The topic of transit benefits is widely discussed in technical literature, trade journals and the popular press. Advocates for transit offer transit benefits as a basis for expanded service and/or increased public expenditures for transit. Benefits frequently cited include air pollution reduction, congestion relief, energy savings, strengthened central cities, land value gains, and reduced automobile dependency. In many cases, these benefits are calculated and, sometimes, combined to present a strong case for transit expansion. There is little consistency in how benefits are combined. Methods for doing calculations vary widely, and the results can often be misleading.

Despite the large amount of prior work on transit benefits, there have been few systematic efforts to deal with the interrelationships between different benefits nor have there been many attempts to provide a comprehensive picture of transit benefits. This section of the report provides a framework for understanding the interrelationship of benefits of transit service. The framework takes the form of a tree diagram.
The Benefit Tree

The benefit tree provides a display of what might happen as the result of transit service. Because transit exists, there are certain consequences. These consequences may not necessarily be benefits but merely impacts resulting from the improvement of a transit system. Impacts can be significant or insignificant depending on the chosen viewpoint, the scope of analysis and the nature of the base alternative.

First, transit provides an alternative means of travel that may or may not actually be used by any given individual. Because transit exists, people have options available for travel for unusual occurrences, for the future when a person may not be able to use an automobile, or for the transit dependent.

Second, trip making occurs, which can result in a shift between automobile and transit travel or trips by persons who could not otherwise travel. Trip making, in turn, results in changes in user resources (time, cost, etc.), changes in facility needs, environmental effects and so forth.

Third, transit accessibility makes land more or less valuable, causes shifts in life styles, preserves open space, affects interaction among people, and affects the efficiency of certain public services.

Fourth, transit exists as an enterprise that employs people in its operation and construction. It too uses resources.

The benefit tree shows how consequences are related. The tree is divided into five branches. Vertically, the tree grows in specificity from top to bottom. Double counting occurs when benefits are included at multiple levels on the tree. Some benefits can be quantified, others cannot.
A FRAMEWORK FOR ANALYSIS

Measurement of Transit Benefits
A FRAMEWORK FOR ANALYSIS

Measurement of Transit Benefits
Transit as an Alternative – Branch 1

Transit provides alternatives to those who regularly use automobiles or for those who have no other option but public transportation, as shown in Branch 1 of the tree. When good transit service exists people need not be solely dependent upon their automobiles. A benefit accrues to the entire population, even those who never use transit, because transit provides an option for travel.

Transit as a Long Term Option. Transit provides a form of mobility insurance. It is available whenever other forms of transport are not. People will see value in having a transit system, even though they may not need to use it right now, feeling they may need it at some time in the future when they are no longer able to drive an automobile.

Unusual Occurrences. Unusual occurrences, such as severe weather, fuel shortages, family emergencies, vehicle breakdowns, community emergencies, and evacuations, temporarily increase society's dependence on transit. In these cases, benefits of transit are large even though the probability of the occurrence is small. In the event of a major disaster (such as floods, earthquakes, and hurricanes), transit has provided mobility for large numbers of people and enabled communities to resume normal operations sooner.

Independent Living. Transit provides the elderly and disabled, as well as those unable to drive for other reasons, freedom to travel without relying on others. This permits them to live independently, to have good access to discretionary activities (such as social events and recreation), as well as essential activities (such as employment, health care, education and shopping). The benefits to them and to others can be far greater than the consumer surplus of the trip itself. If transit service were not available, the costs of providing alternative services might be very high. Access to various
activities, including health care and employment, not only allows for an individual's independence, but reduces public cost.

**Recreational Riding.** Transit can be a form of recreation in many cities, such as San Francisco, where tourists enjoy riding the cable cars or historic vehicles. People may be attracted to the city for other activities (conventions, shopping, fairs, exhibitions, sporting events, etc.) because of the novelty of the transit system.
Branch 1

Provides Alternatives
Public transit offers a choice between transportation modes

Long Term Option
The option is there should transit be needed in the distant future

Unusual Occurrences
An automobile may not be practical or available under a variety of circumstances

Recreational Riding
Rail transit can attract riders because of its novelty

Severe Weather
Transit can be more reliable during severe weather than other modes

Family Circumstances
The need to travel can develop when other family members are using available autos

Vehicle Breakdown
Transit is available when automobiles are being repaired or needing repair

Emergencies: Evacuation, etc.
Transit provides the capacity to move large numbers of people in a short period of time

Viewpoint:
- Local
- Regional
- National

Measurement of Transit Benefits
A FRAMEWORK FOR ANALYSIS

Independent Living
Transit gives youth, elderly and other dependents freedom of movement

Access to Discretionary Activities
Dependent people have a choice of destinations and time of travel

Access to Health Care and Essential Activities
Transit provides consistent access to essential destinations for dependent people

Employment
Dependent people have better job access

Reduced Public Cost
Less dependence means less cost to society

Welfare
Increased employment reduces welfare costs

Measurement of Transit Benefits
Travel Related Consequences – Branches 2 and 3

Transit directly benefits both transit and automobile users as a result of trip making and associated saving in user time and cost. Furthermore, it can lead to savings in the cost of providing transportation facilities and in negative environmental consequences of travel.

**Transit User Effects.** The most obvious benefits of a transit improvement are reductions in the time, cost and inconvenience of transit trips as shown in Branch 3 of the tree. The magnitude of the benefits can be estimated by analyzing choice behavior; if people make a choice to use transit it is because they feel that they will personally benefit from the transit trip. Such benefits can be measured by looking at the attributes of alternative choices and the choice behavior and by observing the differences between them. These effects relate to savings in personal resources, such as time and cost. Some savings may be long run and others may relate to an individual trip. For example, if one member of a household regularly uses transit to travel to work, the household may avoid the purchase of an automobile. Avoiding a car purchase can have substantial benefits over that of a single trip. So-called captive users can have a high benefit since their alternative would be not to travel.

**Change in Well Being and Security.** Shifts of trips to or from transit carry with them changes in user safety, security and feelings about self. Automobile travel and transit travel differ in accident and security experiences. Assessment of these benefits are further complicated by differences between perceived and actual conditions. Users of transit may feel they are helping the environment and society through their transit use and have positive feelings about their personal choice.

**Change in Lifestyle.** Transit riders come in closer physical contact with other riders, allowing for more interaction within the same community. Levels
of privacy, frequency of contact with strangers, and equity are all affected. Some of these consequences can be viewed as benefits, others as disbenefits, depending on the point of view. Interaction increases familiarity with others, and it presents opportunities for networking, better communications, and understanding. Transit use can encourage a different life style. Travel by transit also affects users' freedom and their confidence in the ability to get places, to travel independently, and to travel punctually. For some this change is negative, while many people view it positively.

**Automobile Related Benefits.** Transit travel also provides benefits to both users and nonusers by decreasing the number of automobiles on highways as shown in Branch 2. Fewer automobile trips may mean less need for expanded highways, less parking facilities and less traffic control needs. Fewer automobile trips mean less energy use, less land consumption, and less accidents. Reduced automobile trip making affects the time and cost of meeting travel needs for remaining automobile users.

**Environmental Effects.** Shifts of travel between automobile and transit lead to a healthier environment. Reductions in overall travel lead to lower air pollutant emissions, reduced noise levels and other effects.
Branch 2

Viewpoint:
- Local
- Regional
- National

Fewer Auto Trips
As people choose to ride transit, fewer auto trips are made

User Effects
Those who use autos benefit from less congested highways

Time
Travel times will decrease for auto users as others switch to transit

Operating and Parking Costs
Less demand for highways results in lower vehicle parking and operating costs

Destination Choice
Street closures, HOV lanes, etc. may make certain destinations more difficult to reach

Energy Use
Transit is a more efficient consumer of energy, if used to capacity

Air Pollution
Transit vehicles emit less than the equivalent number of automobiles

Environmental Effects
Trips shifting to transit affect energy efficiency; air and noise pollution
A FRAMEWORK FOR ANALYSIS

Travel by Transit
The choice of transit over other modes for both regular and occasional trips

Transit Trips
See Branch 3

Facility Needs
The supply and demand of highways/parking facilities are affected by fewer auto trips

Noise Pollution
Removing automobiles from the road may have positive effects on noise

Highways
Less auto usage leads to fewer facility repair costs and less need for additional capacity

Parking
Less auto usage leads to less need for parking facilities

Control Systems
Less auto usage reduces the need for elaborate traffic control devices
A FRAMEWORK FOR ANALYSIS

Branch 3

Viewpoint:
- Local
- Regional
- National

Travel By Transit

- The choice of transit over other modes for both regular and occasional trips

Fewer Auto Trips

- See Branch 2

Transit Trips

- Those making transit trips receive benefits directly from their travel

Change in Well Being

- Transit users are confident that their travel needs have been met

Change in Lifestyle

Opportunities and constraints of transit travel affect lifestyles

Security

- Transit has different exposure for travelers from crime and accidents

Privacy

- Privacy on transit vehicles is limited

Contact with Others

- Riders have more contact with different types of people in a confined space

Freedom

- Transit affects users ability to get places, regardless of their mobility limitations

Confidence of Place

- Transit can be a reliable means of getting people to important places on time

Equality

- Transit reduces racial and social inequities

Trip Tours

- Transit makes it more difficult to form multistitution tours

Timetable

- Times from origin to destination remain constant and are restrictive

Connectivity

- Transit system service area may affect ability to connect some origins and destinations

Measurement of Transit Benefits
Land-Use and Economic Consequences

Transit affects land-use and economic activity in different ways than highway systems. Generally, transit can sustain more concentrated land-use patterns. An evaluation of land-use and economic activity is complex. Some of the land value and economic changes occur because of savings in user travel time and cost, while other land-use changes are shifts of activity from one location to another. Care should be taken in the interpretation of these effects, especially if they are combined with others. Increases in economic activity can lead to increases in land values.

**Land-Use Consequences.** With concentrations of activities, public services become more efficient. There is a reduced need for sewer, water, and other utilities with higher densities. Services such as police and fire protection may become more efficient with less land area to cover. Furthermore, operating costs of these services may become smaller per unit of delivered service because of the concentration of activity.

A concentrated land-use pattern also can lead to more interpersonal contacts, increased networking, productivity and community interaction. Communities with high levels of transit service and concentrated land use ("Eurocity") have very different levels of interaction than places that are automobile dominated, and lower densities ("horizontal city"). These effects could be positive or negative depending on how they occur. Increased interactions could have a synergistic effect on the destructive effect (say, from more crime) depending on many factors.

Concentrations of activity also lead to more preservation of open space for agriculture and natural areas. Concentration has effects on the value of land at a specific location. While the net change in land value for all land in an urban region may not
change, it could increase substantially in areas of activity concentration.

It is important to separate those effects on land use that are related to better accessibility from effects due to concentration. Travel time and cost savings and better accessibility can be the cause of land value changes. Thus, double counting can occur if both are added to a benefit measure.

**Economic Consequences.** Economic activity and employment levels at a location may be impacted through job creation or job shifts. Increased economic activity often results in an increased tax base. A concentration of economic activities could produce higher employment levels at a locale and, thus, a more equitable tax base.
Branch 4

Viewpoint:
- Local
- Regional
- National

Efficiency of Public Services
- Other transportation related services become more efficient as fewer people use autos

Facility Needs
- Fewer facilities to accommodate public services may be needed

Operations
- More efficient operation of infrastructure

Interpersonal Contacts
- Transit facilitates contacts with other people before, during and after travel

Networking/Productivity
- Proximity to others facilitates business contacts and productivity

Land Use/Economic Activity
- Transit creates concentrated land use and affects the nature of economic activity

Interaction among People
- Greater concentrations of people and activities occur at specific sites and centers

Measurement of Transit Benefits
A FRAMEWORK FOR ANALYSIS

Land Preservation
As people and activities are concentrated, less land is needed; can be preserved

Open Space, Agricultural Areas
Transit concentrates land uses leaving more land for other useful purposes

Privacy/Community Interaction
Transit concentrates land uses lessening privacy; increasing interactions

Isolation
People in remote areas are less isolated from activity centers
Transit Supply Consequences

Finally, the existence of transit, by itself, has benefits and impacts as shown in Branch 5 of the tree.

Community Support and Prestige. At the local level many people feel that a transit system (particularly a fixed guideway system) adds to the prestige of the city, perhaps qualifying their city for "world class" status. Prestige cannot be quantified, but it can be of critical importance when decisions are made at the local level. People may support transit because they have a general belief that it makes a positive contribution to the environment and to society.

Facilities. Facilities and their construction cause temporary or permanent impacts that may constitute either benefits or disbenefits. Jobs are created through construction and materials consumption if the construction is a new activity for an area. Construction can be temporarily disruptive, including loss of customers for some businesses, spot congestion, and general inconvenience. Facilities consume vacant land or productive land. Land near stations can become good sites for secondary developments.

Operations. Transit agencies employ people, consume resources and make purchases as a result of their operations. These activities are multiplied as their impact is felt through the local economy.

Use of Benefits Tree – An Example

The benefits tree can be used to identify and display the potential benefits of a transit alternative. This would be done by first identifying those boxes on the diagram where it appears that a transit alternative will be significantly different from the null alternative. Only those consequences generate benefits or disbenefits. Each remaining box would then be filled out with numerical or descriptive information to describe the effect.
It is important to understand that measures at one level could include measures at lower levels. Thus, benefits should not be combined across levels since double counting can occur. Rather, the tree is a way of displaying how the pieces fit together, and as a way of comparing alternatives.

The example shows Branch 5 of the tree, transit supply, as filled out for a rail transit alternative as compared to the null alternative, an all bus system. Plan design and travel demand analysis lead to the determination that the rail alternative requires 30 light rail vehicles to operate on 20 miles of track. Operations and construction require the resources shown in the tree. A fully filled out tree could illustrate all consequences and help focus decision-making on key trade-offs between alternatives and aid in the selection of a locally preferred alternative. *This example uses the viewpoint of a local decision rather than a national decision.* As such, consequences that have differential effects at the local level are included. Decisions at other levels of government may use different factors.

To facilitate use of the tree, a blank version of the tree is included as an appendix to this report. A soft-copy version is also available (as Excel spreadsheet files) upon request from the Center for Urban Transportation Studies at the University of Wisconsin – Milwaukee (414-229-5787).
A FRAMEWORK FOR ANALYSIS

Facilities
Transit and related facilities are built and have effects

Facility Construction
Transit requires the building of facilities for operation and maintenance

Pollution
Construction causes air, noise and water pollution

Disruption
Construction can cause disruption to communities and the natural environment

Labor
Employment is generated through the construction of transit facilities

Materials
Materials are needed to build facilities

Land Consumption
Transit facilities use land for rights-of-way and construction

Measurement of Transit Benefits
A FRAMEWORK FOR ANALYSIS

Branch 5

Viewpoint:
- Local
- Regional
- National

Operations
- Operate 16 hrs/day, 365 days/year

Environmental Effects
- Overall, fewer environmental impacts than the null alternative

Energy Use
- Reduction in net daily fuel use of 3700 gallons

Air Pollution
- HC emissions reduced by 2025 lb/day

Noise Pollution
- Bus miles of travel reduced by 9200 miles/day

Employment
- Local employment increases by 30 direct, 45 indirect

Purchases
- Purchase increases of $4,000,000/year

Community Support
- 62% of residents support alternative in latest public opinion survey

Transit Supply
- Facilities, rolling stock, and operation of LRT

Materials
- Local purchases of $1,400,000/year

Prestige
- Alternative needed to attract conventions and new service businesses
Note: All values and descriptions in this sample branch are from a fictitious alternative. They should not be used to indicate the level of benefits that can accrue from any given LRT alternative.
G. STATE OF THE PRACTICE

Benefit Measurement in Transit Studies

This section describes the benefits typically identified in various planning and other technical documents for new transit systems. The description only reflects what is felt to be important by local agencies as they analyze alternative systems and propose systems for implementation.

A list of benefits and impacts was compiled from Alternatives Analysis/Environmental Impact Statements for major transit investments. Within the AA/EIS’s, the government requires certain impacts to be quantified including air and noise pollution, travel times, land value, employment, etc. Local agencies can add other factors to this list and elaborate on required items in order to make their case more convincing.

AA/EIS's provide evidence of which benefits are of greatest importance to each community. One city may emphasize quality of life while another may emphasize travel time savings.

Fifteen alternative analyses, environmental impact statements and economic impact assessments were reviewed. Results from this analysis are given in a table on the following pages. Cited benefits are indicated, as well as whether an effort was made to quantify the benefits. The categories for the benefits were developed from the benefit tree as discussed previously. A reading of the AA/EIS's reveals that communities cite a wide variety of benefits. There are a few differences between cities. None of the cities considered the option value of transit, while most considered the reduction in automobile trips, land preservation and transit operations as benefits. The cited benefits can be discussed in terms of the four major branches of the benefits tree: transit as an alternative, travel related changes (Branches 2 and 3), land-use/economic effects, and transit supply.
Transit as an Alternative

That transit provides an alternative means of travel to the automobile was seldom mentioned in the EIS's. This consequence provides options, greater flexibility, and travel insurance for short-term emergencies or long-term changes in life style. Better accessibility for the elderly and disabled was discussed in only three statements. The Southeastern Pennsylvania Transportation Authority (SEPTA) commented on the importance of transit to the elderly and handicapped. "For the handicapped, SEPTA services, including paratransit, provide a vital link to jobs, health care, recreation, church, shopping and visiting." SEPTA believes the elderly and disabled use mass transit more frequently than any other cross-section of the population. It addressed the option value of transit by discussing whether proposed routes consider the needs of elderly and handicapped.

Travel Related Consequences

These two branches involve what AA/EIS's refer to as "Transit Oriented" benefits. They include accessibility, comfort, congestion, parking, safety/security, travel times, value of time, and VMT charges. These effects result from changes in trip making and are dealt with extensively in the AA/EIS's. Nearly all the reports reviewed provide estimates of facility needs, environmental effects, and user savings.

Of these factors, accessibility, congestion, safety and security were rarely quantified. However, travel times, changes in vehicle miles of travel (VMT), parking effects, and value of time were nearly universally quantified. Fourteen of the benefits

---

5 U. S. Department of Transportation, June 1991, p. 4-12.
## BENEFITS

### CITY

<table>
<thead>
<tr>
<th>Benefits</th>
<th>Atlanta</th>
<th>Chicago</th>
<th>Cleveland</th>
<th>Dallas</th>
<th>Detroit</th>
<th>Harris County, TX</th>
<th>Los Angeles</th>
<th>Honolulu</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>I. Provides Alternatives</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A. Long Term Option</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B. Unusual Occurrences</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C. Independent Living</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>D. Recreational Riding</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>II. Travel By Transit</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A. Fewer Auto Trips</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Facility Needs</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Environmental</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. User Effects</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B. Transit Trips</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. User Effects</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Change Well Being</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Change in Lifestyle</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>III. Land Use/Economic Activity</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A. Concentration Of Activity</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Efficiency of Public Services</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Interpersonal Contacts</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Land Preservation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Open Space</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B. Economic Activity</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Employment Impact</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Land Values</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>IV. Transit Supply</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Community Support</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Facilities</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Operations</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Darker shaded area indicates a quantified benefit*
## BENEFITS

<table>
<thead>
<tr>
<th>CITY</th>
<th>Miami Kendall</th>
<th>Miami Metromov</th>
<th>SE Penn</th>
<th>St. Louis</th>
<th>San Mateo County, CA</th>
<th>Toronto</th>
<th>Tucson</th>
</tr>
</thead>
</table>

### I. Provides Alternatives
- A. Long Term Option
- B. Unusual Occurrences
- C. Independent Living
- D. Recreational Riding

### II. Travel By Transit
- A. Fewer Auto Trips
  1. Facility Needs
  2. Environmental
  3. User Effects
- B. Transit Trips
  1. User Effects
  2. Change Well Being
  3. Change in Lifestyle

### III. Land Use/Economic Activity
- A. Concentration Of Activity
  1. Efficiency of Public Services
  2. Interpersonal Contacts
  3. Land Preservation
  4. Open Space
- B. Economic Activity
  1. Employment Impact
  2. Land Values

### IV. Transit Supply
- 1. Community Support
- 2. Facilities
- 3. Operations

*Darker shaded area indicates a quantified benefit
fifteen EIS's quantitatively analyzed VMT, travel time, value of time, and parking. Air quality, energy and noise pollution are quantified in every document, as these are required items for an AA/EIS. Issues of transit travel (such as change in well-being and in lifestyle) were superficially mentioned in only one EIS as possible spin-off effects of an efficient transit system. The methods for measuring these benefits were as follows.

**Facility Needs. Parking** losses are calculated by the number of parking spaces destroyed so that the land can be used for track or other transit facilities. Parking losses may also occur from coordinated planning efforts to reduce the amount of traffic in downtown corridors and to promote transit ridership. The documents reviewed did not discuss reductions in highway facility needs that might result from an increased transit ridership.

**Environmental Effects.** Environmental effects are the primary subject of an EIS. **Air Quality** indexes are derived from standard formulas, measured in units of carbon monoxide emission levels by transit line and (in some cases) regionally. This method of quantification is consistent throughout the various environmental impact statements. **Noise impacts** are compared between alternatives and are measured in units of decibels. **Energy consumption** is calculated across alternatives and is measured in units of British Thermal Units (BTU) for each alternative.

**User Effects.** User effects occur to both automobile users and to transit riders. They are frequently combined in two overall measures: travel time and vehicle-miles-traveled. **Travel time savings** are estimated in person-minutes of in-vehicle travel for alternative transit system(s) as compared to a base system. These methods treat all components of travel time (waiting, transfer, travel, etc.) with equal weight. Travel time savings are sometimes converted into monetary units to obtain a dollar value of time savings. Changes in traveler cost (e.g., automobile operating costs, parking and transit fares) are seldom included.
A FRAMEWORK FOR ANALYSIS

Congestion is measured in vehicle miles traveled (VMT). The reports reason that more vehicle miles traveled has greater potential for congested highways and arterials. There is a prevailing view that a reduction in VMT is a principal benefit of transit. Accessibility as it relates to transit dependent riders (such as the poor, elderly, and handicapped) is measured in the travel time it takes to reach a work based and/or a nonwork based destination.

Change in Well Being. The effects of the transit system on the general well being of its users, their safety and their security are seldom mentioned in the documents. One report discussed this topic, saying,

Better transit service within the downtown would enhance the convenience of region-serving transit service. This could reduce the use of automobiles for commuting to the Central Area and could encourage people to make longer trips by unifying the C.A. into a unified whole . . . .

The Central Ohio Transit Agency generated accident statistics to determine the relative safety of each alternative to the null alternative. Social Interaction is generally not considered, but some EIS's discuss how neighborhoods will be affected by transit systems. Interaction effects are evaluated by how much a neighborhood will be divided by transit facilities. Quality of Life may be quantified in ways important to a specific community, but differs from place to place. For example, COTA quantified the "quality of life" issue as the need to provide better


7 Economic Impacts of COTA on Central Ohio, January, 1988, p. 27, table 17.
access for the poor, elderly and handicapped to reach job destinations, leading to fewer welfare recipients.\(^8\)

**Change in Lifestyle.** Similarly, the effects of transit on the lifestyle of users were seldom discussed. Transit users have different levels of privacy, contact with others, freedom of movement and confidence in being able to get places than automobile users. Only a limited discussion of these consequences appeared in one of the documents reviewed, where it was stated,

> Better transit service within the downtown will encourage people to make longer trips by unifying the Central Area into a more coherent whole, allowing them [people] access to jobs that were not convenient to them before, and encouraging people to venture farther within the downtown during lunch and in the evening.\(^9\)

**Land-Use/Economic Consequences**

**Concentration of Activity.** Concentrating activities causes greater efficiency of public services, increased interpersonal contacts and preservation of land. Of these items, only land preservation and employment impacts were discussed by all reports. **Efficiency of Public Services** was mentioned in 13 reports with comments such as "The LRT alternatives generally reduce these times [transit travel times] by at least 10 minutes . . . ."\(^10\) **Interpersonal contacts** are not mentioned in any of

---

\(^8\) Economic Impacts of COTA on Central Ohio, January, 1988, p. 32.


\(^10\) Tasman Corridor, Santa Clara County, California, May, 1991, pp. 4-7.
the reports. **Land preservation and open space**, however, were discussed in fourteen of the fifteen reports reviewed. Preservation of parklands and wetlands were most often mentioned, calculating the amount of potentially endangered wetlands or flood plains. Preservation was rarely quantified, but the Honolulu EIS quantified the preservation of a potentially endangered butterfly population.

**Economic Effects.** Transit is often advocated as a way to persuade developers to build commercial, industrial, and residential sites within certain corridors. AA/EIS's attempt to measure the amount of economic activity that will occur and the potential impacts new developments will have on the region's economy. Several different methods of *employment* analysis were implemented depending upon the preference of the city or region. Variations of the input-output analysis for employment impacts are commonly used. Also, multipliers calculated by the Bureau of Labor Statistics are frequently used to determine potential employment. For example, the Colma BART station FEIS/FEIR calculated employment impacts by using the 1982 *I-O Model and Economics Multipliers for the San Francisco Bay Region*. The reports are unclear whether the employment impacts represent real gains or simple shifts from within or outside the region.

**Land Value** is directly related to economic development; attempts were made to determine the cost of land once a transit system is implemented or expanded. Land close to the transit centers may increase in value. Both negative and positive impacts could occur from this kind of development. Land value effects are rarely quantified. Only the St. Louis EIS made a minimal effort to quantify such benefits based on tax revenues: "EWGCC estimates that LRT will potentially attract $532.1 million in development . . ."\(^{11}\) The amount of potential development was usually discussed but there are too many unknowns to permit quantification.

\(^{11}\) 5-29, St. Louis.
Transit Supply

Consequences of an expanded transit system are discussed but not necessarily quantified. Community support (added prestige or "world class" city) is sometimes mentioned. For example, according to the Metropolitan Atlanta Rapid Transportation Authority,

Rapid rail transit represents a major public investment which has and will continue to greatly influence Atlanta's future development pattern. The region will continue as one of the nation's pivotal distribution points linking the United States and the world with the rapidly growing Southeastern market.\textsuperscript{12}

Employment Impacts of facility construction are cited in every AA/EIS. Very often this is done by estimating the employment activity per year during construction. Effects on employment for operations are also given. Generally it is felt by the community that such jobs are a local gain since they are new to the area. Whether such jobs are shifts from other areas and whether more jobs would be created by investing funds in other activities are seldom mentioned.

\textsuperscript{12}MARTA, Transit Station Areas Update, August, 1986, p. 15.
Local Use of Benefit Measures

Visits were made to different cities around the country to gain a better understanding of transportation decision-making and the role of benefits analysis. Cities were selected where expansion of the transit system has been a significant local issue and where extensive analysis has been or is being made of the benefits of transit. The purpose of these visits was to examine how analytical estimates of benefits were used in decision-making and to identify critical factors that lead to the choice of particular courses of action. This effort also looked into the role of referenda as a way to gain a community expression of transit benefits, to determine whether one could estimate overall perceived benefits by looking at how much a community was willing to tax itself voluntarily to support transit.

In each community, interviews were conducted to understand better the technical and political arguments for and against the transit expansion. In-depth interviews were held with staff members of transit agencies, local government, and metropolitan planning agencies, and with citizens and the academic community. A large number of documents were also obtained, including planning documents and promotional information that helped to understand the social, political and philosophical history of transportation decision making. There was good agreement among those interviewed about the key political issues and the areas of dispute.

Issues of Debate

In the communities we visited we found diverse opinions on the general value of transit and even more disagreement on specific projects. This disagreement is especially evident where the issue of building a rail system is a point of local controversy. In these places transit, in general, may have widespread support but particular parts of rail system proposals can be seriously questioned.
Debates over courses of action tend to center on benefit issues. Advocates believe there are substantial benefits of transit investment, while those people opposed doubt that such benefits exist. In most cases, these opinions existed independently of any attempts to quantify benefits. Studies that measured benefits were ignored or discredited or cited as authoritative depending on one's position on the proposed project. In most places we visited benefits were a matter of belief rather than an agreed fact. Furthermore, many benefits cited were intangible and difficult or impossible to measure.

The strongest criticisms come from those who believe that rail development cannot possibly be cost effective. In a role reversal, some critics are accusing political leaders of being too visionary, of not appreciating the obstacles to a successful system, and of placing too much faith in travelers' willingness to adapt to the changing transportation system. Technical analysis used to justify rail programs have been challenged by opponents, saying that the positive results were predetermined by the chosen methods. The critics have taken a conservative position relative to the potential benefits of a rail program, suggesting that most of the benefits are small and that overall non-quantified benefits do not exist. They say that it would be better to spend the money on bus services that can blend with the automobile-oriented life style of the community. Advocates, on the other hand, place high weight on nonquantified consequences and are optimistic on other effects.

In the cities visited those interviewed felt that the community supported transit principally because of the promise of congestion relief. Concerns about air pollution and energy consumption were also expressed in some locations. Supporters of transit included downtown interests, who believed that the center of the city could not experience any future growth without an increase in transportation system capacity. Comparisons to other "world class" cities were made in several of the cities we visited. Transit was seen as an important factor in civil pride and prestige. However, it was also mentioned in several cities that...
transit was supported by people who feel that they would not personally use it. In other words, their view was that people want transit so that other people can ride it.

These reasons for transit support in some cities appear to be based on frustration with the highway system. Transit was presented as a palatable way of solving seemingly intractable problem of traffic congestion. It was mentioned in several places that the city once had a fine streetcar system and things were better then. Lacking tangible evidence that a rail system would actually mitigate today's traffic problems, decision makers accepted this contention as an act of faith.

In some places the issue of socioeconomic status of riders was mentioned. There was a general agreement that trains have more status than buses. They can attract a better class of rider because of the promise of personal safety, comfortable seats, smoother ride, and attractive surroundings. Asked why these same attributes couldn't be given to buses, it was stated by one person that a better bus environment could not be maintained, given the type of people taking the bus. A decision has been made to create trains for affluent travelers, leaving buses as they were for poor people.

Socioeconomic status is also affecting route alignments. There is a discernible tendency to locate rail lines away from richer areas and near poorer areas, somewhat undercutting the objective of increasing the proportion of affluent riders. The desire to serve poorer areas is understandable; poorer areas already have a demonstrated need for transit. The desire to avoid rich areas is perplexing. Interviewees suggested that the rich do not envision taking transit themselves, but fear an increase in crime in their neighborhoods by "those" people who do take transit. Another impediment to providing rail transit in rich neighborhoods is a perception by some individuals that it is visually unattractive and noisy.
Role of Political Process

Transit planning, especially for new rail systems, is fundamentally a political process, assisted by technical analysis. Our experience was that most local planners do not feel it necessary to evaluate the benefits of its rail program because they have received a mandate for the program in the form of a clear political mandate and/or successful referenda. The decision makers are all actors in the political process, and they decide which parts of the transit program receive funding.

Transit is seen by some elected officials as a means of revitalizing the community, containing sprawl, and encouraging growth in high density corridors. There exists a strong belief in the cities visited that they have a dynamic community, rapidly changing in both its urban form and its demographics. The vision of rail transit development is that it can help reshape the community into a more efficient one and that it can overcome the almost complete dependence on highway transportation.

Transit relies on key elected officials for its support. If these key officials lose elections or leave office, there can be significant changes in direction. Projects are dropped or scaled back as other issues gain emphasis. The level of benefits may remain the same, but different people pursue other political objectives.

In some cases support for transit occurs because of a compromise between highway goals, environmental interests and other factors. Some level of transit investment is needed to gain support for overall transportation programs that include substantial investment in other modes of transportation. Furthermore support of advocates for environmental protection is obtained by supporting transit in exchange for compromises in development policy. Transit is another issue that mixes into an overall
package of programs assembled by elected officials. When the overall picture is explained, the level of effort for transit can make more sense than if transit is looked at by itself. Transit decision making is part of local politics, and it cannot be replaced by objective technical analysis.

The political process is sensitive to good technical analysis and systems can be modified or designed differently as a result of objective measures. However, technical analysis that conflicts with strongly held beliefs will tend to be discredited and ignored. Transit decision-making is dominated by intangibles that do not lend themselves to quantification and is done as part of a process of compromise and tradeoffs with other needs.

“The political process is sensitive to good technical analysis and systems can be modified or designed differently as a result of objective measures. However, technical analysis that conflicts with strongly held beliefs will tend to be discredited and ignored.”