,761,000 | 155,958,000 | 158,285,100 | 563,200,000 | 393,968,500 | -- |
| Total Capital Investment to Design Year | 161,597,700 | 252,706,300 | 284,576,100 | 1,080,881,200 | 709,158,500 | -- |
| Net Operating and Maintenance Cost (deficit) | | | | | | |
| Total Deficit in Design Year | 16,328,700 | 35,891,000 | 34,480,300 | 26,049,800 | 27,025,400 | -- |
| Total Deficit to Design Year | 375,942,200 | 532,440,600 | 521,155,000 | 453,711,000 | 461,515,800 | -- |
| Cost-Effectiveness | | | | | | |
| Cost to Design Year per Passenger | | | | | | |
| Total Cost to Design Year per Passenger | 0.43 | 0.58 | 0.59 | 0.90 | 0.76 | -- |
| Capital Cost to Design Year per Passenger | 0.10 | 0.13 | 0.14 | 0.50 | 0.35 | -- |
| Operating Deficit to Design Year per Passenger | 0.33 | 0.45 | 0.45 | 0.40 | 0.41 | -- |
| Percent of Operating and Maintenance Cost Met by Farebox Revenue in the Design Year | | | | | | |
| Total Transit System | 54 | 45 | 39 | 45 | 44 | -- |
| Primary Element | 49 | 27 | 19 | 79 | 67 | -- |

**Figure 6. Summary of evaluation of base system plan and truncated and composite primary transit system plans under moderate-growth scenario centralized land use plan.**

| Evaluative Measure | Alternative | | | | |
|---|---|---|---|---|---|
| | Base Plan | Truncated Bus-on-Freeway Plan | Composite Commuter Rail Plan | Composite Light Rail Transit Plan | Composite Busway Plan |
| Objective No. 1–Serve Land Use | | | | | |
| Accessibility | | | | | |
| Average Overall Travel Time of Transit Trips to the Milwaukee Central Business District (minutes) | 35 | 34 | 36 | 35 | 37 |
| Objective No. 2–Minimize Cost and Energy Use | | | | | |
| Cost | | | | | |
| Total Public Cost to Design Year (capital cost and operating and maintenance cost deficit) | $579,742,000 | $774,474,000 | $781,156,400 | $964,264,000 | $883,375,000 |
| Average Annual Total Public Cost | 27,606,600 | 36,879,700 | 37,197,900 | 45,917,000 | 42,066,200 |
| Capital Cost[a] and Investment | | | | | |
| Capital Cost to Design Year | 148,840,000 | 222,980,000 | 214,551,000 | 435,845,000 | 347,468,000 |
| Average Annual Capital Cost | 7,087,600 | 10,618,100 | 10,216,700 | 20,754,500 | 16,546,100 |
| Capital Investment to Design Year | 233,328,700 | 341,200,000 | 374,573,200 | 833,951,200 | 626,992,700 |
| Average Annual Capital Investment | 11,110,900 | 16,333,700 | 17,836,800 | 39,711,900 | 29,856,800 |
| Operating and Maintenance Cost Deficit (net cost) | | | | | |
| Deficit in Design Year | 23,198,300 | 38,272,600 | 40,161,600 | 35,388,300 | 36,324,300 |
| Deficit to Design Year | 430,900,000 | 551,494,000 | 566,605,400 | 528,419,000 | 535,907,000 |
| Average Annual Deficit | 20,519,000 | 26,261,600 | 26,981,200 | 25,162,800 | 25,519,400 |
| Cost-Effectiveness | | | | | |
| Total Cost to Design Year per Passenger | 0.39 | 0.47 | 0.50 | 0.62 | 0.57 |
| Capital Cost to Design Year per Passenger | 0.10 | 0.14 | 0.14 | 0.28 | 0.22 |
| Operating Deficit to Design Year per Passenger | 0.29 | 0.34 | 0.36 | 0.34 | 0.35 |
| Percent of Operating and Maintenance Cost Met by Farebox Revenue in the Design Year[b] | | | | | |
| Total Transit System | 62 | 56 | 54 | 59 | 59 |
| Primary Element | 56 | 60 | 52 | 76 | 76 |
| Energy | | | | | |
| Total Transit System Energy Use to Design Year (million (BTU's) | 20,278,020 | 24,749,880 | 24,560,460 | 26,987,880 | 25,364,600 |
| Total Transit Construction Energy Use to Design Year (million (BTU's) | 1,498,400 | 1,914,560 | 2,414,100 | 3,940,730 | 3,321,680 |
| Total Transit Operating and Maintenance Energy Use to Design Year (million BTU's) | 18,779,620 | 22,835,320 | 22,146,360 | 23,047,150 | 22,042,920 |
| Total Transit Energy Use per Passenger Mile to Design Year (BTU's) | 3,329 | 3,007 | 3,229 | 3,376 | 3,172 |
| Total Transit Passenger Miles per Gallon of Diesel Fuel to Design Year (BTU's) | 40.9 | 45.2 | 42.1 | 40.2 | 42.9 |
| Dependence on Petroleum-Based Fuel | All trips dependent | All trips dependent | All trips dependent | 27 percent of transit trips not dependent | All trips dependent |
| Petroleum-Based Fuel Use by Transit to Design Year (gallons of diesel fuel) | 134,355,000 | 161,649,000 | 158,861,000 | 143,383,000 | 155,551,000 |
| Automobile Propulsion Energy Use in Design Year (gallons of gasoline) | 404,800,000 | 388,800,000 | 397,600,000 | 395,200,000 | 396,000,000 |
| Objective Nos. 3 and 5–Provide Appropriate Service and Quick Travel | | | | | |
| Average Weekday Transit Trips | | | | | |
| Total Transit System | 326,800 | 378,600 | 366,100 | 374,600 | 372,900 |
| Primary Element | 15,000 | 75,100 | 46,300 | 145,100 | 134,900 |
| Percent of Transit Trips Using Primary Element | 4 | 20 | 13 | 39 | 36 |
| Service Coverage | | | | | |
| Population Served Within a One-Half-Mile Walking Distance of Primary Transit Service | 257,100 | 373,500 | 190,500 | 550,900 | 550,900 |
| Population Served Within a Three-Mile Driving Distance of Primary Transit Service | 1,012,400 | 1,620,700 | 1,428,200 | 1,685,600 | 1,685,600 |
| Jobs Served Within a One-Half-Mile Walking Distance of Primary Transit Service | 237,000 | 293,600 | 221,300 | 441,200 | 441,200 |
| Average Speed of Transit Vehicle (mph) | | | | | |
| Primary Element | 19 | 29 | 29 | 26 | 25 |
| Total System | 14 | 18 | 16 | 18 | 18 |
| Average Speed of Passenger Travel on Vehicle (mph) | | | | | |
| Primary Element | 25 | 34 | 30 | 27 | 26 |
| Total System | 15 | 21 | 18 | 20 | 20 |
| Objective No. 4–Minimize Environmental Impacts | | | | | |
| Community Disruption | | | | | |
| Homes, Businesses, or Industries Taken | None | None | None | None | None |
| Land Required (acres) | 12 | 70 | 90 | 210 | 200 |
| Air Pollutant Emissions–Total Transportation System (Highway and Transit) in Design Year (tons per year) | | | | | |
| Carbon Monoxide | 171,193 | 167,368 | 168,440 | 167,055 | 167,508 |
| Hydrocarbons | 17,361 | 16,887 | 17,025 | 16,853 | 16,905 |
| Nitrogen Oxides | 30,693 | 29,988 | 30,371 | 30,000 | 30,015 |
| Sulfur Oxides | 2,514 | 2,502 | 2,533 | 2,754 | 2,499 |
| Particulates | 4,086 | 4,018 | 4,046 | 4,032 | 4,019 |
| Objective No. 6–Maximize Safety | | | | | |
| Proportion of Total Person Trips Made on Transit | 0.074 | 0.086 | 0.083 | 0.085 | 0.084 |

[a] *The capital cost of a composite plan is equal to the plan's required capital investment, or total capital outlays necessary over the plan design period, less the value of that investment beyond the plan design period.*

[b] *Transit revenues were assigned entirely to the primary transit element for primary transit trips which used, through transfers, local or express transit as a feeder or distributor to the primary transit element. The proportion of trips using primary transit which transfers to or from local and express services was found to be highest under the commuter rail plan–1.2 transfers per primary trip–and lowest under the light rail transit and busway plans–0.4 transfer per primary trip. Under the bus-on-freeway plan, 0.7 transfer was made per primary trip. Consequently, to some extent a disproportionate share of transit revenues was assigned to each plans's primary element, this disproportionate share being the highest under the commuter rail plan and the lowest under the light rail transit and busway plans.*

## Policy or Strategy Planning Is Difficult to Structure

Too often, the long-range, multiple-variable approach to alternative futures or scenarios, as carried forward in Milwaukee, becomes sufficiently complex to tax the comprehension of the typical political decisionmaker, if not the engineers and planners involved as well. The interrelationships of socioeconomic variables are intricate and not well understood, and their intermingling makes them difficult to analyze or discuss clearly (10). Because of this elusiveness and because of the diffi-

Figure 7. Summary of evaluation of base system plan, bus-on-metered freeway system plan, and lower tier of two-tier system plan under moderate-growth scenario centralized land use plan and stable or declining-growth scenario decentralized land use plan.

| Evaluative Measure | Alternative: Base Plan — Optimistic Scenario: Moderate Growth-Centralized Land Use Plan | Base Plan — Pessimistic Scenario: Stable or Declining Growth-Decentralized Land Use Plan | Bus-on-Metered Freeway Plan — Optimistic Scenario: Moderate Growth-Centralized Land Use Plan | Bus-on-Metered Freeway Plan — Pessimistic Scenario: Stable or Declining Growth-Decentralized Land Use Plan | Lower Tier of the Two-Tier System Plan — Optimistic Scenario: Moderate Growth-Centralized Land Use Plan | Lower Tier of the Two-Tier System Plan — Pessimistic Scenario: Stable or Declining Growth-Decentralized Land Use Plan |
|---|---|---|---|---|---|---|
| **Objective No. 1—Serve Land Use** | | | | | | |
| Accessibility | | | | | | |
| Average Overall Travel Time of Transit Trips to the Milwaukee Central Business District (minutes) | 35 | 35 | 34 | 34 | 34 | 34 |
| **Objective No. 2—Minimize Cost and Energy Use** | | | | | | |
| Cost | | | | | | |
| Total Public Cost to Design Year (capital cost and operating and maintenance deficit) | $579,742,000 | $483,703,200 | $722,873,900 | $567,486,900 | $812,880,000 | $619,931,500 |
| Average Annual Total Public Cost | 27,606,600 | 23,033,500 | 34,422,600 | 27,023,100 | 38,708,600 | 29,520,500 |
| Capital Cost | | | | | | |
| Capital Cost to Design Year | 148,840,000 | 107,761,000 | 214,323,900 | 160,906,900 | 306,300,000 | 217,931,500 |
| Average Annual Capital Cost | 7,087,600 | 5,131,500 | 10,205,900 | 7,662,200 | 14,585,700 | 10,377,700 |
| Capital Investment to Design Year | 233,328,700 | 161,597,700 | 329,729,600 | 229,867,300 | 470,700,000 | 364,526,300 |
| Average Annual Capital Investment | 11,110,900 | 7,695,100 | 15,701,400 | 10,946,000 | 22,414,300 | 17,358,400 |
| Operating and Maintenance Deficit (net cost) | | | | | | |
| Deficit in Design Year | 23,198,300 | 16,328,700 | 32,904,700 | 20,158,500 | 32,658,400 | 19,481,200 |
| Deficit to Design Year | 430,900,000 | 375,942,200 | 508,550,000 | 406,580,000 | 506,580,000 | 402,000,000 |
| Average Annual Deficit | 20,519,000 | 17,902,000 | 24,216,700 | 19,360,900 | 24,122,900 | 19,142,900 |
| Cost-Effectiveness | | | | | | |
| Total Public Cost to Design Year per Passenger | 0.39 | 0.43 | 0.46 | 0.50 | 0.52 | 0.54 |
| Capital Cost to Design Year per Passenger | 0.10 | 0.10 | 0.14 | 0.14 | 0.20 | 0.19 |
| Operating Deficit to Design Year per Passenger | 0.29 | 0.33 | 0.32 | 0.36 | 0.32 | 0.35 |
| Total Public Cost to Design Year per Passenger Mile | 0.10 | 0.11 | 0.09 | 0.12 | 0.10 | 0.13 |
| Capital Cost to Design Year per Passenger Mile | 0.03 | 0.03 | 0.03 | 0.03 | 0.04 | 0.05 |
| Operating Deficit to Design Year per Passenger Mile | 0.07 | 0.08 | 0.06 | 0.09 | 0.06 | 0.08 |
| Percent of Operating and Maintenance Cost Met by Farebox Revenue in the Design Year | | | | | | |
| Total Transit System | 62 | 53 | 61 | 52 | 61 | 52 |
| Primary Element | 56 | 49 | 60 | 45 | 63 | 47 |
| Energy | | | | | | |
| Total Transit System Energy Use to Design Year (million BTU's) | 20,278,020 | 15,037,280 | 22,305,100 | 16,120,900 | 23,213,700 | 16,551,300 |
| Total Transit Construction Energy Use to Design Year (million BTU's) | 1,498,400 | 1,044,480 | 1,840,100 | 1,335,200 | 2,414,700 | 1,875,800 |
| Total Transit Operating and Maintenance Energy Use to Design Year (million BTU's) | 18,779,620 | 13,992,800 | 20,465,000 | 14,785,700 | 20,799,000 | 14,675,500 |
| Total Transit System Energy Use per Passenger Mile Traveled to Design Year (BTU's) | 3,330 | 3,530 | 2,730 | 3,380 | 2,830 | 3,540 |
| Total Transit Passenger Miles per Gallon of Diesel Fuel to Design Year (BTU's) | 40.9 | 38.5 | 49.8 | 40.1 | 48.1 | 39.4 |
| Dependence on Petroleum-Based Fuel | All trips dependent | All trips dependent | All trips dependent | All trips dependent | 8 percent of transit trips not dependent | 8 percent of transit trips not dependent |
| Petroleum-Based Fuel Use by Transit to Design Year (gallons of diesel fuel) | 134,355,000 | 100,744,850 | 144,697,000 | 114,936,000 | 124,502,200 | 112,450,000 |
| Automobile Propulsion Energy Use in Design Year (gallons of gasoline) | 404,800,000 | 338,400,000 | 395,200,000 | 332,800,000 | 395,200,000 | 332,800,000 |
| **Objective Nos. 3 and 5—Provide Appropriate Service and Quick Travel** | | | | | | |
| Average Weekday Transit Trips in Design Year | | | | | | |
| Total Transit System | 326,800 | 169,400 | 371,300 | 176,000 | 372,900 | 176,300 |
| Primary Element | 15,000 | 9,500 | 75,100 | 22,500 | 96,300 | 34,200 |
| Percent of Transit Trips Using Primary Element | 4 | 6 | 20 | 12 | 26 | 19 |
| Service Coverage | | | | | | |
| Population Served Within a One-Half-Mile Walking Distance of Primary Transit Service | 257,100 | 181,500 | 373,500 | 250,100 | 392,200 | 260,100 |
| Population Served Within a Three-Mile Driving Distance of Primary Transit Service | 1,012,400 | 698,800 | 1,620,700 | 933,167 | 1,300,000 | 930,600 |
| Jobs Served Within One-Half-Mile Walking Distance of Primary Transit Service | 237,000 | 194,600 | 293,600 | 253,100 | 309,300 | 260,200 |
| Average Speed of Transit Vehicle (mph) | | | | | | |
| Primary Element | 19 | 24 | 29 | 27 | 29 | 27 |
| Total System | 14 | 15 | 18 | 17 | 18 | 17 |
| Average Speed of Passenger Travel on Vehicle (mph) | | | | | | |
| Primary Element | 25 | 25 | 34 | 32 | 32 | 30 |
| Total System | 15 | 15 | 20 | 18 | 21 | 19 |
| **Objective No. 4—Minimize Environmental Impacts** | | | | | | |
| Community Disruption | | | | | | |
| Homes, Businesses, or Industries Taken | None | None | None | None | None | None |
| Land Required (acres) | 12 | 10 | 70 | 20 | 120 | 60 |
| Air Pollutant Emissions—Total Transportation System (Highway and Transit) in Design Year (tons per year) | | | | | | |
| Carbon Monoxide | 171,200 | 165,800 | 167,400 | 163,100 | 167,300 | 163,100 |
| Hydrocarbons | 17,400 | 16,700 | 16,900 | 16,400 | 16,900 | 16,400 |
| Nitrogen Oxides | 30,700 | 30,100 | 30,000 | 29,200 | 30,000 | 29,200 |
| Sulfur Oxides | 2,500 | 2,400 | 2,500 | 2,400 | 2,600 | 2,400 |
| Particulates | 4,100 | 4,000 | 4,000 | 3,900 | 4,000 | 3,900 |
| **Objective No. 6—Maximize Safety** | | | | | | |
| Proportion of Total Person Trips Made on Transit | 0.074 | 0.047 | 0.084 | 0.050 | 0.084 | 0.050 |

culty in showing direct ties to the specifics of choosing alternative transportation projects in a real-world, short-term setting, this policy or strategy approach to planning is difficult to integrate into the ongoing urban planning process. Though many can agree that high or low values for some of these key external factors certainly ought to be significant, it is difficult to show just how significant they are in comparing transportation alternatives.

### Realities of Fiscal Constraints Now Dominate Planning

From all appearances, the 1980s will represent an era of austerity in urban transportation system investment, at least in comparison with the 1960s and 1970s. The well-known spiral of increasing costs and decreasing gasoline-tax-based revenues coupled with resistance on the part of the general public to increased taxation indicates that capital-intensive highway and transit plan alternatives now have less relevance. In many regions, consequently, more emphasis is now being placed on short-range, low-capital improvement alternatives. The differences among these alternatives in terms of potential service levels are less, and more interest is focused on cost and implementation and operational details.

Fiscal problems over the last few years in many regions have placed the solution of present volume and capacity problems via TSM-type measures in highest priority and urgency, with a consequent waning of interest in the distant long-range plan (11). Evaluation of alternative projects within transportation improvement programs (TIPs) has drawn increasing attention from decisionmakers in many regions (9).

### Subarea or Corridor Planning Has Increased Emphasis

In the Dallas example, considerable interest in the definition of community-oriented service areas or corridors was shown by local decisionmakers. This reflected, in turn, their political affiliation with different communities and subareas within the region. Major local community interest in the potential of a regional transit system lay simply in the question, "What's in it for us?" Analyses of the different modal alternatives were consequently conducted on a corridor-by-corridor basis. Corridor travel needs were distinguished according to central-business-district, intracorridor, and between-corridor travel linkages. In general, such subarea planning emphases tend to become both facility oriented and shorter range in focus, further limiting the state of the practice for long-range planning.

### Quick-Response Issue and Problem-Oriented Models are Needed

Partly as a result of this subarea emphasis and the fact that a fair number (5-15) of subareas are likely to emerge in any given region, travel analysis capabilities should offer quick turnaround features. The recent development of a number of such techniques has in fact addressed a continuing and perhaps growing need in the urban transportation planning process. However, the application of such techniques appears of less value in a long-range, regional planning sense than in a medium-range, corridor planning sense.

### Focus on Transportation Systems Management Continues

The need to make more efficient use of existing facilities, mentioned above, will be important throughout the 1980s, particularly in slow-growth, stable, or declining regions. Even in growing sunbelt regions, the realities of fiscal constraint place equal emphasis on maximizing use of the current transportation systems (11,12). Better understanding of operating and maintenance costs, financing strategies, alternative revenue-generation techniques, and related fiscal matters all have a short-range character about them and are clearly management oriented in nature. They correspondingly call for less capability in travel analysis than may already be available in many regions. In this case, the current state of the art is adequate, and the state of the practice must now catch up.

## SUGGESTIONS FOR CLOSING GAPS IN PRACTICE

How can practitioners make better use of travel-analysis technical capabilities that already appear methodologically adequate? A number of possible actions to be taken at federal, state, and/or regional or local levels include the following:

1. Reduce analyst and decisionmaker communication barriers: In too many cases, the breadth of content as well as technical complexity of long-range plan alternatives analyses are overwhelming to decisionmakers. Whether the latter are elected officials, appointed lay citizens, or staff representatives from local public agencies, too often the results of alternatives analyses are simply poorly communicated. A dual educational process may be needed, involving provision of both rudimentary background for decisionmakers and improved communication skills (oral, written, graphic) for planners and engineers.
2. Address inadequate funding problems: As transportation planning work programs for many regions respond to stable or possibly reduced budgets, the shifting priorities reviewed previously indicate that short-range planning activities are likely to receive increasing emphasis; reduced budgets will then remain for long-range planning (including many travel analysis activities). [NCTCOG now allocates only 10 percent of its budget to long-range planning (1).] These potential funding problems provide a basic real-world constraint, indicating that long-range or strategic planning must prove its value.
3. Short-range planning issues have long-range planning implications: One of the important components of current NCTCOG planning efforts involves an exploration of the long-range planning consequences of short-range, TSM-oriented low-capital solutions (2). Although such solutions are designed to solve immediate problems, particularly in growth regions, these problems ultimately often have serious long-range dimensions. Continuing short-range, interim-type solutions may prove inadequate, and such consequences must be more thoroughly addressed.
4. Stress quick-response, simpler travel analysis methods: This emerging environment for long-range and strategy planning suggests that those state-of-the-art capabilities that involve sketch-planning activities, oriented toward corridor or subarea geography and permitting the relatively rapid analysis of many potential transportation alternatives, will have carryover into short-range transportation planning as well. These more flexible travel analysis methods consequently can be of service across the board and should be emphasized.

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# Research Needs

1. Freight study and goods movement (develop a reporting procedure for intercounty and intracounty motor carrier data consistent with Interstate data)

a. Specification of intercounty and intracounty data set
b. Contact of government and regulatory agencies to identify data currently being collected
c. Modification of existing procedures or development of new collection methods to obtain specified data

2. Addressing uncertainty in travel simulation models

a. Investigation of input forecasts
b. Quantitative study of uncertainty

3. Synthesis of techniques for planner communications

a. Survey that includes list and description of various techniques
b. Case studies and examples of each technique
c. Step-by-step discussion of how to use the techniques

4. Revenue forecasting

a. Examination of existing revenue-forecasting models, such as California's PYPSCAN
b. Examination of existing procedures for estimating local government revenue and expenditure patterns for transportation
c. Development of logic for multimodule forecasting model capable of accepting a range of exogenous inputs (national and international) and capable of allocating revenues to programs, agencies, and local governments under alternative allocation or apportionment formulas
d. Preparation of manuals and review with sample of states to ensure workability
e. Preparation of microcomputer programs to perform the calculations
f. Deal with uncertainty by multiple runs of programs under alternative assumptions and by regular (every quarter-year) rerunning of programs

5. Communication with decisionmakers

a. Uncertainties: interview of decisionmakers to identify areas of dissatisfaction in transportation planning with emphasis on
(1) Understanding techniques used by planners
(2) Determining whether planners provide useful information
(3) Determining whether there are any concerns not addressed by planning staff
b. Communication techniques: improved techniques, especially
(1) How to describe the interaction of various factors, their impact on transportation, and the decision points and risks
(2) Effective ways to present relevant data
(3) Effective ways to measure and explain performance