Section 3: Transit Planning for Operations

- Introduction and Assignments
- Transit Operations Decisions
- Transit Operations Decisions – power point
- Transit Performance Measurement
- Transit Performance Measurement – power point
- Use of Performance Data
- Use of Performance Data – power point
- Transit and Geographic Information Systems – power point
- Transit Five Year Plan Examples
Introduction to Transit Planning for Operations

Transit planning for operations refers to the types of decisions that need to be made to effectively keep an existing transit system operation effectively and efficiently. This section of the course describes some of the fundamental relationships for transit systems and describes procedures for route location, scheduling, cost analysis and demand estimation.

Transit planning for operations involves getting a clear understanding of the decisions to be made in the planning process and the use of performance indicators to determine specific problems to be addressed. There is some important background information that should be looked at. The following should be read first:

- Transit Operations Decisions
- Transit Performance Evaluation
- Use of Performance Data

For those interested in the use of Geographic information systems, several topics are also provided.

- Use of GIS for performance evaluation
- Transit GIS case studies, power point

Once you have read these, answer the following questions:

1. What do you feel are the five best performance indicators to use for transit route planning?
2. What do transit passengers want? Give a list of five factors that are of most importance to someone considering using transit.
3. Compare the two lists and discuss, are they similar or different and what are the implications if they are different?
4. Post you answer in the course email reflector and discuss the results with other class members.

Five year plan:

You should look at the examples of five year transit plans

- Transit Five Year Plan examples

Answer the following questions:

1. What portion of a five year plan would have to be completely rewritten each year?
2. What is the role of performance indicators in a five year plan?
3. How would the process of preparing a five year plan for transit compare with something done for highways?
4. What is the status of transit planning in your community, what approach do they use?
Transit Operating Decisions

Objectives

- Understand the concept of decision based transit planning
- Understand the role of performance indicators in transit decision making
- Understanding of the use of geographic data for transit decisions

Transit Decisions

The purpose of transit planning is to make decisions. It is essential to clearly define the decisions that will need to be made. A clear definition of the problem will help in determining the scope and direction of the study, and the research method to be used. The following questions should be asked:

- What is the decision in a narrow sense?, i.e. commit money, approve, go to the next step?
- Who makes the decision?
- Who else is involved?
- When must it be made?
- What has to be decided now vs. later?
- What information will be needed to make the decision?
- What criteria will be used to make the decision?
- What are your cost criteria?
- What are your performance criteria?
- What impacts are you concerned with?
- What techniques will be needed to provide the information for the decision?

Despite the massive public financing and operation of urban transit systems, they remain an enterprise which requires considerable field data to be successful. Historically, transit data collection to drive operating decisions has been very labor intensive, requiring a cadre of filed observers and data analysts in the office. In 1947, the American Transit Association, predecessor of the American Public Transit Association sponsored a study of traffic checking to prepare transit schedules. While the data collection practices have changed dramatically, this manual, reprinted by the Federal Transit Administration in 1982, contains considerable insight into the use of operating data. The primary author of the study Walter S. Rainville, the ATA Director of Research, eloquently summarized the need for data collection in the introductory paragraph.

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1 Portions of this material is adapted from a NTI course “Improving Transit System Performance: Using Information Based Strategies” developed at the University of Wisconsin-Milwaukee 1996-98. This material was written by Jack Reilly of the Capital District Transportation Authority (Albany, N.Y.), Edward Beimborn of UWM and Robert Schmitt of RTR Associates in Pittsburg.
There are perhaps no more important elements of transit operations than the function of traffic checking and schedule preparation. The comfort and convenience of the public, the compensation and working conditions of company employees, and the economic welfare of the company itself are all directly and significantly affected by transit schedules.

The table below lists a number of operating decision which face transit management and the desirable data necessary to drive the decision.

### Table 1.1 Operating Decisions and Data Requirements

<table>
<thead>
<tr>
<th>Operating Decision</th>
<th>Required Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Service frequency and vehicle assignment</td>
<td>customers at maximum load point</td>
</tr>
<tr>
<td></td>
<td>average duration of standing</td>
</tr>
<tr>
<td>Service span</td>
<td>customer boardings by trip</td>
</tr>
<tr>
<td>Bus stop and shelter placement</td>
<td>customer boardings by stop, access routes to the stop, land use at stop</td>
</tr>
<tr>
<td>Running time</td>
<td>travel time between timepoints, street patterns, traffic control</td>
</tr>
<tr>
<td>Route alignment</td>
<td>customer boardings by segment, transfers by route, demographic characteristics of people along route, location of major trip generators</td>
</tr>
</tbody>
</table>

### Service frequency

The historic method of determining transit frequency was to determine the number of customers on-board a transit route at the so-called maximum load point, a point outside of the central business district at which loads were heaviest. A more sophisticated method is to assign a sufficient number of trips to assure that the percentage of passenger-miles during which customers are standing is less than a specified standard. In any event, making good decisions about appropriate frequency involves the collection of either point-check data at the maximum load point or ride check data to determine the passenger miles by trip. Maximum load data is also useful to determine appropriate vehicle deployment (small vs. large buses). Ridership profiles that show transit ridership along a route are very useful ways to determine where schedules could be modified.
Service span

The span of service is the time interval between the first morning trip and latest evening trip. A rational for increasing or reducing the span of service is some measure of the performance of trips already operated. For example, if the last evening departure is 8:00PM and its performance is only 10 customer boardings per service hour, it is unlikely that a later trip will carry as many customers as the one scheduled at 8:00PM. Insight into this decision can be obtained through a count of customer boardings by trip.²

Bus stop and shelter placement

The decision about bus stop spacing is a judicious balance between customer access and system speed. Knowing about the level of customer interchanges at the stop per day or per hour provides the insight necessary to ascertain proper stop amenities. Stops and shelters should be placed where there is good local access to the stop location. A good rule is to minimize the distance from the doorway of the vehicle to the doorways of the buildings and locations where trips begin or end.

Running time

Running time is an essential part of determining appropriate schedules. Field data from repeated observations are essential to prepare schedules which can be operated safely and also assure that buses do not run early or excessively late.

Route alignment

Determining the proper alignment of a route is as much art as science. Determining if a route should be terminated closer to the downtown or if a particular pattern within a route has outlived its usefulness can be aided by data on the number of boardings and alightings by stop or route segment. A large number of transfers between routes might be a signal that through-routing may be appropriate.

Geographic information such as demographic characteristics of the population along the route is very useful in these decisions. Transit usage depends on market size, the number of persons who could potentially use a transit service and market share, the portion of those users who actually use the service. If there is a low potential market size, there will be low use no matter how attractive the service is. Good GIS information can help define market size and be used to locate services that have the best potential.

² The span may be looked at as a social decision rather than a business decision. For example a transit system may have a standard that communities with densities grater than 20 households per acre will have evening bus service until 10:00PM. If this is the decision basis, then geographic information systems with census data is a more appropriate tool.
Table 1.2 Examples of Secondary Information Sources

1. U. S. Census

   Socioeconomic, demographic and housing data are available in census tracts or block groups, always aggregated, sometimes incomplete.

   Critical Information
   1. Location of place of work
   2. Income distribution
   3. Automobile availability
   4. Mode to work
   5. Age distribution

   Available from planning agency or the U.S. Bureau of the census directly.

2. Planning Agencies

   Current Land Use Plan
   Current Zoning
   Raw Data
   1. Employment Locations
   2. Centers of Commercial Activity Sales Tax Data
   Locations of Special Trip Generators
   1. Elderly Housing
   2. Medical Facilities
   3. Schools
   4. Employment
   5. Shopping

3. Traffic Department

   Traffic Volumes/Capacity
   Intersection Geometry-Control
   Parking and Other Regulations
   Construction Plans

4. In-House Data Collection

   Running Time Information
   1. Time Between Check Points
   2. Schedule Adherence
   3. Running Time on Alternative Routes
   Passenger Comments/Complaints
   Driver Comments/Complaints
   Ridership Counts
   1. Rate Revenue
5. Community Sources

- Political Leaders
- Other Community Leaders/Knowledgeable Persons
  - Informal Contacts
  - Task Forces
- Public Hearings

6. Private Sources

- Utility Records and Surveys
- Newspaper Surveys and Market Information
- Chamber of Commerce Surveys, Local Area Promotional Information
Transit Operating Decisions

E. Beimborn, University of Wisconsin-Milwaukee

- Service Frequency
  - based on customers at max load point, average duration standing
- Service Span (time of day)
  - customer boardings by trip
- Bus Stop and Shelter Placement
  - customer boardings by stop
More Transit Operating Decisions

- Scheduling
  - running time - travel time between timepoints
- Route Alignment
  - customer boardings by segment, transfers by route

Decision Based Planning

- The purpose of good transit planning and management is to make decisions.
- The following questions should be asked (1):
  - What is the decision in a narrow sense?, i.e. commit money, approve, go to the next step?
  - Who makes the decision?
  - Who else is involved?
  - When must it be made?
  - What has to be decided now vs. later?
Decision Based Planning

- The following questions should be asked (2):
  - What information will be needed to make the decision?
  - What criteria will be used to make the decision?
  - What are your cost criteria?
  - What are your performance criteria?
  - What impacts are you concerned with?
  - What techniques will be needed to provide the information for the decision?

Information Based Strategy: Steps

- Preparation
- Implementation
- Utilization
Preparation

- Define the Problem
- State Objectives
- Identify Needed Information
- Review Secondary Sources

Table 1.2 Examples of Secondary Information Sources

1. U. S. Census: Socioeconomic, demographic and housing data are available in census tracts or block groups, always aggregated, sometimes incomplete.
   Critical Information
   1. Location of place of work
   2. Income distribution
   3. Automobile availability
   4. Mode to work
   5. Age distribution

Available on tape or hard copy, usually from planning agency.
2. Planning Agencies
   - Current Land Use Plan
   - Current Zoning
   - Raw Data
     1. Employment Locations
     2. Centers of Commercial Activity Sales Tax Data
   - Locations of Special Trip Generators
     1. Elderly Housing
     2. Medical Facilities
     3. Schools
     4. Employment
     5. Shopping

3. City Traffic Department
   - Traffic Volumes/Capacity
   - Intersection Geometry/Control
   - Parking and Other Regulations
   - Construction Plans

4. In House Data Collection
   - Running Time Information
   - Time Between Check Points
   - Schedule Adherence
   - Running Time on Alternative Routes
   - Passenger Comments/Complaints
4. In House Data Collection (con’t)
   - Driver Comments/Complaints
   - Ridership Counts
   - Rate Revenue
   - Off On Counts
   - # of Transfers Issued/Accepted

5. Community Sources
   - Political Leaders
   - Other Community Leaders/Knowledgeable Persons
   - Informal Contacts
   - Task Forces
   - Public Hearings

6. Private Sources
   - Utility Records and Surveys
   - Newspaper Surveys and Market Information
Implementation (Collect the Data)

- When?
- Where?
- How Often?
- Who?, How trained?
- How Summarized?
- How Presented?

Utilization

- Coding, Tabulating and Weighing Information
- Data Analysis and Interpretation
- Report Writing
- Decision Making
- Follow Up
Acknowledgements

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- The opinions expressed are the product of independent university work and not necessarily those of the sponsoring agencies or of the agencies supplying data for the project.
Transit Performance Measurement

Outline:
- Introduction
- Business vs. Social Measures
- The Performance Evaluation Process
- Steps in the Process
- Paratransit Performance Evaluation
- Use of Performance Measures

Introduction

Evaluation and monitoring are as important to quality transit service as product development and marketing are to a successful business. Evaluating and monitoring service performance is essential to the efficient provision of transit to a community. Evaluation also enables managers to fine-tune services to meet the needs of riders more effectively. Likewise, monitoring the quality of transit service is an essential ingredient for good customer service. Since most systems are public-funded, the transit manager needs to improve productivity and effectiveness by providing the most rides possible with existing funds. This need for better productivity has to be balanced with maintaining a level of service that retains current riders and, hopefully, attracts new ones. Funding agencies, elected officials, and transit boards increasingly insist on performance reports to ensure that public funds are being spent wisely. A few state departments of transportation (DOTs) require performance evaluations or the reporting of performance indicators as a condition of state funding.

There are six major reasons for evaluating and monitoring transit service:

1) Control costs and ensure the integrity of the system
2) Justify changes in service levels (hours of operation, route extensions, etc.)
3) Maintain or improve the quality of service
4) Monitor subcontractors
5) Guide marketing efforts
6) Report the status of transit service performance to policy boards

Performance indicators are powerful tools for monitoring and improving transit service. While there are many possible indicators that could be used, typically a small subset is used on a regular basis to monitor the important aspects of transit system performance. The approach for using indicators to assess performance is relatively easy to implement. Some of the indicators used to evaluate service performance are readily available in most systems and others can be collected and analyzed as conditions warrant.

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In this section we will examine the different types of indicators, the transit evaluation process and the role of indicators. We will also look at a hypothetical transit system and how performance indicators might be used to evaluate service and assess changes in service.

**Types of Performance Indicators**

A performance indicator is a measure, usually quantitative, which reveals information about certain characteristics of a service. Sometimes the measure is a ratio of two other measures. For example, miles per hour is a measure of the average number of miles traveled in an hour. It is composed of total miles traveled divided by the total hours spent in travel. In a system as complex as transit, one could probably devise hundreds of measures to assess performance. However, experience has shown that in many situations a relatively small number of measures can be used effectively.

Considering the vast number of possible indicators, it will be helpful to classify performance measures into a smaller set of categories. In a study published in 1982, a classification of performance indicators was devised. An abbreviated version of this classification is given below.

**Financial Indicators**

- **Expense**
  - Total Operating Expense (Cost) / Total Passenger Trips: This is a measure of how well the system is serving riders with available resources.
  - Total Operating Cost / Vehicle Miles (or Vehicle Hours): Measures of productivity useful in setting standards or comparing services, including the services of peer systems.
  - Administrative Expenses / Total Expenses: A measure of the appropriate balance between these two cost centers. As a rule of thumb, administrative costs should not exceed 15-20 percent.

- **Revenue**
  - Total Revenue / Total Passenger Trips: A measure of the average revenue for a passenger trip.
  - Total Fare Revenue / Total Revenue: An indicator of the percentage of revenue accounted for by fares.
  - Revenue / Expense (Cost): Also called operating ratio or cost recovery. A measure of the degree to which operating expenses are covered by revenues.

- **Subsidy**
  - Total Subsidy / Total Vehicle Hours: The average subsidy per vehicle hour of service.
  - Total Subsidy / Total Passenger Trips: A measure of the average subsidy for each passenger trip.

**Non-Financial Indicators**

- **Ridership**
  - Total Passenger Trips / Total Vehicle Hours: The average number of trips served per

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vehicle hour. A measure of productivity.

- Total Passenger Trips / Total vehicle Miles: A productivity measure useful for comparing services, especially in rural areas or on longer suburban routes.
- Elderly Passengers / Total Passengers: An indicator of the use of transit by elderly passengers. May be useful in designing stops and assigning equipment.
- Passenger Trips / Population of Service Area: An indicator of the level of transit use in an area.

**Service Quality**

- Number of Complaints / Number of Drivers: A rough measure of consumer dissatisfaction.
- Stops On-Time / Total Stops: A measure of on-time performance.
- Vehicle Miles / Road Calls: A measure of miles between road calls; a surrogate for fleet age and maintenance effectiveness.

**Level of Service**

- Revenue Miles / Revenue Hours: A measure of the concentration of service.
- Vehicle Miles / Year: A useful measure for comparing level of service over time.
- Vehicle Hours / Year: A useful measure for comparing level of service over time and as an element in calculating additional indicators.

**Safety**

- Vehicle Miles / Vehicle Accidents: The number of vehicle miles between accidents, an important safety indicator.
- Avoidable Accidents per Year: A useful safety indicator and one often used for setting safety standards.

The indicators may be expressed in many different ways depending on what the manager wants to measure. Total vehicle miles and revenue vehicle miles are different indices, they measure slightly different things; farebox revenue and total revenue also differ significantly in some systems. Most indicators are appropriate at the system and route level while others are useful primarily at the route level.

Performance indicators have two major uses. First, they may be employed to assess how well the system is doing with respect to the standards established by management. Second, they may be used to identify areas within the system that need attention or remedial action. Both of these approaches come together in the transit system evaluation process.

**Business vs. Social Measures**

Most of the transit performance work to date using on-board data has focused on business measures of service (cost per customer transported, etc.) The recent advent of geographic information systems has enabled transit analysts to make a number of social measurements of transit service. For example, coupled with a description of the service (stop lists, frequencies, etc.) an analysts can determine the proportion of households without autos served by daytime service, the proportion of households with direct access by transit to grocery stores and the proportion of jobs in the transit service territory. The social mobility measures when coupled with more traditional business measures of transit service (revenue to cost ratio, for example) provide a more complete picture of transit performance in a metropolitan areas. Through the use of these technologies one can estimate the cost to achieve certain levels of mobility.
**Business Measures**

Business measures of transit service can be performed at the systemwide, route or even route segment level. Most important to transit operators are resource utilization measures such as customer boardings per revenue mile or revenue hour. Other measures of some interest in this area include revenue to cost ratio or cost per customer transported. In fact, several transit systems have some type of service standards against which actual performance levels are measured.

Providing cost information below the route level requires the use of some type of cost allocation model. This can either be a short run avoidable cost model (to determine the short run impact of changes in the level of service) or fully allocated costs in which all system costs including short run avoidable costs and fixed costs are pro-rated among routes.

By using farebox data for example, one can develop business measures for routes in the system. The table below shows a set of measures for Saturday routes in a transit system.
Table 1: Example of Route Comparison

<table>
<thead>
<tr>
<th>Route</th>
<th>Revenue/Cost</th>
<th>Passengers/Hour</th>
<th>Margin/Passenger</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>.26</td>
<td>14.2</td>
<td>$1.60</td>
</tr>
<tr>
<td>4</td>
<td>.20</td>
<td>12.8</td>
<td>$1.98</td>
</tr>
<tr>
<td>3</td>
<td>.37</td>
<td>21.4</td>
<td>$1.23</td>
</tr>
<tr>
<td>8</td>
<td>.14</td>
<td>10.1</td>
<td>$3.15</td>
</tr>
<tr>
<td>14</td>
<td>.28</td>
<td>16.1</td>
<td>$1.74</td>
</tr>
<tr>
<td>18</td>
<td>.19</td>
<td>10.4</td>
<td>$2.24</td>
</tr>
</tbody>
</table>

Social Measures

While most of the work in system wide performance measures is focused on business measures, such as revenue to cost ratios, transit systems do not have good estimates of some social indicators. Examples of these would include what proportion of households without autos have transit service of a specified quality. One particularly helpful social measure is an estimate of the number of households in a transit district within .25 mile of a bus stop (this is a five minute walk at three miles per hour).

Table 2.2 shows the system wide performance measures by service period. The table shows that although the transit service territory includes only 4% of the transit district, fully 73% of the households without autos are within 0.25 miles of a transit route.

Social measures can also be made at the route level. By using geographic information systems, one can compute the number of households within 0.25 miles of the route, the distribution of auto ownership within the route’s market area etc. Further, the characteristics of the route service can be compared with the characteristics of the system service area. The tables below illustrate this.
### Table 2: Proportion of Population in Service Area by Service Period

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Total</th>
<th>Peak</th>
<th>Midday</th>
<th>Evening</th>
<th>Saturday</th>
<th>Sunday</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total population</td>
<td>100%</td>
<td>42%</td>
<td>39%</td>
<td>27%</td>
<td>37%</td>
<td>23%</td>
</tr>
<tr>
<td>Total households</td>
<td>100%</td>
<td>44%</td>
<td>42%</td>
<td>29%</td>
<td>39%</td>
<td>24%</td>
</tr>
<tr>
<td>Elderly population</td>
<td>100%</td>
<td>47%</td>
<td>45%</td>
<td>30%</td>
<td>42%</td>
<td>24%</td>
</tr>
<tr>
<td>Employment</td>
<td>100%</td>
<td>62%</td>
<td>62%</td>
<td>50%</td>
<td>60%</td>
<td>46%</td>
</tr>
<tr>
<td>Households (0 cars)</td>
<td>100%</td>
<td>73%</td>
<td>71%</td>
<td>58%</td>
<td>70%</td>
<td>52%</td>
</tr>
<tr>
<td>Households (0,1 car)</td>
<td>100%</td>
<td>57%</td>
<td>55%</td>
<td>41%</td>
<td>53%</td>
<td>35%</td>
</tr>
<tr>
<td>Workers</td>
<td>100%</td>
<td>44%</td>
<td>42%</td>
<td>29%</td>
<td>40%</td>
<td>24%</td>
</tr>
<tr>
<td>Area</td>
<td>100%</td>
<td>5%</td>
<td>4%</td>
<td>2%</td>
<td>3%</td>
<td>2%</td>
</tr>
</tbody>
</table>

### Table 3: Performance Measures of Route 50 - Burnt Hills

**Business Measures**

- Passengers per hour: 8.5
- Cost per passenger: 6.55
- Public support cost (annual): $105,633

**Social Measures**

- Households in service area: 3,191
- Households without autos in service area: 270
- Public support cost per household: $33
- Public support cost per household w/o autos: $391
### Table 4: Residential Route Analysis - Route 50 Burnt Hills

<table>
<thead>
<tr>
<th>Key Indicators</th>
<th>CDTA Service Area</th>
<th>Route 50 Service Area</th>
<th>Route Percent of Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population density (pop/sq.mi.)</td>
<td>4,105</td>
<td>2,116</td>
<td>-</td>
</tr>
<tr>
<td>Percent of households without autos</td>
<td>13%</td>
<td>2%</td>
<td>-</td>
</tr>
<tr>
<td>Percent of households with 0,1 auto</td>
<td>43%</td>
<td>12%</td>
<td>-</td>
</tr>
<tr>
<td>Percent of population over age 65</td>
<td>13%</td>
<td>4%</td>
<td>-</td>
</tr>
<tr>
<td>Households without autos per sq. mi.</td>
<td>415</td>
<td>26</td>
<td>-</td>
</tr>
<tr>
<td>Percentage of region’s workers living in route service area using transit</td>
<td>6%</td>
<td>0.2%</td>
<td></td>
</tr>
</tbody>
</table>

### Supplemental Indicators

<table>
<thead>
<tr>
<th></th>
<th>CDTA Service Area</th>
<th>Route 50 Service Area</th>
<th>Route Percent of Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total population</td>
<td>468,719</td>
<td>8,377</td>
<td>2%</td>
</tr>
<tr>
<td>Total area (sq. mi.)</td>
<td>264</td>
<td>7</td>
<td>3%</td>
</tr>
<tr>
<td>Total population over age 65</td>
<td>68,667</td>
<td>1,333</td>
<td>2%</td>
</tr>
<tr>
<td>Total households without autos</td>
<td>30,310</td>
<td>270</td>
<td>0.9%</td>
</tr>
<tr>
<td>Total workers</td>
<td>187,283</td>
<td>3,190</td>
<td>2%</td>
</tr>
<tr>
<td>Population over age 65 per sq. mi.</td>
<td>575</td>
<td>345</td>
<td>-</td>
</tr>
<tr>
<td>Workers per sq. mi.</td>
<td>1,675</td>
<td>236</td>
<td>-</td>
</tr>
</tbody>
</table>
The Performance Evaluation Process

The performance evaluation process consists of six steps as shown in Figure 2.1. Because the process of identifying problems and solving them is a continuous one, the performance evaluation framework described here is a loop whereby the results of specific actions are further evaluated using the performance measures that are used to quantify the goals and objectives set for the system. An overview of the six steps is presented in this chapter; more detailed descriptions of each performance measure, data collection, and diagnostic information are presented later.

Figure 1 Performance Evaluation Process.

1. Establish Goals and Objectives
2. Select Functions to Evaluate and Select Indicators
3. Collect and Tabulate Data
4. Analyze Indicators
5. Present the Results
6. Take Corrective Actions and Monitor Results
Steps in the Process

1. Establish Goals and Objectives

The first step in setting up a performance evaluation process is to define overall system goals and objectives. While each system may have specific local goals and objectives, most often the overall goal of a system can be stated as follows:

**Goal:** to provide, safely and reliably, the greatest number of trips to the greatest number of persons at the lowest possible cost within the budget provided.

After the general goal of a transit system is established, more specific, quantifiable objectives must be defined so that the specific measures necessary to a performance evaluation methodology can be determined. In the case of the general goal stated above, a number of more quantifiable objectives are implicit within this overall goal statement. These objectives can be grouped into categories such as financial, safety, ridership, and service quality. Specific indicators can then be selected to measure accomplishment of these specific objectives.

A sample set of measurable objectives that logically follow from the previously stated goal statement are given on the table 2.5:

This sample set of objectives is not meant to be comprehensive; many other worthwhile quantitative and qualitative objectives can be defined. However, this set encompasses the major, *measurable* objectives that might be established by a paratransit system that serves a specialized or general market.

Measurability is an essential attribute of objectives formulated for use as part of a performance evaluation framework. Certain qualitative aspects of a system, such as the degree to which the transportation service affords individuals the opportunity to lead a "full life," while laudable, are nonetheless difficult or impossible to measure. Therefore, a list of the objectives of a transit system such as the one presented above must be limited to financial and operating attributes of the system that can be measured unambiguously.

Data availability and data collection costs also limit the range of objectives that can be considered since transit systems typically have few resources available to support extensive data collection efforts. Ideally, the performance evaluation framework should be workable using readily available or easily collectable information. Fortunately, experience has shown that a small number of objectives, measured by clearly defined performance statistics, provides for the most effective evaluation process and, therefore, the resource limitations of a system do not preclude an effective evaluation process.
Table 5: Sample Performance Indicators (paratransit)

Operating Efficiency

Operating expense per vehicle hour should not exceed the statewide average and should annually increase by no more than the rate of inflation.

Administrative expense as a percentage of total operating expense should not exceed 15 percent.

The percentage of live hours (when passengers are in the vehicle) to total paid driver hours should be at least 50 percent.

Effectiveness

A minimum of 3.5 one-way passenger trips per vehicle hour should be provided.

A minimum of 4.0 one-way passenger trips by senior citizens should be provided annually for each senior citizen within the service area.

Service Quality

Service-related complaints by customers should not exceed one complaint per 1,000 one-way passenger trips.

Ninety-five percent of all pickups will be made within +/- 15 minutes of the promised time.

Financial

The expense per one-way passenger trip should increase by no more than the Consumer Price Index and should not exceed the maximum rate allowed by the State DOT.

The revenue per one-way passenger trip should be set to recover, on average, 100 percent of the operating expense per trip.

Safety

The system should have no more than one avoidable accident per 100,000 vehicle miles.
2. Selection of Performance Indicators

After the system's objectives have been clearly defined, the next step in the performance evaluation process is the selection of the specific performance indicators that will measure accomplishment of the objectives. Three sub-issues related to the selection of indicators include:

1. The extent to which a specific indicator has a generally agreed upon meaning, permitting cross-system comparisons, can be calculated using readily available or easily collectable data, and is unambiguous as to its meaning.

2. The operating level at which the indicator will be applied; for example, will the indicator be used to measure overall system performance, or will it be used to measure sub-service performance, such as by time of day or service sector area?

3. The time period to be measured (e.g., annual, quarterly, or monthly).

Dozens of indicators can be calculated using readily available information; however, a few key measures that meet the characteristics listed above are all that is needed to carry out an effective evaluation process. Gordon Fielding found that a preliminary list of 48 indicators could be reduced to 7 "marker variables" that captured the essential aspects of fixed-route performance. A similar, selective list of indicators for paratransit systems is proposed in this guide. A short, focused list of indicators not only reduces the data collection required, but will encourage managers and external constituencies to focus on the overall condition of a system before delving into detailed aspects of sub-functional areas.

The first step in selecting indicators is to identify measurable indices for each objective developed in the framework of goals and objectives established in step one. After an overall list has been compiled, the list should be screened to eliminate indicators that measure the same performance attribute. For example, indicators with miles or hours in the denominator generally can be substituted for each other (e.g., expense per mile and expense per hour both track overall efficiency so that only one of these indicators is needed in an evaluation framework to measure the efficiency of a system).

Data availability and data collection costs will undoubtedly be the most important determinants of whether a performance indicator can be considered for inclusion in the evaluation methodology. For example, an excellent measure of services delivered is passenger miles; however, calculation of the average trip length data needed to estimate passenger miles is very time consuming, and therefore may limit use of this measure.

The system level at which the indicators are calculated and the frequency with which they are reported will determine the resources required to conduct the recommended evaluation. The recording of financial and operating data by service sector, or time of day, not only requires maintenance of more detailed data files; it also requires that cost information usually maintained

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3 Fielding, Gordon J., *Managing Transit Strategically*, pp. 64-65. The seven performance indicators include: revenue vehicle hours per operating expense, unlinked passenger trips per revenue vehicle hour, corrected operating revenue per operating expense, total vehicle hours per total employees, total vehicle miles per peak vehicle, total vehicle miles per maintenance employee, and total vehicle miles per collision accident.
at the system level be allocated to sub-services. Monthly or quarterly analysis also requires that accrual accounting systems be used to report financial data. While the record-keeping and additional procedural issues increase the complexity of the performance evaluation process, both transit and paratransit systems need the type of data that this evaluation provides. Therefore, a primary goal of this guide is to assist system staff in developing and implementing such an evaluation scheme by providing easy-to-understand explanations and examples of the recommended approach.

3. Collection and Tabulation of Data

After the overall goals and objectives of the transit system have been determined and the specific performance indicators are selected, the data elements needed to calculate each indicator must be collected. Nearly all of the data required to conduct the performance analysis can be obtained from basic financial and operating records normally maintained by a system. For example, except for accident and complaint statistics, all data required to calculate the performance indicators listed earlier in this chapter could be obtained from the driver's log and the system's financial accounting system. Furthermore, the accident and complaint data can be obtained through a simple record-keeping system that tabulates these events.

While the basic data for the performance evaluation can be obtained from readily available sources, these data must be analyzed and aggregated before they can be used to calculate the required measures. Before aggregating the raw data into the performance indicators, the time period must be established for the analysis and the operational level being considered. Typically, a performance evaluation such as the one described in this guide covers a 12-month period of operation so that annual financial and operating data are required. While the manager may wish to calculate some indicators on a monthly or quarterly basis to spot problems or to monitor how the system is moving toward its 12-month objectives, annual reporting of results is usually sufficient for funding agencies and other external constituencies. Furthermore, even with a good accrual accounting system that assigns costs and revenues to the proper time period, wide variations in month-to-month cost, revenue, and performance could unnecessarily complicate the interpretation of performance results. Therefore, the 12-month performance period is recommended.

The level of system detail to be included in the evaluation also must be determined prior to data collection and tabulation. For example, as will be demonstrated in a case study, an important use of the performance framework described in this guide is the analysis of individual service sectors or subcontractors within a transit or paratransit system. This type of detailed analysis helps the manager identify services within the overall operation that are unproductive and that need special attention. Also, special analysis of the services provided by subcontractors can aid a manager in monitoring the quality and performance of services provided by these outside vendors.

One common pitfall that should be avoided when collecting and tabulating financial and operating data is inconsistency of the data with respect to time period or level of aggregation. For example, annual ridership figures should not be divided into a one-month sample of vehicle hours to calculate the rides-per-vehicle-hour productivity measure. Such an error often occurs when a data element such as vehicle hours or trip length is not available for the entire year, so that only a sample measure of the data is available. This sample data may be used; however, adjustments to the data would be required to allow for proper calculation and interpretation of
the resulting measures.

A similar inconsistency error is also possible in the analysis of a specific service sector. Here the common error is to compare data, such as ridership for a particular portion of the service area, with costs or other performance data for the entire system. Obviously, the resulting calculation is meaningless. Recommendations for addressing these data collection and tabulation issues are presented in chapter 3.

4. Analysis and Interpretation of Indicators

Though most of the time required to conduct a performance evaluation will be spent collecting and organizing the required data, this step, analyzing and interpreting the indicators, is the most important one. In each case, the indicator must be analyzed to determine if the system's performance is satisfactory relative to the goals set for the system, or with respect to an external norm. One or more of the following three approaches may be employed to analyze the results. All three may be used as part of a system's evaluation and reporting procedure.

The first and most common method of analysis is to compare similar statistics for the system over time. Time-series analysis for a single system allows a manager (or external evaluators such as funding agencies or governing boards) to see how a system is progressing toward the system’s own goals and whether its performance is improving or deteriorating over time. Some systems set annual goals at the beginning of a year so that the year-end performance evaluation includes a comparison of how the system performed relative to the established goals. For example, if in the prior year, a system achieved a productivity of 2.5 one-way passenger trips per vehicle hour, then the system’s goal for the next year might be set at 2.7 one-way passenger trips per vehicle hour to increase overall efficiency. Even if specific goals are not set (e.g., the 2.7 goal), a time-series analysis of the system will allow the manager and others to identify areas of performance that need improvement and allow for an overall assessment of the system's condition.

A second way to interpret performance indicators is to compare the value obtained for a particular system to that of other, peer systems. Peer systems would include those systems that are comparable in key aspects such as size, operating environment (e.g., urban, suburban, rural), and type of operation (e.g., contracted, directly provided). Another operational characteristic that must be considered when selecting peers for valid comparison are the characteristics of the riders and the type of service provided. For example, a system that primarily transports ambulatory senior citizens to senior centers in a many-to-one operating mode will display significantly different performance characteristics than a system that transports disabled persons in wheel chairs to medical facilities in a many-to-many mode of operation. Also, for financial indicators, it is important to compare cost data for the same period or to use cost indices to adjust data from different years.

The third approach that may be used to analyze performance indicators involves comparing a particular statistic for the individual system to an industry norm or standard. However, few such norms exist unless there are funding agency-imposed minimum standards. Some states may require, for example, a certain minimum cost recovery, or a maximum cost per passenger trip. Certainly if such norms or standards exist, the performance analysis must acknowledge them.

In practice, a complete performance evaluation will include all three types of comparisons, with
the time-series presentation of results being the most common and achievable for all indicators. Peer group comparisons will likely be possible for some indicators, but may not be possible or appropriate for others, such as safety or customer satisfaction measures where data is not collected or reported in the same way for a group of peer systems. Finally, the comparison of performance measures against norms or standards will be very limited since few such norms exist.

5. Presentation of Results

Effective presentation of the results of a performance evaluation is an integral part of the evaluation process because it not only helps the manager to interpret the results (the previous step), but it also allows the manager to communicate the results to outside constituencies. Because people think in terms of pictures rather than words or numbers, graphical presentations are often the most effective way to accomplish both objectives. While modern microcomputer hardware and software (spreadsheet and business graphics programs) allow for cost-effective production of professional graphics and can greatly speed the analysis and presentation of evaluation results, the techniques described in this guide can also be effectively implemented manually. The case study example presented later demonstrates several graphical formats for presenting performance results.

6. Take Corrective Action and Monitor Results

The final and most important step in the evaluation process is the corrective actions that will be taken by the manager and/or policy board to increase the efficiency or effectiveness of the system. This step is certainly the most challenging and creative part of the process, but it also may require difficult choices regarding the level of service offered or the resources used to provide the service. Common problems and possible corrective actions for paratransit systems are described and illustrated in the case study described later.

Once the corrective actions are implemented, the evaluation cycle begins again with a review of the goals, indicators, and data collection. Then, during the next review cycle, the results of the previously implemented corrective actions are evaluated using the next period's performance results, and additional corrective actions can be taken as needed.
Paratransit Performance Evaluation

Collecting and tabulating the operating and financial data required to calculate performance ratios is the most time-consuming performance evaluation related task. However, this task need not be difficult if the record-keeping system is planned so that it produces the necessary information. While many shared-ride systems now use computers to maintain service records and prepare driver logs, the evaluation framework described in this guide does not require such an automated system to produce the necessary data. A comprehensive, accurate manual system can also yield the necessary statistics. Nevertheless, advanced planning is required to ensure that the basic records of the shared-ride system (e.g., the driver log, the monthly finance report, the complaint log, accident files) are designed to capture the needed statistics at the level of detail required.

This section describes how the required data elements can be collected and applied to the paratransit evaluation. Table 1 lists the performance indicators to be calculated, the data elements required to calculate them, and the source used to obtain each element. Certainly the list of indicators presented in table 1 is not exhaustive, and the manager of a shared-ride paratransit system may wish to modify this list to reflect the goals and objectives of the individual system. Nevertheless, the basic data collection and tabulation procedures will illustrate the key issues associated with data collection.

As shown in the table, the two primary sources for the 13 data elements used to calculate the 10 indicators are the driver log that records the daily activity of each shared-ride vehicle, and the system's financial records—primarily the monthly income statement, which summarizes the system's revenue and expenses. The following section describes how the daily driver log can be used to collect most of the operating data required for the performance analysis. Because the expense and revenue statistics required for the performance evaluation often require special treatment, especially if expenses and revenues are to be assigned to specific vehicles or types of service, tabulation of the financial data will be dealt with elsewhere.

Four data elements used in the performance evaluation are not derived from financial records or the driver log. These items—avoidable accidents, service-related complaints, paid driver hours, and senior citizen population—must be tabulated from other records. The six data elements derived from the driver log are discussed in the following section along with a brief discussion of the accident, complaint, population, and paid driver information required. Cost allocation procedures for paratransit are essentially the same as for fixed route transit and are discussed elsewhere.

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4 Portions of this section are adapted from James H. Miller, Shared-Ride Performance Guide, prepared for the USDOT, Urban Mass Transportation Administration; September, 1989.

5 For more information on available paratransit software see Lave, Roy E. and Piras, Pat, A Handbook for Acquiring Demand-Responsive Transit Software, TCRP, TRB, NRC, July 1996.
Table 6: Data Requirements for Paratransit Evaluation - Data Requirements for Shared-Ride Paratransit Evaluation

<table>
<thead>
<tr>
<th>Performance Measure</th>
<th>Data Element</th>
<th>Source of Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating Efficiency</td>
<td>a. Operating Expense</td>
<td>Finance report</td>
</tr>
<tr>
<td></td>
<td>b. Vehicle hours</td>
<td>Driver log</td>
</tr>
<tr>
<td></td>
<td>c. Administrative expense</td>
<td>Finance report</td>
</tr>
<tr>
<td></td>
<td>d. Live hours</td>
<td>Driver log</td>
</tr>
<tr>
<td></td>
<td>e. Paid driver Hours</td>
<td>Payroll</td>
</tr>
<tr>
<td></td>
<td>f. Total one-way passenger trips</td>
<td>Driver log</td>
</tr>
<tr>
<td></td>
<td>g. Senior citizen population</td>
<td>Driver log</td>
</tr>
<tr>
<td></td>
<td>h. Senior citizen one-way trips</td>
<td>Driver log</td>
</tr>
<tr>
<td></td>
<td>i. Service-related complaints</td>
<td>Complaint log</td>
</tr>
<tr>
<td></td>
<td>j. On-time pickups</td>
<td>Driver log</td>
</tr>
<tr>
<td></td>
<td>k. Total passenger revenue</td>
<td>Finance report</td>
</tr>
<tr>
<td></td>
<td>l. Avoidable accidents</td>
<td>Accident log</td>
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<td></td>
<td>m. Vehicle miles</td>
<td>Driver log</td>
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<td>Effectiveness</td>
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<td>4. One-way passenger trips/vehicle hour</td>
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<td>5. Senior citizen one-way passenger trips/</td>
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<td>senior citizen residents of service area</td>
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<tr>
<td>Service Quality</td>
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<td>6. Service-related complaints/1000 one-way</td>
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<td>passenger trips (i)/(f)</td>
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<td>7. On-time pickups/total pickups (j)/(f)</td>
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<tr>
<td>Financial</td>
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<tr>
<td></td>
<td>8. Operating expense/one-way passenger trip</td>
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</tr>
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<td>9. Revenue/one-way passenger trip</td>
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<tr>
<td>Safety</td>
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<tr>
<td></td>
<td>10. Avoidable accidents/100,000 vehicle miles</td>
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</tr>
</tbody>
</table>

1 Formula and data elements required to calculate performance measure
Data Items Derived from the Driver Log

The driver log, used by the paratransit vehicle driver to record daily trip activity, provides the raw data for 6 of the 13 data elements required for the proposed evaluation framework. While the information contained on the driver log varies widely among systems due to differences in funding agency data requirements and operating procedures, the driver log shown in figure 2 is typical of those used by specialized transit providers.

Typically, a driver is given a daily log that already lists the trips scheduled for the day, including the scheduled pick-up time, the person's name and the address of the trip origin, and the trip destination. Once the transportation is provided, the driver completes the log by entering times and odometer readings for the pick up and delivery of each passenger. In addition, the driver completes the information at the top of the log that describes the vehicle and driver's activity for the entire day. One common variation to the procedure described above occurs when taxis are used to provide shared-ride service and trip requests are radio-dispatched to drivers rather than provided in advance for the entire day. In this situation, all information is recorded by the driver as the trips are provided. In either case, however, information such as that contained on the sample driver log shown in figure 2 is required for the performance evaluation; therefore, a shared-ride system that does not presently record this information must modify its data collection procedures to obtain these data. To help determine if a driver log in its current form provides the required information, each of the data elements listed on the log are defined in table 2-4.

The next section defines each of the driver log-derived data elements and describes how each can be tabulated using information from the driver logs.
Figure 2: Sample Shared-Ride Driver Log. Sample Shared-Ride Driver Log.

<table>
<thead>
<tr>
<th>CARRIER NAME</th>
<th>PARATRANSIT DRIVER'S LOG</th>
<th>DATE</th>
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<tbody>
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<table>
<thead>
<tr>
<th>LOG NUMBER</th>
<th>ENDING ODOMETER READING</th>
<th>STARTING TIME</th>
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<thead>
<tr>
<th>VEHICLE ID</th>
<th>BEGINNING ODOMETER READING</th>
<th>ENDING TIME</th>
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<table>
<thead>
<tr>
<th>DRIVER NAME</th>
<th>TOTAL VEHICLE MILES</th>
<th>TOTAL TIME</th>
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</table>

<table>
<thead>
<tr>
<th>TRIP ID</th>
<th>PASSENGER</th>
<th>NAME OF PASSENGER</th>
<th>TRIP CLASS</th>
<th>ORIGIN</th>
<th>DESTINATION</th>
<th>ODOMETER</th>
<th>PSGR. FARE</th>
<th>TIME</th>
</tr>
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<tr>
<td></td>
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<td>65+</td>
<td>NAMB</td>
<td>PURP</td>
<td>ON</td>
<td>OFF</td>
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</table>

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Table 7: Explanation of Driver Log Entries.

<table>
<thead>
<tr>
<th>Item</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Carrier Name</td>
<td>Name of service provider.</td>
</tr>
<tr>
<td>2 Date</td>
<td>The date that the trips listed on the log were made</td>
</tr>
<tr>
<td>3 Log Number</td>
<td>Any unique number that can be used to identify log sheet during the tabulation of data.</td>
</tr>
<tr>
<td>4 Vehicle ID</td>
<td>A letter, number, or other unique identification.</td>
</tr>
<tr>
<td>5 Driver Name</td>
<td>Enter the driver’s name. If log stays with the vehicle rather than with the driver, and a vehicle has more than one driver in a given day, list all drivers.</td>
</tr>
<tr>
<td>6 Ending Odometer Reading</td>
<td>The odometer reading of the vehicle once it is parked for the day.</td>
</tr>
<tr>
<td>7 Beginning Odometer Reading</td>
<td>The odometer reading of the vehicle at the start of the day.</td>
</tr>
<tr>
<td>8 Total Vehicle Miles</td>
<td>Difference of the ending odometer reading (6) and the beginning odometer reading (7).</td>
</tr>
<tr>
<td>9 Starting Time</td>
<td>The time, to the nearest five minutes, when the vehicle is first available to provide service.</td>
</tr>
<tr>
<td>10 Ending Time</td>
<td>The time when the vehicle is removed from service.</td>
</tr>
<tr>
<td>11 Total Time</td>
<td>The total driver hours for the vehicle by determined by calculating the difference between the starting time (9) and ending times (10).</td>
</tr>
<tr>
<td>12 Trip ID</td>
<td>An identifier for each trip.</td>
</tr>
<tr>
<td>13 Sched. Pick Up Time</td>
<td>The time that the trip was scheduled to be made</td>
</tr>
<tr>
<td>14 Name of Passenger</td>
<td>The last name and at least the first initial of the rider</td>
</tr>
<tr>
<td>TRIP CLASS</td>
<td>Items 15, 16, 17 allow the provider to categorize trips by purpose or characteristic of the rider. The categories listed are typical of the types of designations used but may be modified to a particular system’s needs.</td>
</tr>
</tbody>
</table>
Check to identify trips made by persons 65 years or older.

Check to identify trips made by nonambulatory persons.

Enter code for type of trip, e.g. M for medical, S for shopping, etc.

Table 2. Explanation of Driver Log Entries (continued).

<table>
<thead>
<tr>
<th>Item</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>18 Origin</td>
<td>Origin of the trip.</td>
</tr>
<tr>
<td>19 Destination</td>
<td>Destination of the trip.</td>
</tr>
<tr>
<td>20 Odometer Reading ON</td>
<td>Odometer reading when the passenger boards the vehicle.</td>
</tr>
<tr>
<td>21 Odometer Reading OFF</td>
<td>Odometer reading when the passenger gets off the vehicle.</td>
</tr>
<tr>
<td>23 Time ON</td>
<td>The time when the passenger gets on the vehicle to the nearest 5 minutes.</td>
</tr>
<tr>
<td>24 Time OFF</td>
<td>The time when the passenger gets off the vehicle to the nearest 5 minutes.</td>
</tr>
<tr>
<td>25 Total Fare</td>
<td>The total fare due for the trip.</td>
</tr>
<tr>
<td>26 Psgr. Fare</td>
<td>The fare collected from the passenger.</td>
</tr>
<tr>
<td>27 Zones</td>
<td>The number of grids or zones charged (if applicable).</td>
</tr>
</tbody>
</table>
Definitions and Tabulation methods for Driver-Log Based Data

**Vehicle Hours**

**Definition:** Total time during which a paratransit vehicle is available to provide service. Lunch breaks, pre-trip inspection time, and scheduled or unscheduled maintenance periods are not included as part of the vehicle-hour statistic since the vehicle is not available for service.

**Method of Tabulation:** Total vehicle hours can be calculated for the overall system by summing the number of vehicle hours of service provided by each vehicle each day. Data element (12) on the driver log provides this information for each vehicle each day.

Vehicle hours for specific vehicles or groups of vehicles can be tabulated by totalling individual vehicle hours for the desired vehicles. However, if a specific vehicle provides two or more types of service during the day, a more detailed tabulation method is needed to determine the total vehicle hours required to provide a particular service. For example, in Pennsylvania, taxi operators commonly provide shared-ride as well as exclusive-ride taxi service using the same vehicle and driver. Therefore, to determine the number of vehicle hours devoted to paratransit service, the time spent on the two types of service must be separated.

If a vehicle is used a portion of the day for one type of service, and then at other times for other services, vehicle hours can be determined by totaling the hours spent in each type of service. However, if paratransit and other types of trips are intermixed throughout the day, this method will be cumbersome.

One approach used by some operators faced with this problem has been to prorate the vehicle hours devoted to each type of service based on the number of live hours associated with each service. For example, if 30 percent of the live hours (time when passengers are being transported) are associated with paratransit service, then paratransit vehicle hours for that vehicle are assumed to be 30 percent of the total. So, if a vehicle is available for 10 hours of service on a particular day, and if 30 percent of the live hours derive from paratransit service, then 3 vehicle hours of service (10 hours x 30 percent) are assumed to be provided. This calculation is based on the reasonable assumption that the amount of dead time (time when no passengers are on board) is proportionately the same for both the paratransit and non-paratransit service.

**Live Hours**

**Definition:** The amount of time vehicles are in use providing shared-ride service when passengers are on the vehicle. Dead time—the difference between total vehicle hours and live time—includes both the time that the vehicle spends enroute between trips, and unproductive time when no trips are requested. This measure is an indicator of dispatcher effectiveness and also gauges how well a system matches its services (vehicle hours) to the demand for the service. The goal of a shared-ride system is to maximize the amount of live time that vehicles and drivers are in service.

**Method of Tabulation:** Total live hours of service for a paratransit system are tabulated from a detailed analysis of the driver log. The simplest way to calculate this measure is to
examine the driver log to determine the amount of time the driver is not transporting persons (dead time) and subtract it from the total vehicle hours that the vehicle was in service that day. The dead time is determined by scanning the starting and ending times on the driver log to determine when the vehicle did not have passengers on board and noting the number of minutes without passengers in the margin along the edge of the log. The total live time can then be derived by totaling the number of dead minutes, dividing this number by 60 to determine dead hours, and then subtracting this result from the total vehicle hours listed at the top of the log.

One common error that should be avoided when calculating this measure is double counting of live time when more than one person is on the vehicle. This error results from calculating live time by summing the total riding time of all passengers rather than just the total amount of the day that the vehicle was transporting passengers. For example, if four persons were on a vehicle from 9:00 am until 9:20 am, the total amount of live time would be 20 minutes. The incorrect calculation would result in 80 minutes (4 passengers x 20 minutes) being tabulated as live time. The 80 minutes, which represents the number of passenger minutes of service provided, may be a desired performance indicator, but it is not the one used in this analysis.

**Total One-Way Passenger Trips**

**Definition:** The total number of individual rides provided to individuals where each separately scheduled segment of a ride constitutes a one-way passenger trip. For example, if a passenger rides from home to a doctor's appointment, from the doctor's appointment to a shopping center, and then home, a total of three one-way passenger trips have been provided. Similarly, if 15 senior citizens are transported to and from a senior nutrition program, 30 one-way passenger trips of service have been provided.

**Method of Tabulation:** Total one-way passenger trips is a very simple statistic to tabulate once the basic definition of the measure is established. Assuming that each entry on the driver log represents an individual one way trip, total one-way trips can be tabulated by summing the number of entries on each log.

Though total ridership as measured by one-way passenger trips is the performance measure used in this evaluation, most shared-ride systems will want to maintain more detailed ridership records that indicate the number of one-way trips provided to different categories of riders or for different trip purposes. These more detailed statistics may be required by funding agencies or may be used by the system to describe the benefits derived from the transportation program. For example, systems commonly tabulate the number of seniors, people with disabilities, low-income, or other target population riders that they serve. The trip classification fields on the driver log allow for this recording of subcategories of ridership.

**Senior Citizen One-Way Trips**

**Definition:** The number of one-way passenger trips provided to persons 65 years or older. Because a goal of many paratransit systems is to provide mobility to the elderly population, this particular subcategory of ridership is specifically identified and reported. However, a system's effectiveness in serving other target populations may also be measured by adding or substituting other measures such as the number of low-income one-
way passenger trips provided, or the number of non-ambulatory one-way trips provided.

**Method of Tabulation:** The number of one-way passenger trips provided to senior citizens or other specified subgroups can easily be calculated if riders are identified as belonging to the category being studied. The trip classification fields on the driver log allow for this categorization. Total senior citizen one-way passenger trips can be tabulated by totalling from the driver log the number of trips by this category of rider.

**On-Time Pickups**

**Definition:** The number of one-way passenger trips where the actual pick-up time is within the tolerance desired from the requested pick-up time. For example, if the system established that on-time was within plus or minus 15 minutes, then a trip would be considered on time if the driver arrived for the pick up within the time period 15 minutes before or after the requested time.

**Method of Tabulation:** The total number of on-time trips is determined by comparing the scheduled and actual pick-up times on the driver log. Because of the time required for this examination and tabulation, one might elect to sample this measure by randomly selecting a day’s or a week’s set of driver logs (depending on the size of the system) for analysis of this measure. The performance measure that uses this data element, the percentage of on-time trips, requires two statistics, the number of on-time trips and the number of total trips. Therefore, in sampling this statistic, be sure to also determine the total number of one-way trips provided during the sample period so that the percentage statistic can be calculated correctly.

**Vehicle Miles**

**Definition:** The miles operated by vehicles are measured by the vehicle odometer. The statistic includes miles operated with and without passengers.

**Method of Calculation:** Total vehicle miles can be determined in one of two ways. First, vehicle odometer readings at the end of each reporting period can be used to calculate vehicle miles. Second, the number of vehicle miles listed on each driver log can be summed. The second way is preferred since it may be a more accurate measure of vehicle miles of service, especially if the vehicles are also used for other purposes and if these miles would be included if the periodic odometer readings were used to tabulate this measure.

If during a given day a vehicle is used to provide services other than paratransit, and the exclusion of mileage resulting from these other services is desired for analysis, then a procedure similar to the one described above for vehicle hours must be followed to prorate the total daily miles among the various services provided by the vehicle. In the case of vehicle miles, this method requires that total vehicle miles be apportioned in a ratio equal to the proportion of live miles (miles with passengers on board) provided for each type of service. As with the vehicle hour estimate, this method of using live miles to apportion total miles assumes that dead miles (miles driven without passengers on board) are in proportion to live miles for all categories of vehicle use.
**Miscellaneous Paratransit Data Items**

In addition to the six driver log-based data elements described above and the three financial data elements considered in the next chapter, the proposed performance evaluation framework requires four data elements derived from other system records. Definitions and tabulations for these measures (paid driver hours, avoidable accidents, service-related complaints, and senior citizen service area population) are presented below.

**Paid Driver Hours**

**Definition:** The time for which compensation is paid to drivers to operate vehicles in paratransit service. For operations using commissioned drivers (e.g., taxi operators), paid driver hours may equal live hours. Paid driver hours will usually exceed vehicle hours due to pretrip inspection time, paid meal breaks, vacations, and so forth, which result in drivers being paid for time when service is not available.

**Method of Tabulation:** Paid driver hour data may be obtained from one of two sources. If drivers only provide paratransit service, or if it is easy to segregate driver hours paid for paratransit service, payroll records will provide an accurate source for this data element. However, if drivers provide paratransit service along with other services, and it is not possible to easily document the number of hours spent providing each type of service, then a method of estimating paid driver hours based on live time will be required. Again, as recommended in the section describing the tabulation of vehicle hours, when several services are provided by the same driver, the best way to allocate paid driver hours is to assign them to each service based on the proportion of live hours devoted to that service.

As defined for this evaluation, paid driver hours are those for which the vehicle operator is compensated. If all operators are paid drivers, then this measure will truly reflect the productivity of the paratransit service. However, if volunteer drivers are used, as is the case for many specialized providers, special care must be taken in calculating the performance measures that use the paid driver statistic. Perhaps the simplest way to accommodate volunteer drivers is to modify the definition of "paid driver hours" to include the volunteer time. Doing so will allow valid calculations of one-way trips per hour and live time to paid driver hours. Alternatively, the trips provided by the volunteers and the live time involved in providing these trips should be excluded from the totals for these measures. If the live time and passenger trips provided by volunteers are not excluded, and total trips and live time are divided by only the paid driver hours, the actual amount of time required to provide the transportation will be understated, thus distorting the values of the performance indicators.

**Avoidable Accidents**

**Definition:** All passenger or collision-type accidents involving revenue vehicles, whether in service or on system property, that, as determined by the system manager, police, and other investigators, resulted from infractions of either motor vehicle law or system policy by the transportation system's operator.

**Method of Tabulation:** The number of avoidable accidents can be tabulated by simply
keeping a count of all such occurrences. The most difficult aspect of this performance measure is not its tabulation. Often the determination of whether an accident was avoidable will be difficult. Such a determination is often important not because the number will be used in a performance indicator, but rather, because employee discipline or other action may be involved. If the police report does not assign fault, or if other circumstances do not present easy identification of the cause of the accident, it may be necessary to seek third-party interpretation of the results.

Because paratransit systems may define "avoidable" in different ways, care must be taken when making cross-system comparisons of this indicator. Once peer systems are selected for this measure, the system manager should be contacted regarding this definition to ensure that comparable data are evaluated.

**Service-Related Complaints**

**Definition:** The number of concerns expressed by riders and nonriders above adverse operating practices and/or equipment. Service-related complaints are distinguished from policy-related complaints in that policy complaints (such as inadequate service hours or service area, or too high a fare) are related to actions taken by funding agencies or policy boards and are not directly within the control of the system manager. Ideally, a paratransit system should track both types of complaints; however, the quality of service can best be monitored by the more narrowly defined service-related complaint measure.

**Method of Tabulation:** Again, as for the case of the accident data, the key to obtaining service-related complaint data is to clearly define the meaning of the measure and then set up a system to log and count the number of complaints. A paratransit system should maintain a written record of all telephone, driver-relayed, and written complaints that not only records the complaint, but also indicates the follow-up action taken by the system management.

**Senior Citizen Service Area Population**

**Definition:** The number of persons age 65 or older living within the system service area. Senior citizen population is just one of several target population statistics that might be used. If a primary goal of the shared-ride system is to serve low-income residents, a measure such as number of one-way trips by low-income persons per low-income population in the service area could also be calculated.

**Method of Tabulation:** Senior citizen population data can be derived from U.S. Census data since paratransit systems are demand-responsive and usually define their service areas in terms of discrete political subdivisions. Even if the service area boundaries do not follow municipal or county boundaries, census track data can be used to estimate the target population within a service area.

In addition to the 10 data elements described in this section that are derived from the driver logs, other system records, and census data, three very important financial data elements must also be obtained to conduct the proposed performance evaluation. These measures, total operating expense, administrative expense, and total revenue, are discussed elsewhere.
Transit Performance Measurement

This material is adapted from a NTI course "Improving Transit System Performance: Using Information Based Strategies" developed at the University of Wisconsin-Milwaukee 1996-98. This material was written by Jack Reilly then of the Capital District Transportation Authority (Albany, N.Y.), Edward Beimborn or UWM and Robert Schmitt of RTR Associates in Pittsburg.

Performance Evaluation Process

- Establish Goals and Objectives
- Select Functions to Evaluate and Select Indicators
- Collect and Tabulate Data
- Analyze Indicators
- Present Results
- Take Corrective Actions, Monitor Results
Reasons for Monitoring and Evaluating Transit Service

- Control Costs and Ensure Integrity
- Justify Service Changes
- Maintain or Improve Service
- Monitor Subcontractors
- Guide Marketing
- Report to Policy Boards
Financial Indicators

 Expense
 - Total Operating Expense (Cost) / Total Passenger Trips:
 - Total Operating Cost / Vehicle Miles (or Vehicle Hours):
 - Administrative Expenses / Total Expenses:

 Revenue
 - Total Revenue / Total Passenger Trips:
 - Total Fare Revenue / Total Revenue
 - Revenue / Expense (Cost):

 Subsidy
 - Total Subsidy / Total Vehicle Hours:
 - Total Subsidy / Total Passenger Trips:

Non-Financial Indicators

 Ridership
 - Total Passenger Trips / Total Vehicle Hours:
 - Total Passenger Trips / Total vehicle Miles:
 - Elderly Passengers / Total Passengers:
 - Passenger Trips / Population of Service Area

 Service Quality
 - Number of Complaints / Number of Drivers
 - Stops On-Time / Total Stops
 - Vehicle Miles / Road Calls
More Non-Financial Indicators

- **Safety**
  - Vehicle Miles / Vehicle Accidents:
  - Avoidable Accidents per Year:

- **Service Quality**
  - Revenue Miles / Revenue Hours:
  - Vehicle Miles / Year:
  - Vehicle Hours / Year:

Business Performance Measures

- Customer boardings per revenue mile or revenue hour
- Revenue to cost ratio
- Cost per customer transported
- Implications of different measurements
  - Do you manage system to get good scores on measures or to serve customers?
Social Performance Measures

- Proportion of households w/ .25 mile access
- Public support per household
- Proportion of jobs in transit service territory
- Number of transfers necessary to arrive at main destinations
- Peer comparison measures
- Some systems conduct customer satisfaction surveys, say every six months to get feedback from customers

Example: Route Comparisons

CAPITAL DISTRICT TRANSPORTATION AUTHORITY
KEY INDICATOR SUMMARY
Saturday Total Period: May 1997

<table>
<thead>
<tr>
<th>Route</th>
<th>Revenue/ Cost</th>
<th>Passengers/ Hour</th>
<th>Margin/ Passenger</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>West Albany</td>
<td>26</td>
<td>14.2</td>
</tr>
<tr>
<td>4</td>
<td>Pine Hills</td>
<td>20</td>
<td>12.8</td>
</tr>
<tr>
<td>3</td>
<td>Quail Street</td>
<td>37</td>
<td>21.4</td>
</tr>
<tr>
<td>8</td>
<td>Arbor Hill</td>
<td>1.14</td>
<td>10.1</td>
</tr>
<tr>
<td>14</td>
<td>Third Street</td>
<td>28</td>
<td>16.1</td>
</tr>
<tr>
<td>18</td>
<td>Delaware Avenue</td>
<td>19</td>
<td>10.4</td>
</tr>
</tbody>
</table>
Proportion of Population in Service Area

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Total</th>
<th>Peak</th>
<th>Midday</th>
<th>Evening</th>
<th>Saturday</th>
<th>Sunday</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total population</td>
<td>100%</td>
<td>42%</td>
<td>39%</td>
<td>27%</td>
<td>37%</td>
<td>23%</td>
</tr>
<tr>
<td>Total households</td>
<td>100%</td>
<td>44%</td>
<td>42%</td>
<td>29%</td>
<td>39%</td>
<td>24%</td>
</tr>
<tr>
<td>Elderly population</td>
<td>100%</td>
<td>47%</td>
<td>45%</td>
<td>30%</td>
<td>42%</td>
<td>24%</td>
</tr>
<tr>
<td>Employment</td>
<td>100%</td>
<td>62%</td>
<td>62%</td>
<td>50%</td>
<td>60%</td>
<td>46%</td>
</tr>
<tr>
<td>Households (0 cars)</td>
<td>100%</td>
<td>73%</td>
<td>71%</td>
<td>58%</td>
<td>70%</td>
<td>52%</td>
</tr>
<tr>
<td>Households (0.1 car)</td>
<td>100%</td>
<td>57%</td>
<td>55%</td>
<td>41%</td>
<td>53%</td>
<td>35%</td>
</tr>
<tr>
<td>Workers</td>
<td>100%</td>
<td>44%</td>
<td>42%</td>
<td>29%</td>
<td>40%</td>
<td>24%</td>
</tr>
<tr>
<td>Area</td>
<td>100%</td>
<td>5%</td>
<td>4%</td>
<td>2%</td>
<td>3%</td>
<td>2%</td>
</tr>
</tbody>
</table>

Performance of Route 50 - Burnt Hills

**Business Measures**
- Passengers per hour: 8.5
- Cost per passenger: 6.55
- Public support cost (annual): $105,633

**Social Measures**
- Households in service area: 3,191
- Households without autos in service area: 270
- Public support cost per household: $33
- Public support cost per household without auto: $391
## Route Analysis - Route 50 Burnt Hills

<table>
<thead>
<tr>
<th>Key Indicators</th>
<th>CDTA</th>
<th>Route 50 Route</th>
<th>Percent of Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population density (pop/sq.mi.)</td>
<td>4,105</td>
<td>2,116</td>
<td></td>
</tr>
<tr>
<td>Percent of households without autos</td>
<td>13%</td>
<td>2%</td>
<td></td>
</tr>
<tr>
<td>Percent of households with 0-1 auto</td>
<td>43%</td>
<td>12%</td>
<td>-</td>
</tr>
<tr>
<td>Percent of population over age 65</td>
<td>13%</td>
<td>4%</td>
<td>-</td>
</tr>
<tr>
<td>Households without autos per sq. mi.</td>
<td>415</td>
<td>26</td>
<td>-</td>
</tr>
<tr>
<td>Percentage of region's workers living in route service area using transit</td>
<td>6%</td>
<td>0.2%</td>
<td></td>
</tr>
</tbody>
</table>

### Supplemental Indicators

<table>
<thead>
<tr>
<th>Supplemental Indicators</th>
<th>CDTA</th>
<th>Route 50 Route</th>
<th>Percent of Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total population</td>
<td>468,719</td>
<td>8,377</td>
<td>2%</td>
</tr>
<tr>
<td>Total area (sq. mi.)</td>
<td>264</td>
<td>7</td>
<td>3%</td>
</tr>
<tr>
<td>Total population over age 65</td>
<td>68,667</td>
<td>1,333</td>
<td>2%</td>
</tr>
<tr>
<td>Total households without autos</td>
<td>30,310</td>
<td>270</td>
<td>0.9%</td>
</tr>
<tr>
<td>Total workers</td>
<td>187,283</td>
<td>3,190</td>
<td>2%</td>
</tr>
<tr>
<td>Population over age 65 per sq. mi.</td>
<td>575</td>
<td>345</td>
<td>-</td>
</tr>
<tr>
<td>Workers per sq. mi.</td>
<td>1,675</td>
<td>236</td>
<td>-</td>
</tr>
</tbody>
</table>
Implications of Indicators

- Indicators should include issues management can control and recognize factors beyond your control.
- Example: You may have little control over transit speeds and the effects of sprawl.
- Vehicle hours and revenue vehicle hours may give very different results.
- Recognize that speeds and deadhead ratios can be very different between transit systems.
- Combination of paratransit and fixed route transit service into one set of indicators can distort results when doing peer comparisons.

Paratransit Performance Indicators

- Operating Efficiency
  - Operating expense per vehicle hour.
  - Administrative expense as a percentage of total operating expense.
  - The percentage of live hours to total paid driver hours.
- Effectiveness
  - One-way passenger trips per vehicle hour.
  - One-way passenger trips by senior citizens.
More Paratransit Performance Indicators

- **Service Quality**
  - Service-related complaints per 1,000 one-way passenger trips.
  - Percent of all pickups will be made within +/- 15 minutes of the promised time.

- **Financial**
  - expense per one-way passenger trip
  - revenue per one-way passenger trip

- **Safety**
  - avoidable accident per 100,000 vehicle miles.

Acknowledgements

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- The opinions expressed are the product of independent university work and not necessarily those of the sponsoring agencies or of the agencies supplying data for the project.
Use of Performance Data

Outline

- Introduction
- Standards and Norms
  - Peer Group Comparisons
  - Time-series Comparisons
  - Presentation of Results
- Diagnosis of Problems and Corrective Actions
  - Operating Efficiency
  - Effectiveness
  - Service Quality
  - Financial
  - Safety
- Report Preparation

Introduction

Once the financial and operating data have been collected, and the results compiled, the next step in the performance evaluation process is calculation of the values of the performance indicators, and interpretation and reporting of the results. This section describes three ways to interpret the results of the proposed performance evaluation framework: 1) comparison of system results to norms or standards, 2) peer group comparison, and 3) comparison of current period results to previous periods. All three methods may be used for both internal management analysis of performance results and presentation of the performance information to external audiences.

This section also discusses methods that can be used to present the results of a performance evaluation. The method used depends upon the intended use of the evaluation. For example, external reporting of the performance evaluation to a governing board, news media, elected officials, and in some cases, funding agencies, can best be accomplished through a graphical presentation of trends in key indicators. Because people think in images, not words or numbers, the use of graphical presentation can hardly be over-emphasized. Suggested formats for this type of presentation are discussed in this chapter.

Interpretation of Results

Performance indicators alone have little value to either the transit system manager or to external audiences. They must be placed in a context that allows them to be compared in one of three ways: to absolute standards or norms, to the values achieved by similar systems (peers), or to the performance of the same system in previous periods (time-series comparison). All three methods can be used to interpret and

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1 This material is adapted from a NTI course “Improving Transit System Performance: Using Information Based Strategies” developed at the University of Wisconsin-Milwaukee 1996-98. This material was written by Jack Reilly of the Capital District Transportation Authority (Albany, N.Y.), Edward Beimborn or UWM and Robert Schmitt of RTR Associates in Pittsburg.
communicate the results of evaluation efforts; however, each method has limitations that must be understood when interpreting the results of a performance analysis. The strengths and weaknesses of each of the three methods of interpretation listed above are described in the following section.

**Standards or Norms**

The first method of interpreting performance indicators is to compare the results for the particular transit system with industry-wide standards or norms. While such standards would provide objective benchmarks for performance comparisons, few if any such standards exist. For example, no ideal productivity rate measured by the one-way trips per-vehicle-hour statistic exists except as an average of the performance for a group of peers or another industry average. The actual productivity rate varies widely depending on the type of passenger being transported, trip length, and trip purpose.

On the other hand, some benchmarks or standards can be put forth as goals for a system. For example, a system policy board could adopt annual performance goals for the coming year. Performance reports for the year would track actual performance compared to these self-imposed standards. Again, some states such as Pennsylvania require that all urban transit systems adopt a set of performance objectives and then report to the public and the State how the agency's service measures up to the goals. For example, ParaTransit, Inc. had adopted annual goals for a wide range of performance measures. Figure 7-1 shows the system's monthly actual cost per passenger trip compared to the cost goal that was assumed during the budgeting process. The goal varies by month due to known differences in cost attributable to, for example, harsh winter weather that reduces ridership and increases operating costs during the December-through-March period.

Funding agencies may also impose standards upon an operation. For example, the system may be required to cover a certain percentage of expenses from passenger revenue, or as in the case of private for-profit systems, may require that systems break even from fares. In these cases, these requirements pose performance goals that can be used to evaluate a specific system's performance.

In addition to self-imposed or funding agency-imposed goals, another way to compare a system's performance to less specifically defined standards is to compare performance of the system to the range of other systems' performance ratings on a specific measure, without formally comparing systems that are peers. For example, no specific standard exists for the performance indicator percentage of live hours to paid driver hours. However, upon examination of the actual experience of a large group of systems one can see that systems typically achieve a percentage of live time in the range of 33 to 66 percent. Therefore, if a system's proportion of live time is less that 33 percent, one might conclude, unless the system has operating characteristics significantly different from those in the sample, that performance needs to be improved in this area.

This method of comparing a system's performance to gross averages or ranges of values for a number of heterogeneous systems can help interpret performance results if a particular indicator is extremely out of line with other systems. However, it is not precise enough to allow for valid comparisons if the system's performance is within the range of other systems and the performance evaluation is being used to fine tune the system's operation. A comparison of the system's performance with that of more
carefully selected peers is more appropriate and will provide more valid comparative information.

Figure 1. Example of Performance Measure Compared to Budget Goal. Example of performance measure compared to budget goal
Peer Group Comparison

Transit system managers undoubtedly compare their systems’ performance to that of other systems with which they are familiar. This is done either informally through discussions with other managers, or more formally through comparison of statistics published by funding agencies. In Pennsylvania, for example, PennDOT publishes annual statistical reports on all of its programs including urban, rural, intercity bus, and paratransit systems. System managers routinely select performance statistics on other systems within the State that they consider peers of their own systems. Not unexpectedly, these managers most often report to external audiences those comparisons that favorably reflect upon their system and downplay less favorable ones.

This tendency to selectively use peer comparisons is one of several shortcomings to peer comparisons of performance data. Other difficulties with this method include selecting peers that are truly comparable to the system being evaluated, and assuring that all peer systems define, collect and report performance data the same way.

The most difficult aspect of peer comparison is selecting the peer systems. The goal of such an effort is to allow comparison of the performance of systems that are similar in the key attributes that influence overall efficiency and effectiveness of operation. Therefore, in order to select appropriate peers for a given system, one must first understand the environment in which the systems operate, as well as their organizational structure, and then select those systems that are similar. Some of the key attributes that should be considered are:

1. Population of area served
2. Type of area (e.g., urban, rural, suburban)
3. Type of population served (e.g., general public or specialized clientele, ambulatory or nonambulatory ridership)
4. Type of service (e.g., random trips or regular scheduled, subscription trips)
5. Type of organization (e.g., for-profit, non-profit, or public agency)
6. Type of operation (e.g., brokerage, direct provider)
7. Size of operation (e.g., annual one-way trips, size of budget, number of vehicles)

Obviously, few systems will be exactly comparable; therefore, some judgement may be required to identify systems that are sufficiently similar to allow for meaningful comparisons.

To use peer comparison as part of the performance evaluation process, one should identify a sample of from 3 to 10 systems that are comparable. Systems within one’s home State that receive funding from the same agencies are likely to be most similar. In addition, these similarly-funded agencies will often have data that can be used for the comparisons.
Once similar systems have been identified, the other essential element of peer comparison is uniformity of definitions and data collection methods. This uniformity is difficult to assure for other systems unless all of the systems used for the peer comparison report to the same funding agency, or for some other reason are subject to the same reporting requirements. These systems use common definitions for terms and collect and report data that should be comparable between systems. If a system manager intends to routinely compare a given system to a group of peers, the peer systems should be contacted to determine how their data elements are defined and collected to ensure that valid comparisons are made. Unless one can be certain that the performance measures reported by other systems are equivalent to those being calculated, peer comparison should not be relied upon as a primary basis for evaluating a system’s performance.

**Time-Series Comparison**

Peer group comparisons and comparing system performance to predetermined standards provide objective benchmarks for the transit system. However, time-series comparison--whereby a system’s performance is tracked over time and observed for improvement relative to previous periods--represents the most useful comparison both in terms of internal management appraisal, and for external reporting. Furthermore, in many cases, standards or peer data may be unavailable or unreliable so that a system’s own data may be the only source of comparative information. This is especially true for measures such as on-time performance or service complaints per 1000 one-way trips, where each system is likely to have different definitions of terms and methods of data collection.

Because a complete performance evaluation framework should take advantage of all available means of comparison, and because one technique need not be used to the exclusion of others, a combination of peer comparison, standards, and time-series analysis should be used to evaluate the performance of a system. All indicators for the system should be tracked over time. In addition, internally set standards should be used to check performance, and, when appropriate and available, peer data should be considered.

Figures 2 and 3 present examples of time-series reporting of performance data. Figure 2 shows quarterly total and senior citizen ridership for a paratransit system. This is the most basic form of time-series presentation. This graphical presentation indicates, for example, that while overall ridership is growing, senior citizen ridership is declining. If a primary goal of the system is to provide mobility to the elderly population, then steps may be needed to increase ridership for this target population. Alternatively, the data portrayed in figure 2 might indicate that nonelderly riders are increasingly using the system, and because capacity is limited, may be depriving senior citizens of service. Obviously, a knowledge of the system is required to interpret the performance data; however, the time-series graph will help the manager to identify issues that need to be addressed.

Figure 3 shows how ParaTransit, Inc. combines a monthly reporting of one-time performance with a comparison to the system’s standard of 93 percent on-time trips. This type of graph allows the manager and external audiences not only to see variations in a measure over time, but also to compare actual performance to the goals that were previously established.
In summary, the manager of a transit system should use a combination of comparison methods to help interpret and report the results of a performance evaluation. In all cases, time-series analysis can be used to portray a system’s performance over time and to identify positive and negative trends. If the system has established its own performance goals, a highly desirable practice, then the time-series data can be compared to the goals. Also, if funding agencies or other external agencies have established mandatory or suggested performance standards, these benchmarks can be incorporated into the analysis. Finally, if reliable, comparable data from similar peer systems can be obtained, the system’s performance can be compared to that of other systems.

![Time Series Presentation of Ridership Data](image)

**Figure 2.** Example of Time-Series Presentation of Ridership Data. Example of time-series presentation of ridership data. (Hypothetical)
Figure 3. Example of Time-Series Presentation. Example of time-series presentation that includes performance standards.
Presentation of Results

Once the performance indicators are tabulated, and time-series, norm, or peer-group comparisons have been made, the next step in the performance evaluation process is presentation of the results to the intended audience. If the performance evaluation has been prepared solely for internal management use, then the method of presentation is less important than if the results are to be communicated to a policy board, funding agency, or the media. Use of performance indicators for internal management analysis and decision making requires a more complex analysis and presentation of operating and financial data than that which can be effectively presented to external audiences.

Performance reports to external audiences need to be simple yet complete. The ten-indicator list of measures proposed in this guide represents a straightforward report card on a transit system that includes measurements of key aspects of the operation that should be understandable to external audiences. A more lengthy list of indicators, while better describing the details of the operation, will likely overload the reader with information that cannot be accurately interpreted and therefore will be of little value in describing the paratransit operation's efficiency and effectiveness.

For external reporting, a simple graphical presentation format is recommended. Figure 4 presents an excellent example of the type of external reporting that clearly communicates the needed information about key performance indicators. The example is taken from the Queen City Metro General Manager's Report, which is distributed to the board of directors, local elected officials, the media, and other interested parties. This report includes a series of the type of graph and table shown in figure 4. Note that the graph includes time-series data for the fiscal year as compared to the goal for the particular statistic. Monthly and year-to-date data for the current and previous years are included in a table that accompanies the graph. Also included with each table and graph is a definition of the performance measure, and in some cases, the source of the data used to calculate the indicator.

Additional examples of presentation formats are included in a case study example of a performance evaluation. The reader should feel free to design reporting formats that best respond to the needs of the audience. However, the two key attributes of an effective presentation that should be maintained are: the list of indicators, which should be kept at 10 or fewer measures that can easily be understood; and a graphical presentation of the results that is simple but includes key time-series information as well as any standards, norms, or peer comparisons that will help with the interpretation of the data.
Paratransit Trips Per 1,000 Passenger Trips

<table>
<thead>
<tr>
<th></th>
<th>Jan</th>
<th>Feb</th>
<th>Mar</th>
<th>Apr</th>
<th>May</th>
<th>Jun</th>
<th>Jul</th>
<th>Aug</th>
<th>Sep</th>
<th>Oct</th>
<th>Nov</th>
<th>Dec</th>
</tr>
</thead>
<tbody>
<tr>
<td>1997 Actual</td>
<td>0.44</td>
<td>0.22</td>
<td>2.09</td>
<td>1.87</td>
<td>0.64</td>
<td>0.70</td>
<td>0.54</td>
<td>1.40</td>
<td>0.80</td>
<td>1.20</td>
<td>1.20</td>
<td>0.95</td>
</tr>
<tr>
<td>1997 Goal</td>
<td>1.20</td>
<td>1.20</td>
<td>1.20</td>
<td>1.20</td>
<td>1.20</td>
<td>1.20</td>
<td>1.20</td>
<td>1.20</td>
<td>1.20</td>
<td>1.20</td>
<td>1.20</td>
<td>1.20</td>
</tr>
<tr>
<td>1996 Actual</td>
<td>1.70</td>
<td>0.90</td>
<td>0.35</td>
<td>1.40</td>
<td>1.45</td>
<td>0.75</td>
<td>0.66</td>
<td>0.69</td>
<td>1.30</td>
<td>0.90</td>
<td>0.85</td>
<td>0.87</td>
</tr>
</tbody>
</table>

Definition: The number of service delivery and/or equipment complaints per 1,000 one-way passenger trips per month.

Figure 4. Example of Graphical Presentation of Performance Results with Definitions and Back-up Data.
Diagnosis of Problems and Corrective Actions.

This section focuses on the use of indicators by the system manager to diagnose system problems and make changes in the operation to improve performance. The performance indicators recommended in this guide represent the starting point in a more detailed analysis of the system's operation. This analysis usually involves examining additional, secondary indicators in order to diagnose fully the cause of problems first identified by one of the primary indicators. The remainder of this section describes how each of these primary indicators can be used along with appropriate secondary indicators to identify problems within the transit system. Possible corrective actions are also presented for each indicator. Additional examples of how these indicators can be used to manage a transit or paratransit system are included in a case study example.
# Problems and Corresponding Actions

<table>
<thead>
<tr>
<th>Problem</th>
<th>Indicators</th>
<th>Possible Actions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Financial</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A. High Total Operating Cost</td>
<td><strong>Primary Indicators</strong></td>
<td>Decrease expenses</td>
</tr>
<tr>
<td></td>
<td>Exp/veh.-mi.</td>
<td>Reroute service</td>
</tr>
<tr>
<td></td>
<td>Exp/veh.-hour</td>
<td>Expand ridership</td>
</tr>
<tr>
<td></td>
<td>Exp/passenger</td>
<td>Decrease deadhead</td>
</tr>
<tr>
<td></td>
<td><strong>Secondary Indicators</strong></td>
<td>Modify fares</td>
</tr>
<tr>
<td></td>
<td>Exp/rev-hour</td>
<td>Eliminate marginal routes</td>
</tr>
<tr>
<td></td>
<td>Admin. exp/exp</td>
<td>Part time help</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Renegotiate labor contract</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Shorten phase-in for new employees</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Cooperative purchasing and maintenance</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Insurance pooled risk</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Private contractors</td>
</tr>
<tr>
<td>B. Poor Cost Effectiveness</td>
<td><strong>Primary Indicators</strong></td>
<td>Increase speed</td>
</tr>
<tr>
<td></td>
<td>Rev/rev-hour</td>
<td>Increase service</td>
</tr>
<tr>
<td></td>
<td>Rev/passenger</td>
<td>Stop unproductive routes</td>
</tr>
<tr>
<td></td>
<td><strong>Secondary Indicators</strong></td>
<td>Decrease headways</td>
</tr>
<tr>
<td></td>
<td>Pass rev/rev-mi.</td>
<td>Increase stop locations</td>
</tr>
<tr>
<td></td>
<td>Pass rev/rev-hour</td>
<td>Increase fares</td>
</tr>
<tr>
<td></td>
<td>Pass rev/passenger</td>
<td>Reduce administrative cost</td>
</tr>
<tr>
<td></td>
<td>Pass rev/exp</td>
<td>Increase fare paying passengers</td>
</tr>
<tr>
<td></td>
<td>Fares/rev</td>
<td>Increase contract service</td>
</tr>
<tr>
<td></td>
<td>Pass rev/rev</td>
<td>Increase ancillary services</td>
</tr>
<tr>
<td>C. Limited Subsidy Revenue</td>
<td><strong>Primary Indicators</strong></td>
<td>Reduce administration</td>
</tr>
<tr>
<td></td>
<td>Rev/exp</td>
<td>Reduce staff</td>
</tr>
<tr>
<td></td>
<td>Subsidy/veh.-mi.</td>
<td>Streamline procedures</td>
</tr>
<tr>
<td></td>
<td>Subsidy/veh.-hour</td>
<td>Reduce service</td>
</tr>
<tr>
<td></td>
<td>Subsidy/pass</td>
<td>Reroute and reschedule</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Improve promotions</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Increase fares</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Modify fare structure</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Increase contract service</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Improve fleet reliability</td>
</tr>
</tbody>
</table>
2. Quality of Service

A. Poor Service Quality

**PRIMARY INDICATORS**
- % stops on time
- Complaints/driver

**SECONDARY INDICATORS**
- Stops with signs/stops
- Veh.-mi./road call

**Solutions**
- Monitor drivers
- Change stop dwell time
- Reroute congested areas
- Speed up fare collection
- Increase stop spacing
- Improve on-time performance
- Improve vehicle reliability
- Improve employee training
- Improve bus cleanliness
- Improve preventative maintenance
- Rehabilitate and replace vehicles
- Improve passenger amenities

B. Schedule Adherence Problem

**PRIMARY INDICATORS**
- % of trips late

**Solutions**
- Holding strategy
- Increase run time and/or layover
- Modify route

C. Unacceptable Crowding

**PRIMARY INDICATORS**
- Load factor

**Solutions**
- Increase frequency
- Articulated buses

3. Efficiency

A. Poor Productivity

**PRIMARY INDICATORS**
- Rev/cost
- Load factor
- Pass/veh.-hour

**Solutions**
- Decrease frequency
- Split route
- Short turn strategies
- Local/express/zonal strategies
- Partial deadheading

B. Poor Vehicle Utilization

**PRIMARY INDICATORS**
- Rev/cost
- Pass/veh.-hour

**Solutions**
- Eliminate route segments
- Eliminate trips
- Extend route
- Modify schedule
4. Ridership
   A. Low Ridership

<table>
<thead>
<tr>
<th>PRIMARY INDICATORS</th>
<th>SECONDARY INDICATORS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pass/veh.-mi.</td>
<td>Improve cleanliness, safety, and reliability</td>
</tr>
<tr>
<td>Pass/veh.-hour</td>
<td>Modify fare structure</td>
</tr>
<tr>
<td></td>
<td>Fare incentives</td>
</tr>
<tr>
<td>SECONDARY INDICATORS</td>
<td>Alter routes and schedules</td>
</tr>
<tr>
<td>Fare pass/pass</td>
<td>Increase vehicle speed</td>
</tr>
<tr>
<td>Elderly pass/pass</td>
<td>Improve marketing</td>
</tr>
<tr>
<td>% change pass/year</td>
<td>Decrease deadhead</td>
</tr>
<tr>
<td></td>
<td>Increase number of fare passengers</td>
</tr>
</tbody>
</table>
## DATA REQUIRED FOR PRIMARY AND SECONDARY INDICATORS

<table>
<thead>
<tr>
<th>Performance Concern</th>
<th>Data Needed for Primary Indicators</th>
<th>Data Needed for Secondary Indicators</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1. Financial</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A. Expense</td>
<td>Passengers</td>
<td>Administrative expense</td>
</tr>
<tr>
<td></td>
<td>Total expense</td>
<td>Total expense</td>
</tr>
<tr>
<td></td>
<td>Vehicle-hour</td>
<td>Vehicle-hour</td>
</tr>
<tr>
<td></td>
<td>Vehicle-mile</td>
<td></td>
</tr>
<tr>
<td>B. Revenue</td>
<td>Passengers</td>
<td>Expense</td>
</tr>
<tr>
<td></td>
<td>Revenue-hour</td>
<td>Fares</td>
</tr>
<tr>
<td></td>
<td>Revenue-mile</td>
<td>Passengers</td>
</tr>
<tr>
<td></td>
<td>Total revenue</td>
<td>Passenger revenue</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Revenue-hour</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Revenue-mile</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Total revenue</td>
</tr>
<tr>
<td>C. Subsidy</td>
<td>Passengers</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Subsidy</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total expense</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total revenue</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Vehicle-hour</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Vehicle-mile</td>
<td></td>
</tr>
<tr>
<td><strong>2. Quality of Service</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A. System Quality</td>
<td>Complaints</td>
<td>Road calls</td>
</tr>
<tr>
<td></td>
<td>Drivers</td>
<td>Stops</td>
</tr>
<tr>
<td></td>
<td>Stops</td>
<td>Stops with signs</td>
</tr>
<tr>
<td></td>
<td>Stops on time</td>
<td>Vehicle-mile</td>
</tr>
<tr>
<td>B. Schedule</td>
<td>Trips late</td>
<td></td>
</tr>
<tr>
<td>Adherence</td>
<td>Trips</td>
<td></td>
</tr>
<tr>
<td>C. Crowding</td>
<td>Load factor</td>
<td></td>
</tr>
</tbody>
</table>
3. Efficiency
   A. Productivity
      Cost
      Load
      Passengers
      Total revenue
      Vehicle-hours
   B. Vehicle Usage
      Cost
      Passengers
      Total revenue
      Vehicle-hours

4. Ridership
   A. Low Ridership
      Passengers
      Vehicle-hour
      Vehicle-mile
      Elderly passengers
      Fare passengers
      Passengers
      Prior year's number of passengers
      Year's number of passengers
Operating Efficiency Indicators

The following three operating efficiency indicators measure the amount of resources required to provide transit or paratransit service.

1. Operating expense per vehicle hour.
2. Administrative expense as a percentage of total expense
3. Live hours as a percentage of paid driver hours.

The most important indicator in this group, operating expense per vehicle hour, measures how efficiently or economically the system provides service. The other two indicators can be used to identify causes if the expense per hour figure is too high. In addition, the live hours/paid driver hours indicator can be regularly tracked to measure the efficiency of dispatching and labor utilization.

The operator’s objective should be to minimize the operating expense per hour. At the time of this report, paratransit systems typically reported operating expense-per-hour rates between $16.00 and $30.00. The wide variation is due to differences in labor rates, vehicle maintenance costs, and other factors which vary depending upon the environment in which the system operates. Generally, urban systems experience higher hourly costs than those in suburban and rural areas because of higher labor rates, higher maintenance costs, and higher rents.

Possible causes of higher-than-desired hourly operating expenses include:

- High rates for inputs such as labor and maintenance
- High administrative expenses relative to the amount of service provided
- High percentage of paid driver hours versus vehicle hours
- Old, high-cost fleet that requires excessive maintenance expenses.

Labor rates paid for drivers are largely determined by the environment in which the system operates so that, to a great extent, this factor is out of the control of the manager. However, an effective manager should continuously seek ways to keep total labor wages and benefits at the lowest level consistent with attracting qualified drivers. Part-time drivers and volunteer drivers often can be used to reduce labor expenses.

Maintenance expenses are also a major, controllable cost for transit systems. Obviously, an old fleet with worn-out vehicles will result in extremely high maintenance expenditures and therefore increase the overall cost of operation. If high maintenance costs for old vehicles are expected to be a cause of the high overall operating cost, performance measures such as maintenance expense per vehicle mile can be calculated and compared with those of similar systems. Such information can then be used by the manager, the policy board, and funding agencies to support the case for capital funding of new vehicles.

Another cause of high maintenance expenses may be an ineffective preventive maintenance program, or a poorly run maintenance program that results in premature failure of repairs or a high frequency of breakdowns. The service quality indicators related to complaints and on-time performance may provide support for this diagnosis. Also, more detailed analysis of the causes of breakdowns and unscheduled
maintenance may provide insight into the validity of this cause of high maintenance expense.

High overall operating expenses may be due to the level of administrative expenditures relative to the size of the operation. Small publicly-owned systems often suffer from an administrative structure that is too large for the number of rides provided. Spreading of administrative expenses is always a problem for a small operation since basic management, accounting, personnel, and other functions must be provided no matter how small the system. However, public agencies often employ administrative and support staff beyond that needed for efficient operation.

One way to evaluate this potential cause of high cost is to examine the ratio of administrative expense to total operating expense. As indicated earlier, administrative expense must be carefully defined, especially when the statistic is to be compared across systems. As used in this guide, administrative expenses do not include passenger reservation and dispatching expenses, a cost commonly included in the administrative category. Assuming the narrower definition of administrative expenses, paratransit systems typically devote 8 to 15 percent of their expenses to administration. Values in excess of 15 or 20 percent suggest that the system should either increase ridership to support the administrative structure that has been established, or it should reduce administrative staffing and expenses to the scale appropriate for the size of the operation.

Finally, the third efficiency indicator, live hours as a percentage of paid driver hours, can be used to evaluate how efficiently the greatest single expense, the driver, is used. The live hours statistic represents the amount of time the driver spends actually transporting passengers. The difference between live time and total paid driver hours represents dead time spent traveling between trips, and time spent "on the clock" but not in service. While some dead time is unavoidable, too much dead time may indicate ineffective dispatching and trip scheduling. It may also indicate that rider demand is insufficient to support the number of drivers in service.

While paratransit systems are usually not burdened with labor work rules that mandate full shifts or payment for non-revenue time, these systems often suffer from driver staffing levels that do not match demand. This situation is particularly common when county or municipal employees of a paratransit system are paid for a 37.5 or 40-hour workweek even though the demand characteristics of the service result in significant off-peak periods with little demand.

The Pennsylvania systems that reported data on the percentage of live hours to paid driver hours most often reported that drivers spent between 33 and 66 percent of their paid time actually transporting passengers. A more detailed examination of cases where live time represented less than a third of total driver time indicated that too many drivers were employed for the level of demand, and that part-time drivers should have been used in some cases (where, for example, demand occurred within two narrow time periods and therefore could not justify full-time drivers).
Effectiveness Indicators

The first three indicators described above measure how efficiently a transit system could produce its service. They reveal nothing about how well the service is used. However, the following two performance measures do indicate how effectively the service is provided, relative to the cost of providing it and the extent to which it serves the target population it was designed to serve. These measures are:

1. One-way passenger trips per vehicle hour
2. Senior citizen one-way passenger trips per senior citizen resident in the service area.

The first measure, one-way passenger trips per vehicle hour, is perhaps the most important single indicator that can be tracked for a transit system. It indicates how successful the system is in providing its product and how well the supply and demand for service are matched to each other.

A review of the Pennsylvania system statistics, as well as reports on other systems around the United States indicates that paratransit systems typically average from 2 to 6 one-way trips per hour if they provide a significant amount of random trips, or as many as 10 one-way trips per hour if a large portion of their demand is accounted for by group trips such as to senior centers. The number of rides a system can provide per vehicle hour depends on a number of factors, including:

- Average trip length. The average trip length in rural areas is likely to be much greater than that in urban areas; therefore, fewer passengers per hour can be served.

- Population density and the concentration of rides. Because more riders can be picked up and delivered in a given time period in a more densely populated area, more rides can be provided per hour. On the other hand, in very densely populated areas, traffic congestion may reduce productivity.

- Type of service provided. High ridership per hour (10 one-way trips or more) can be achieved if the system provides regularly scheduled route service to senior centers, sheltered workshops, and other locations where full vehicle loads can efficiently be assembled. On the other hand, systems that provide medical transportation for non-ambulatory passengers may achieve ridership productivity rates of 1 or 2 one-way trips per vehicle hour.

- Dispatching efficiency. The number of rides per hour can be influenced by the efficiency of the dispatchers in grouping rides and organizing vehicle tours.

- Driver scheduling. As indicated above, overall productivity, as measured by one-way trips per vehicle hour, can be greatly influenced by the match between demand and driver shifts. If a driver is scheduled for 8 hours of work and produces 8 vehicle hours, but demand is effectively satisfied with trips during only 3 hours, then overall productivity will be greatly reduced.

The first three factors listed above, while generally beyond the control of the paratransit system manager, are environmental control variables that should be considered when
selecting peer systems for comparison. The other two factors, dispatching and driver scheduling, are within the control of the manager, and are the primary factors that should be examined if the one-way trips per vehicle hour statistic is too low.

Unfortunately, the most effective approach for increasing productivity as measured by this indicator is to decrease the number of drivers or change some full-time driver slots to part-time ones. Neither of these actions is a popular one. A more positive approach, and one that should be tried before reducing service, is to encourage increased ridership during off-peak periods when greater passenger traffic could be served. In either case, the manager's objective should be to more closely balance demand with the service supplied. This can best be accomplished by looking at each component of the service (e.g., each vehicle or service sector). The case study in chapter 7 presents this type of detailed analysis that helps the manager to determine if the entire system performs poorly, or as is more often the case, poor productivity in one or two service sectors is dragging down overall performance.

The second effectiveness indicator listed above, one-way senior citizen trips per senior citizen resident, indicates how well the service responds to the needs of the community being served. While the indicator used in this guide compares senior citizen usage to total senior citizen population, other population groups such as low-income or disabled persons could be targeted, depending upon the objectives of the system. Because calculation of this measure relies on U.S. Census data, the indicator should use census data that is readily available.

Again, using the Pennsylvania experience, the systems in the State provided about 4 annual one-way trips per senior citizen resident. The value of this indicator varies significantly from community to community due to factors such as the amount of service provided, the availability of other public and specialized transportation services in the community, the quality of the service, and the fare charged for the service. A free, high-quality service that is readily available to residents will be used much more intensively than a high-fare, low-quality system that, because of equipment availability or policy decision, limits trips.

The system manager can use this indicator to determine whether the target population is being served, and whether additional marketing efforts or other actions are likely to result in increased ridership. If, for example, the value of the indicator for the system being evaluated is 7 one-way trips per capita, major growth in ridership would not seem likely. Therefore, efforts to increase productivity as measured by one-way trips per vehicle hour should focus on the denominator rather than the numerator, and service hours should be cut.

Service Quality

Most often, the system manager focuses upon financial and productivity indicators, since operating within budget and providing as many rides as possible are the primary goals of specialized as well as general public transit systems. However, a balanced performance review should include one or more indicators of the quality of the service provided. Two quality-of-service measures are included in the proposed evaluation guide:

6. Service-related complaints per 1,000 one-way passenger trips
7. On-time pick-ups as a percentage of total pickups
The two measures are interrelated because late pick ups are likely to become service-related complaints; however, complaints also result from other factors. The most effective way to identify the cause of complaints and ultimately to reduce them is to document each one and develop a reporting system that summarizes them. Adequate documentation will allow the manager to determine if a particular driver, vehicle, rider, or portion of the service area is responsible for an inordinate number of the complaints. Building a written case by using complaint information will also allow the manager to discipline, or ultimately dismiss an employee who is the cause of the complaint.

The on-time performance indicator can be used to monitor the quality of service that is delivered, and then, by taking appropriate action, improve the service so that complaints can be avoided. Because the on-time performance data is obtained from driver logs and therefore can be tabulated by driver, vehicle, or service area, the manager can determine the factors leading to poor service quality. Perhaps a particular vehicle is off schedule because of frequent breakdowns, or a driver is always late because of poor work habits, or lack of knowledge of the service area. If none of these factors is at fault, perhaps the dispatchers need to revise their scheduling to allow for more time between trips or schedule fewer trips per hour. This latter factor is often the cause of late trips because trips are scheduled too closely, so that when a rider is late for a pickup or if other disruptions delay the schedule, many trips will be thrown off schedule. The manager needs to closely monitor the dispatching function so that the proper trade-off between operating efficiency (trips per hour) and on-time performance can be achieved.

Financial Indicators

Every transit or paratransit system manager must be concerned about the financial performance of the system, whether as a private for-profit taxi operator that seeks a profit or as a government or nonprofit agency that seeks to balance the budget through passenger revenues and grants. Two key indicators that track the financial viability of the system are:

8. Operating expense per one-way passenger trip
9. Passenger revenue per one-way passenger trip

Both indicators should be calculated for the system as a whole and for sub-services. The cost allocation method described in chapter 4 can be used to estimate the cost of providing particular sub-services. The revenue earned by each sub-service can best be calculated using the methods described in section 5.

Although each measure should be tracked independently, the most likely use of these indicators will be in comparison to each other. If the goal of the system is to cover all expenses from fares, then the operating expense and passenger revenue per passenger should be equal. If the system is subsidized so that the policy goal is to recover 50 percent of the cost from passenger fares, then the average revenue per passenger should equal at least half the expense per passenger.

Considered independently, the expense per one-way passenger trip figure can be used to evaluate whether other service options are less expensive and therefore should be considered. For example, if a trip costs $5.50 to provide, but an exclusive taxi ride for
the same distance would cost $4.50, then the paratransit manager should consider contracting with the taxi for the trip.

If the expense per one-way trip is too high when compared to previous time periods, or to peer systems, the manager needs to examine the factors discussed above for the indicators expense per vehicle-hour and one-way passenger trips per hour. If revenue per passenger is too low, then steps need to be taken to raise fares.

Safety

The final indicator on the proposed 10-measure list tracks the paratransit system’s accident record. Safety performance is measured by the following indicator:

10. Avoidable accidents per 100,000 vehicle miles

Unlike most of the other indicators that can be measured for a short time interval and for sub-services of the system, avoidable accidents per 100,000 vehicle miles should only be reported for the overall system. The primary reason for this is that most paratransit systems would experience only a few accidents system-wide for an entire year, so that a single accident would cause a wide variation in the statistic on a month-to-month basis or between small sub-services.

The most likely cause of a high level of avoidable accidents is driver error. Careful selection of drivers and continuous driver training are the two actions that will result in a reduction in this indicator. The manager should also review accident patterns to determine if particular locations are hazardous and result in a high proportion of accidents, or if design flaws in vehicles make them more accident prone due to such factors as blind spots, excessive overhangs, etc.

The list of causes and solutions for poor performance as reflected by the proposed indicators is meant to be representative and not exhaustive. Additional examples of how the performance measures can be used to diagnose
Use of Transit Performance Data

This material is adapted from a NTI course “Improving Transit System Performance: Using Information Based Strategies” developed at the University of Wisconsin-Milwaukee 1996-98. This material was written by Jack Reilly then of the Capital District Transportation Authority (Albany, N.Y.), Edward Beimborn or UWM and Robert Schmitt of RTR Associates in Pittsburgh.

- Standards and Norms
- Peer Group Comparison
- Time-Series Comparison
Standards and Norms

- Benchmarks as Goals
- Funding Agency Imposed Standards
- Comparison to Other Systems

Example of Performance Measure Compared to Budget Goal

- Actual
- Budget
Peer Group Comparison

- Selection of Peers
  - population served
  - area served
  - population characteristics
  - type of service
  - type of organization
  - type of operation
  - size of operation

Time-Series Comparison

- Most Effective for Internal Management Appraisal
- Portray System Trends
Time Series Presentation of Ridership Data

Percent of Trips On-Time
Revenue miles per vehicle

Source: Broward County 2005-2009 plan

Figure 5-14
BCT’s Revenue Miles/Vehicle
Miles/Vehicle (000’s)

Figure 5-15
Peer Revenue

Operating expense

Source: Broward County 2005-2009 plan

Figure 5-42
BCT’s Operating Expense per Rev. Mile
per Rev. Mile

Figure 5-43
Peer Operating Expense

Graphs showing revenue miles and operating expense for various cities and metropolitan areas.
Presentation of Results

- Once the performance indicators are tabulated, and comparisons have been made, the next step in the process is presentation of the results to the intended audience.
- If the evaluation has been prepared solely for internal use, then the method of presentation is less important than if the results are to be communicated to a policy board, funding agency, or the media.
- Performance reports to external audiences need to be simple yet complete. A graphical presentation is recommended.

Complaints Per 1,000 Trips

![Graph showing complaints per 1,000 trips with actual and goal data for each month of 1997.]
Diagnosis of Problems and Corrective Actions

- See detailed charts that relate problems to indicators to possible actions
- Problem -> Indicator -> Action
- Categories
  - Financial: high operating cost, poor cost effectiveness, limited subsidy
  - Quality of Service: poor service quality, schedule adherence, crowding
  - Efficiency: poor productivity, vehicle utilization
  - Ridership
  - Safety

Example: high operating cost

- Problem: High Total Operating cost
- Primary Indicators
  - Expense/vehicle mile
  - Expense/vehicle hour
  - Expense/passenger
- Secondary Indicators
  - Expense/revenue hour
  - Administrative expense/expense
- Possible Actions:
  - Decrease expenses
  - Reroute service
  - Expand ridership
  - Decrease deadhead
  - Modify fares
  - Eliminate marginal routes
  - Part time help
  - Renegotiate labor contract
  - Shorten phase-in for new employees
  - Cooperative purchasing and maintenance
  - Insurance pooled risk
  - Private contractors
Acknowledgements

- Some of this material was developed as part of work being conducted by the Great Cities University consortium under the lead of the University of Alabama at Birmingham using funds provided by the Federal Transit Administration of the U.S. Department of Transportation.

- The opinions expressed are the product of independent university work and not necessarily those of the sponsoring agencies or of the agencies supplying data for the project.
Transit and Geographic Information Systems – Case Studies

L. Parve, MS CE/UP/GIS Student Researcher and
E. Beimborn, PHD, University of Wisconsin-Milwaukee

Example: Belle Urban System

- Base Map (Vector and raster data)
- Base Map (Census data including population-households, income, employment-workers per HH, auto ownership, etc.)
- Layers
  - Bus routes,
  - Stops, and
  - Time schedules
  - Census information
  - Land use
  - Trip generators

Operatons 81
Belle Urban System-Racine, WI
Bus Route 86

GIS Spatial Analysis
- Overlaying-Layers, Intersects & Unions
- Extracting-Queries, Attribute Selects & Clips
- Proximity-Buffers & Multiple Buffers
- Patterns/Hot Spots/Choropleth Mapping
- Clusters/Outliers
- Linear Referencing
- Networks
- Areas/Events
- Geodistributions/Statistics
Air buffers vs. walk buffers

- Normal buffers give the direct airline distance from a point and do not take into account the street pattern and actual walking paths.
- Air buffers can substantially overestimate the service area of a route, especially if the access paths are complex and indirect.
- Typical maximum walk distance to a transit stop is ¼ mile or 1300 feet.
- The following examples show the differences in Tallahassee, Florida using TLOS software.
Air buffers

Walk buffers
More examples

- The following were used in the Northwest Minneapolis transit restructuring plan.
- Sources:

---

Route 5 weekday boardings
Service frequency

Bus stop density (stops per mile)
Ridership, population and employment density

Households in poverty
Resources and References

- Internet Sites
  - [http://www.autodesk.com](http://www.autodesk.com)
  - [http://www.caliper.com](http://www.caliper.com)
  - [http://www.e-transit.org](http://www.e-transit.org)
  - [http://www.esri.com](http://www.esri.com)
  - [http://grass.itc.it](http://grass.itc.it)
  - [http://www.intergraph.com](http://www.intergraph.com)
  - [http://www.mapinfo.com](http://www.mapinfo.com)

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Resources and References

- Guidebooks and Manuals
Resources and References

- Books and Papers

Acknowledgements

- Special thanks to the faculty and staff at the Center for Urban Transportation Studies and Civil Engineering, Urban Planning, and GIS Departments at UW-Milwaukee.
- Some of this work was developed as part of work being conducted by the Great Cities University consortium under the lead of the University of Alabama at Birmingham using funds provided by the Federal Transit Administration of the U.S. Department of Transportation.
- The ideas and opinions expressed are the product of independent academic work and not necessarily those of the sponsoring agencies or of the agencies supplying data for the project.
Transit Planning Examples

Five year plan:

It is important that transit agencies develop and update a regular plan for a transit system change. Ideally this is in the form of a five year plan which outlines actions to be taken in the following year and also sets goals for subsequent years. Such a plan should be updated annually and should be a topic of major discussion with the governing board of the transit agency. It also can be used as input to the regional Transportation Improvement Program (TIP) of the Metropolitan Planning Agency.

In general, a five year plan for a transit agency contains the following major elements:

- Community profile
- Description of existing services and resources
- Related plans programs and policies
- Transit system Goals and Objectives
- Performance evaluation of current system
- Alternatives for future change
- Five year program of projects

Some of these sections do not change very much over time, while others may. Performance evaluation of the system is an important component in that it provides clues on how to modify the system in the future.

The following pages provide examples of transit planning projects from the state of Florida. Florida requires that transit agencies annually prepare transit plans that describes the current system and its performance and describes what they intend to do for the next five years.

The examples are from the Fort Lauderdale area (Broward County), the Orlando region (Lynx transit) and Lee County (Ft. Myers). These are excerpts from the plans which show how performance indicators are used to develop the plan. In most cases you can get the latest version of the full plan from the internet;

Some web sites are:
- Broward County: http://www.broward.org/transportationplanning/tpi02601.pdf
- Lee County: http://www.rideleetran.com/tdppdf.htm

Most of these give good examples of how GIS can be used for transit planning. For example, the Lee county plan, chapter 1 has extensive maps that show trends and characteristics of census tracts as they relate to the potential for transit use.

This section also has an example of goals for a smaller rural transit service
# Broward County Transit Development Plan FY 2005–FY 2009

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Appendix C Previous Surveys
Appendix D Focus Groups
Appendix E Bus Stop Inventory
Appendix F Summary Table of Operational Improvements
Statement of Broward County Goals and Objectives

“… the following goals and objectives have been specifically developed for this Broward County Transit Development Plan. These are intended to be used for discussion in the planning process for the TDP.

“Goal 1: Increase ridership within existing transit service areas through cost-effective transit improvements
Objectives:
• Increase bus headways on routes that currently exhibit strong ridership demand.
• Realign bus service routes to provide line haul service on major transportation corridors.
• Install ITS and other passenger infrastructure at bus stops (i.e., hardstands, shelter, lighting, seating, bus schedules, route connectivity maps etc.).
• Maintain schedule adherence through operational improvements along arterials that are planned for transit improvements.

“Goal 2: Enhance local and regional transit connectivity
Objectives:
• Develop major transfer stations where major transit corridors intersect
• Integrate transit routes and mode connections with corresponding service schedules to facilitate efficient passenger transfer transition.
• Encourage adoption of County and local ordinances that support Transit Oriented Development and pedestrian and bicycle enhancements.
• Improve the interconnection of the local transit system with the regional network of transit services i.e., South Florida Regional Transportation Authority (SFRTA/Tri-Rail), Miami-Dade Transit (MDT), and Palm Tran.

“Goal 3: Implement transit capital improvements that support the County’s GMP Land Use and Development Goals
Objectives
• Implement transportation improvements in a manner coordinated with orderly development within the County.
• Provide a transportation system that is coordinated and consistent with agency plans of Broward County, its communities and neighbors
• Support collaborative land use and transportation planning efforts that ensure the community can develop in an efficient and sustainable way.

“Goal 4: Develop cost effective transit alternatives
Objectives
• Implement smaller scale transit projects during the TDP timeframe that will be needed to support large, capital intensive improvement projects in later years.
• Implement an evolutionary process within corridors programmed for BRT development by gradually building up service.

“Goal 5: Increase funding opportunities for Broward County Transit services
Objectives
• Seek to move flex funds from highway projects to transit projects in accordance with the funding plans of the 2025 LRTP.
• Identify and pursue opportunities of joint development with private sector.
• Determine favorability of various options for increasing local funds for transit, including
  options for a sales tax to finance transportation improvements similar to initiatives
  proven successful in Miami-Dade and in other areas of the country.
• Support efforts of the RTA to develop local funds for transit purposes."

**Broward County Performance Measures**

**General Operational Measures**
- Service Area Population
- Passenger Trips (Boardings)
- Operating Expense
- Revenue Miles
- Route Miles

**Vehicles**
- Vehicle Available in Maximum Service Local Contribution
- Vehicle Operated in Maximum Service Directly-Generated Non-Fare Revenue
- Revenue Miles per Vehicle in Maximum Service Passenger Revenue
- Average Age (yrs.) of Fleet

**Employee (Full Time) Efficiency**
- Total Employees
- Revenue Hours per Employee
- Passenger Trips per Employee

**Service**
- Vehicle Miles per Capita Average Fare
- Passenger Trips per Capita
- Passenger Trips per Revenue Mile
- Passenger Trips per Revenue Hour

**Financial Measures**
- Maintenance Expense
- Vehicle Local Revenue

**Local Revenue**
- Local Contribution
- Directly-Generated Non-Fare Revenue
- Passenger Revenue

**Farebox Recovery Efficiency**
- Operating Expense per Capita
- Operating Expense per Passenger Trip
- Operating Expense per Revenue Mile
- Operating Expense per Revenue Hour
Examples of Broward County Peer Group comparisons

Figure 5-14
BCT’s Revenue Miles/Vehicle
Miles/Vehicle (000’s)

Figure 5-15
Peer Revenue

Figure 5-42
BCT’s Operating Expense per Rev. Mile
per Rev. Mile

Figure 5-43
Peer Operating Expense

Figure 5-46
BCT’s Farebox Recovery

Figure 5-47
Peer Farebox Recovery
<table>
<thead>
<tr>
<th>Objective</th>
</tr>
</thead>
<tbody>
<tr>
<td>Broward County shall continue to implement strategies to facilitate local traffic to use alternatives to the Florida Intrastate Highway System (FIHS) as a means of protecting its interregional and intrastate functions</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Policy (Measurable Target)</th>
<th>Baseline Condition-1998 Adoption</th>
<th>Current Condition-1999</th>
<th>Policy Achieved</th>
</tr>
</thead>
<tbody>
<tr>
<td>→70% peak-hour LOSS</td>
<td>Ongoing</td>
<td>Ongoing</td>
<td>YES</td>
</tr>
<tr>
<td>→Work with the Broward County Planning Council and affected municipalities to identify a FDOT public transportation corridor and to amend the Broward County Land Use Plan as appropriate.</td>
<td>Ongoing</td>
<td>Ongoing</td>
<td>YES</td>
</tr>
<tr>
<td>→Investigate the potential of programming public transit route headways and span of service, and the provision of information kiosks along County roads that are parallel to FIHS roads.</td>
<td>Ongoing</td>
<td>Ongoing</td>
<td>YES</td>
</tr>
<tr>
<td>→Enhance regular route service to Tri-Rail stations.</td>
<td>Ongoing</td>
<td>Ongoing</td>
<td>YES</td>
</tr>
<tr>
<td>→Expand transit service alternatives jointly developed by the County and affected municipalities in areas which otherwise would not qualify under set standards.</td>
<td>Ongoing</td>
<td>Ongoing</td>
<td>YES</td>
</tr>
<tr>
<td>→Provide public education through marketing strategies about public transit desirability and availability.</td>
<td>Ongoing</td>
<td>Ongoing</td>
<td>YES</td>
</tr>
<tr>
<td>→Promote transit oriented design along County roads that are parallel to FIHS roads.</td>
<td>Ongoing</td>
<td>Ongoing</td>
<td>YES</td>
</tr>
<tr>
<td>Objective</td>
<td>Policy (Measurable Target)</td>
<td>Baseline Condition-1999 Adoption</td>
<td>Current Condition-1999</td>
</tr>
<tr>
<td>-----------</td>
<td>---------------------------</td>
<td>----------------------------------</td>
<td>------------------------</td>
</tr>
<tr>
<td>Broward County Mass Transit Division shall improve the efficiency of public transit services by increasing operating revenue from 29.87 percent in 1997 to 35 percent by 2002 per operating expense.</td>
<td>➔ Annual review of public transit routes or route segments for cost effectiveness.</td>
<td>Ongoing</td>
<td>Ongoing</td>
</tr>
<tr>
<td></td>
<td>➔ Coordinate new transit routes and changes with established development and land use plans to serve existing and future generators.</td>
<td>Ongoing</td>
<td>Ongoing</td>
</tr>
<tr>
<td></td>
<td>➔ Annual evaluation of bus routes or route segments which provide large numbers of work trips for an increase in service frequency during base hours.</td>
<td>Ongoing</td>
<td>Ongoing</td>
</tr>
<tr>
<td></td>
<td>➔ Provide passenger amenities at transfer locations which generate no less than 25 passenger activities per day.</td>
<td>Ongoing</td>
<td>Ongoing</td>
</tr>
<tr>
<td></td>
<td>➔ Ensure full utilization of advertising potential on buses, benches, and shelters in order to generate system revenues and reduce costs associated with providing fixed amenities.</td>
<td>Ongoing</td>
<td>Ongoing</td>
</tr>
<tr>
<td></td>
<td>➔ Provide mechanisms for private participation in the funding of mass transit.</td>
<td>Ongoing</td>
<td>Ongoing</td>
</tr>
<tr>
<td></td>
<td>➔ Monitor the effectiveness of the Congestion Management System and the permit monitoring system.</td>
<td>Ongoing</td>
<td>Ongoing</td>
</tr>
<tr>
<td></td>
<td>➔ Future trafficways be conveyed to the public by dedication or grant of easement which is necessary for the ultimate construction of roadways, intersections, turn lanes, bicycle facilities, sidewalks, bus pullout bays, bus shelters, or roadway drainage facilities.</td>
<td>Ongoing</td>
<td>Ongoing</td>
</tr>
<tr>
<td>Broward County shall continue to identify transit corridors in future rights-of-way.</td>
<td></td>
<td></td>
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</tbody>
</table>
### TABLE 12
ROUTE RIDERSHIP AND PERFORMANCE MEASURES
Broward County Transit System
FY 1998

<table>
<thead>
<tr>
<th>Route</th>
<th>Passengers</th>
<th>Revenue Miles</th>
<th>Revenue Hours</th>
<th>Pass./ Mile</th>
<th>Pass./ Hour</th>
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<tbody>
<tr>
<td>1</td>
<td>1,637,404</td>
<td>409,979</td>
<td>33,081</td>
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<td>2</td>
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<td>546,765</td>
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<tr>
<td>3</td>
<td>483,029</td>
<td>177,614</td>
<td>12,201</td>
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<td>5</td>
<td>426,826</td>
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<td>6</td>
<td>501,891</td>
<td>236,705</td>
<td>19,616</td>
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<td>7</td>
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<td>10</td>
<td>993,202</td>
<td>398,020</td>
<td>31,015</td>
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<td>11</td>
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<td>12</td>
<td>334,003</td>
<td>205,958</td>
<td>12,856</td>
<td>1.62</td>
<td>25.98</td>
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<tr>
<td>14</td>
<td>985,134</td>
<td>377,115</td>
<td>26,729</td>
<td>2.61</td>
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<td>17</td>
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<td>109,624</td>
<td>9,091</td>
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<td>15.08</td>
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<td>18</td>
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<td>772,909</td>
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<td>191,618</td>
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<td>16.35</td>
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<td>19,648</td>
<td>2,125</td>
<td>1.79</td>
<td>16.53</td>
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</tbody>
</table>

**TOTAL** 24,182,108 9,583,967 696,379 2.52 34.73

Source: Broward County Mass Transit Division, 1999.
Performance Indicators and Transit Propensity

A transit propensity analysis was prepared for the transit needs study and current needs assessment for the FY 2000 - FY 2004 TOP to understand existing transit demand. This analysis was used to identify areas that may be candidates for service adjustment. The analysis is based on 1990 U.S. Census data at the census tract level and 1990 Florida Standard Urban Transportation Modeling Structure (FSUTMS) data for the Transportation Analysis Zone (TAZ) level. The data was plotted in a GIS information base. The data used are: population density, density of employment, density of persons over age 64, density of households below poverty level, population and employment density, and density of households without a vehicle (See Appendix E). These factors are related to the propensity of the Census Tract population to be, or to become, transit riders.

The transit potential variables are depicted in the map: very high, high and medium, and low. This information is presented with the transit service area in MAP 9. The results of this portion of the needs study concluded that, relative to existing demand, the current structure (fixed-route and community bus service) of the transit system provides excellent coverage. It was also recognized that increased levels of service may be warranted in some areas.
From 2005-2009 plan

**Figure S-1**
Transit Propensity

**Legend**
- **BCT Route**: BCT Route
- **Transit Propensity**:
  - High
  - Medium
  - Low

[Map showing transit propensity with different color regions]
<table>
<thead>
<tr>
<th>Chapter Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>CHAPTER 1 – INTRODUCTION</strong></td>
<td>1</td>
</tr>
<tr>
<td>TDP Purpose and Background</td>
<td>1</td>
</tr>
<tr>
<td>The LYNX Story</td>
<td>1</td>
</tr>
<tr>
<td>LYNX History</td>
<td>2</td>
</tr>
<tr>
<td>The End of the Cat Nap</td>
<td>5</td>
</tr>
<tr>
<td>What Is &quot;LYNX-like&quot;?</td>
<td>6</td>
</tr>
<tr>
<td>Organizational Goals and Objectives</td>
<td>7</td>
</tr>
<tr>
<td>Visions for the New Millennium</td>
<td>16</td>
</tr>
<tr>
<td>How to Read this TDP</td>
<td>17</td>
</tr>
<tr>
<td><strong>CHAPTER 2 - OUR COMMUNITY</strong></td>
<td>19</td>
</tr>
<tr>
<td>Introduction</td>
<td>19</td>
</tr>
<tr>
<td>Central Florida Defined</td>
<td>20</td>
</tr>
<tr>
<td>Employment Growth</td>
<td>21</td>
</tr>
<tr>
<td>The Balancing Act</td>
<td>23</td>
</tr>
<tr>
<td><strong>CHAPTER 3 - TRANSPORTATION AND LAND USE DESIGN</strong></td>
<td>25</td>
</tr>
<tr>
<td>Community Building Through Transportation Planning</td>
<td>25</td>
</tr>
<tr>
<td>Transit Oriented Developments</td>
<td>26</td>
</tr>
<tr>
<td>Other Suggested Guidelines for Urban and Transit Design</td>
<td>27</td>
</tr>
<tr>
<td>Location of Land Uses</td>
<td>27</td>
</tr>
<tr>
<td>Site Planning and Design Standards</td>
<td>28</td>
</tr>
<tr>
<td>Transit Facility Design</td>
<td>29</td>
</tr>
<tr>
<td>Parking Design and Management</td>
<td>31</td>
</tr>
<tr>
<td>Toward Sustainable Development</td>
<td>31</td>
</tr>
<tr>
<td><strong>CHAPTER 4 - COORDINATION WITH RELATED PLAN PROGRAMS, AND POLICIES</strong></td>
<td>35</td>
</tr>
<tr>
<td>Introduction</td>
<td>35</td>
</tr>
<tr>
<td>Coordination Efforts for Achieving LYNX’s Goals</td>
<td>35</td>
</tr>
<tr>
<td>Transit Friendly Land Development Patterns</td>
<td>36</td>
</tr>
<tr>
<td>Sufficient Financing to Operate and Maintain the Necessary Transit System</td>
<td>36</td>
</tr>
<tr>
<td>Integration of Transportation Plans and Special Studies to Achieve the Shared Vision</td>
<td>37</td>
</tr>
</tbody>
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Transit system Goals:

One of the most important steps in transit planning and management is to develop a good set of goals and associated indicators. These can be used to direct all elements of the transit system and to provide a common basis for management and the board to proceed. The following are from Fort Meyer (Lee County) Florida. The performance indicators associated with the goals are also given.

Example of Transit Goals

LEE COUNTY TRANSIT DEVELOPMENT PLAN, 1995-1999

Table 30
Proposed LeeTran Goals

<table>
<thead>
<tr>
<th>Goal 1</th>
<th>Ensure Availability of Transit Service to Lee County Residents and Visitors</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Provide transit service that meets demand and needs.</td>
</tr>
<tr>
<td></td>
<td>Identify the appropriate service area for LeeTran.</td>
</tr>
<tr>
<td></td>
<td>Increase span of service, as appropriate.</td>
</tr>
<tr>
<td></td>
<td>Increase frequency of service on busiest routes.</td>
</tr>
<tr>
<td></td>
<td>Comply with all requirements of the Americans with Disabilities Act (ADA).</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Goal 2</th>
<th>Provide Quality Passenger Amenities to Enhance Bus Service and Attract Discretionary Riders</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Provide bus shelters and/or benches at highly used bus stops and transfer locations.</td>
</tr>
<tr>
<td></td>
<td>Coordinate with local governments for the construction of accessible sidewalks in proximity to bus stops.</td>
</tr>
<tr>
<td></td>
<td>Develop a multimodal transfer center in the downtown area coordinated with other transportation modes.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Goal 3</th>
<th>Intensify Marketing Efforts and Increase Visibility of LeeTran</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Increase the availability of information regarding routes and schedules.</td>
</tr>
<tr>
<td></td>
<td>Include information kiosks at bus shelter locations.</td>
</tr>
<tr>
<td></td>
<td>Institute a community outreach/education program for residents and visitors.</td>
</tr>
<tr>
<td></td>
<td>Develop and implement a marketing program geared towards downtown workers.</td>
</tr>
<tr>
<td></td>
<td>Provide the system transit map in the Yellow Pages directory.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Goal 4</th>
<th>Promote System Efficiency</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Monitor overall system performance through trend and peer analyses.</td>
</tr>
<tr>
<td></td>
<td>Develop and apply measures to monitor individual route performance. Coordinate with local transportation agencies for the early inclusion of transit amenities in the planning process.</td>
</tr>
<tr>
<td></td>
<td>Integrate transit needs into the land use planning and development process.</td>
</tr>
<tr>
<td></td>
<td>Coordinate transit service with other transportation providers.</td>
</tr>
</tbody>
</table>

| Goal 5 | Investigate Innovative Approaches to the Provision of Efficient Transit Service |
• Explore the use of smaller vehicles.
• Consider the possibility of route deviation in appropriate areas.
• Investigate the implementation of a Guaranteed Ride Home Program. Coordinate with the local transportation planning agencies for inclusion of dedicated bus lanes in transportation projects.
• Investigate private funding/operating opportunities.

<table>
<thead>
<tr>
<th>Goal 6</th>
<th>Secure Adequate Funding for the Transit System</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Secure a long-term, dedicated funding source for the transit system.</td>
<td></td>
</tr>
<tr>
<td>• Seek FDOT Service Development funds to implement innovative service techniques on a trial basis.</td>
<td></td>
</tr>
<tr>
<td>• Leverage local matching funds to the maximum extent possible.</td>
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</table>
###CHAPTER THREE, PERFORMANCE EVALUATION

####Table 31
Selected Performance Review Indicators and Measures
Fixed-Route Transit Services

<table>
<thead>
<tr>
<th>Performance Indicators</th>
<th>Effectiveness Measures</th>
<th>Efficiency Measures</th>
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<tr>
<td>Service Area Population</td>
<td><strong>Service Supply</strong></td>
<td><strong>Cost Efficiency</strong></td>
</tr>
<tr>
<td>Service Area Size (square miles)</td>
<td>Vehicle Miles Per Capita</td>
<td>Operating Exp. Per Capita</td>
</tr>
<tr>
<td>Passenger Trips</td>
<td><strong>Service Consumption</strong></td>
<td>Operating Exp. Per Passenger Trip</td>
</tr>
<tr>
<td>Revenue Miles</td>
<td>Passenger Trips Per Capita</td>
<td>Operating Exp. Per Revenue Mile</td>
</tr>
<tr>
<td>Total Operating Expense</td>
<td><strong>Quality of Service</strong></td>
<td></td>
</tr>
<tr>
<td>Total Operating Expense (1984 $)</td>
<td>Average Age of Fleet (in years)</td>
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</tr>
<tr>
<td>Total Maintenance Expense</td>
<td></td>
<td><strong>Operating Ratios</strong></td>
</tr>
<tr>
<td>Operating Revenue</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Employees</td>
<td></td>
<td><strong>Labor Productivity</strong></td>
</tr>
<tr>
<td>Vehicles Available in Max. Service</td>
<td></td>
<td>Revenue Hours Per Employee</td>
</tr>
<tr>
<td>Vehicles Operated in Max. Service</td>
<td></td>
<td>Passenger Trips Per Employee</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Fare</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Average Fare</td>
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</table>
Table 47
Performance Measures Applied to LeeTran Goals

<table>
<thead>
<tr>
<th>Goals</th>
<th>Applicable Performance Measures</th>
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</thead>
<tbody>
<tr>
<td>Goal 1</td>
<td>Ensure Availability of Transit Service to Lee County Residents and Visitors</td>
</tr>
<tr>
<td></td>
<td>Service Supply</td>
</tr>
<tr>
<td></td>
<td>Vehicle Miles Per Capita</td>
</tr>
<tr>
<td></td>
<td>Fare</td>
</tr>
<tr>
<td></td>
<td>Full Cash Fare</td>
</tr>
<tr>
<td></td>
<td>Average Fare</td>
</tr>
<tr>
<td>Goal 2</td>
<td>Provide Quality Passenger Amenities to Enhance Bus Service and Attract Discretionary Riders</td>
</tr>
<tr>
<td></td>
<td>Quality of Service</td>
</tr>
<tr>
<td></td>
<td>Average Age of Fleet</td>
</tr>
<tr>
<td>Goal 3</td>
<td>Intensify Marketing Efforts and Increase Visibility of LeeTran</td>
</tr>
<tr>
<td></td>
<td>No applicable performance measures in Section 15 database. Specific actions are addressed in the recommendations as system enhancements.</td>
</tr>
<tr>
<td>Goal 4</td>
<td>Promote System Efficiency</td>
</tr>
<tr>
<td></td>
<td>Service Consumption</td>
</tr>
<tr>
<td></td>
<td>Passenger Trips Per Capita</td>
</tr>
<tr>
<td></td>
<td>Passenger Trips Per Revenue Mile</td>
</tr>
<tr>
<td></td>
<td>Cost Efficiency</td>
</tr>
<tr>
<td></td>
<td>Operating Expense Per Capita</td>
</tr>
<tr>
<td></td>
<td>Operating Expense Per Passenger Trip</td>
</tr>
<tr>
<td></td>
<td>Operating Expense Per Revenue Mile</td>
</tr>
<tr>
<td></td>
<td>Operating Ratios</td>
</tr>
<tr>
<td></td>
<td>Farebox Recovery</td>
</tr>
<tr>
<td></td>
<td>Labor Productivity</td>
</tr>
<tr>
<td></td>
<td>Revenue Hours Per Employee</td>
</tr>
<tr>
<td></td>
<td>Passenger Trips Per Employee</td>
</tr>
<tr>
<td>Goal 5</td>
<td>Investigate Innovative Approaches to the Provision of Efficient Transit Service</td>
</tr>
<tr>
<td></td>
<td>No applicable performance measures in Section 15 database.</td>
</tr>
<tr>
<td>Goal 6</td>
<td>Secure Adequate Funding for the Transit System</td>
</tr>
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<td>No applicable performance measures in Section 15 database. Specific actions are addressed in the recommendations as system enhancements.</td>
</tr>
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</table>
### Table 48
Status of Goal 1: Ensure Availability of Transit Service to Lee County Residents and Visitors

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
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</thead>
<tbody>
<tr>
<td><strong>Service Supply</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vehicle Miles Per Capita</td>
<td>39%</td>
<td>5%</td>
<td>-35%</td>
</tr>
<tr>
<td><strong>Fare</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average Fare</td>
<td>-11%</td>
<td>-12%</td>
<td>-17%</td>
</tr>
</tbody>
</table>

### Table 49
Status of Goal 2: Provide Quality Passenger Amenities to Enhance Bus Service and Attract Discretionary Riders

<table>
<thead>
<tr>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td><strong>Quality of Service</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average Age of Fleet</td>
<td>9%</td>
<td>16%</td>
<td>-16%</td>
</tr>
</tbody>
</table>

### Table 50
Status of Goal 4: Promote System Efficiency

<table>
<thead>
<tr>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td><strong>Service Consumption</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Passenger Trips per Capita</td>
<td>35%</td>
<td>14%</td>
<td>-62%</td>
</tr>
<tr>
<td>Passenger Trips per Revenue Mile</td>
<td>-2%</td>
<td>10%</td>
<td>-32%</td>
</tr>
<tr>
<td><strong>Cost Efficiency</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Operating Expense Per Capita</td>
<td>19%</td>
<td>-5%</td>
<td>-56%</td>
</tr>
<tr>
<td>Operating Expense per Passenger Trip</td>
<td>-12%</td>
<td>-17%</td>
<td>-18%</td>
</tr>
<tr>
<td>Operating Expense Per Revenue Mile</td>
<td>-13%</td>
<td>-8%</td>
<td>-27%</td>
</tr>
<tr>
<td><strong>Operating Ratios</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Farebox Recovery</td>
<td>1%</td>
<td>6%</td>
<td>-18%</td>
</tr>
<tr>
<td><strong>Labor Productivity</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Revenue Hours Per Employee</td>
<td>-14%</td>
<td>-9%</td>
<td>17%</td>
</tr>
<tr>
<td>Passenger Trips Per Employee</td>
<td>32%</td>
<td>14%</td>
<td>-6%</td>
</tr>
</tbody>
</table>
SMALL TRANSIT AGENCY
SAMPLE TRANSPORTATION SYSTEM GOALS AND OBJECTIVES
(applicable to quantitative performance evaluation)

Financial

- Recover at least 40 percent of public service operating expense from farebox revenue.
- Recover at least 60 percent of all system operating costs from farebox, contract service revenues and advertising fees.
- Maintain local tax base financial support at a maximum of 20 percent of the system's total operating expense.
- Contain system operating expense to a maximum increase of 10 percent per year.
- Increase the ratio of passenger revenue to total operating expense by at least 3 percent per year.
- Keep changes in the passenger fare system equivalent to increases in the area’s consumer price index.
- Administrative expenses for the system should not exceed 20 percent of the system’s total operating expenses.
- The operating cost per vehicle mile and per vehicle hour should not exceed the average cost for other similar-size systems in Pennsylvania.
- Total subsidy per passenger should not increase by more than 8 percent per year.

Ridership

- The total number of passengers carried each year should exceed the number for the previous year even if the size of the system does not increase. If system cutbacks occur, ridership for retained service segments should still increase each year.
- A minimum of 30 percent and a maximum of 60 percent of the total annual passengers should be persons 60 years or older.
- At least 50 percent of all passengers should be fare-paying passengers.

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The entire system should maintain a minimum of five (5.0) passengers per vehicle hour.

- Expand special routes for non-peak service to major shopping locations.
- All fixed route services should maintain a minimum of one (1.0) passenger per vehicle mile.
- Maintain headways at a schedule that will minimize recurring overloads.

**Service Quality**

- At least 90 percent of all stops should be on time (0 minutes early to 5 minutes late).
- There should be no more than three complaints per individual driver per year.
- All bus stops should have clearly marked bus stop signs and no-parking signs.
- There should be a minimum of 8,000 miles between road calls per individual vehicle.
- Match all routes with vehicles of adequate size, design and accessibility features, depending upon route demand and characteristics.
- All buses in daily service should be thoroughly cleaned at least once a week on the exterior and daily on the interior.

**Level of Service**

- Urban area fixed route service should maintain an average speed of between 12 and 15 miles per hour (ratio of revenue miles to revenue hours).
- Rural area demand responsive service should maintain an average speed of at least 25 miles per hour and intra-urban area demand responsive service an average of 15 miles per hour (ratio of revenue miles to revenue hours).
- The system's vehicle hours per year should not be increased by more than 10 percent over the amount for the previous year.

**Safety**

- The entire system should have no more than one avoidable revenue vehicle accident per two years.
- The entire system should have no more than two non-vehicle accidents per year.
- The system should average no less than 18,000 vehicle miles per revenue vehicle accident for 12 months.
Public Relations and Support

- Attempt to change the perceived importance of the automobile as the major transportation mode.

- Stimulate interest, acceptance and understanding of public transportation by taking a progressive and interactive role in the community.

- Inform the public of the environmental and economic benefits of public transportation.

- Periodically present system goals, plans and accomplishments to local elected officials.

- Increase political support for the system by increasing management's and board members' involvement with political and governmental groups.

- Assist local businesses in developing and providing for public transportation access to shopping and employment centers.

- Design and implement a rider information system (on and off routes) and a targeted promotion plan.

- Maintain constant surveillance of existing and potential route structures for optimum social, financial and operating benefits.

Passenger Amenities

- Improve bus stop shelters and benches.

- Install passenger information displays at key locations.

Personnel

- Build a positive community, service and organization spirit and attitude.

- Ensure continuous communications among operations, supervisory, management and administrative personnel.

- Implement driver and management training policies and programs.

- Ensure that all personnel present an attractive appearance and a professional and courteous attitude to the general public.

- The number of annual sick days per employee should not exceed the average for the past three years.
Management

- Provide regular financial and operating performance statistics and reviews to the governing board.

- Maintain a dedicated and competent staff that presents a positive image and attitude to the general public.

- Increase the level of public support for the system.

- Maintain and update system policies and development plan.

- Secure the system’s position as the lead and central coordinating entity for all transportation needs in the service area.

- The ratio of administrative staff to total staff should not exceed 20 percent.