CHAPTER SIX
ROUTE DIAGNOSTICS

This chapter will present an analysis of various diagnostic testing methods utilized during the study process and an analysis of transfer patterns on the Citilink system. The diagnostic data has been summarized to present an analysis of four basic diagnostic indicators. Through this analysis each route in the Citilink system is viewed as an individual operating entity for comparison to all other routes in the system. These four indicators are:

- Farebox Recovery – This indicator measures the amount of overall individual route cost that is covered by patron fares. This contributory measure presents each route based on ridership as compared to service level.
- Total Passengers per Revenue Hour – This analysis tool balances route level ridership with the amount of service for each individual route in the system. This productivity measure allows comparison of routes based on balanced performance measures.
- Total Passengers per Revenue Mile – This indicator is a productivity rating that measures the number of passengers being carried per mile of the route.
- Net Cost per Passenger – This indicator compares routes based on the net operating cost and ridership levels that each route is able to maintain. Net cost refers to costs after passenger fares have been taken into account. Overall cost is placed on a per passenger basis to present the effectiveness of each system route.

The first portion of this chapter will present each of these indicators for the system as a comparison and diagnostic tool. Each route is compared individually to the average for that indicator. For three indicators: farebox recovery, passengers per hour, and passengers per mile, routes can be viewed as operating in four categories:

-over 100% of system average
-between 80 and 100% of system average
-between 60 and 80% of system average, and
-below 60% of system average.

Routes that perform above 100% of average are less likely to require major overhaul of routing to improve performance. Routes ranking between 80 and 100% of average are considered to perform well and will also generally be viewed as well-planned routes which will not have a priority placed on them for re-design. Routes falling in the lower two categories (60 to 80% and below 60% of average) will be candidates for investigation during the initial route planning efforts. This additional investigation does not necessarily mean that the routes will be recommended for elimination or modification, but that they will have to be reviewed closely and route structure and purpose will have to be justified. These categories are reversed for net cost per passenger, as the best performing routes are below the system average. In this instance, lower financial amounts are desired. Routes 21 and 22, although they are deviated fixed routes, are compared to the overall system average and can be expected to perform poorly on this basis. These specialized services will need to be addressed from the viewpoint of service standards to recognize that traditional fixed routes and mobility-enhancing services such as deviated service will perform differently.

It must be noted that this information is purely an analysis tool and data should not be utilized for reporting purposes for the Citilink system. Route level hours and miles were taken directly from data supplied by Citilink. Hourly costs were developed through National Transit Database data and reports supplied by Citilink. Passenger revenues were based on a per passenger fare that was applied to daily ridership. Daily ridership data was taken as an average of ridership from three days in October 2003. Based on this variety of sources, a one-day "snapshot" of route level diagnostics was developed. This information provides the study team with a tool for comparison of routes in order to assist in the prioritization of route modification needs. As such, statistics can vary slightly from overall system reporting data, based on ridership fluctuations and additional miles and hours provided during the year, making this data unreliable for overall reporting.

6.1 Net Cost per Passenger

Net cost per passenger analyzes each fixed route individually based on its ridership level compared to net cost (cost minus revenue). This measure allows a level comparison based on passenger levels in light of the actual cost of service provided. The average net cost per passenger for the Citilink system was $4.37 for the day tested. The lowest net cost per passenger was $1.69 (Route 3) and the highest was $11.73 (Route 21). Table 6-24 presents the data for net costs per passenger for Citilink.

Table 6-24: Net Cost per Passenger

ROUTE	Net Cost per Passenger	Percent of System Average
Below 60% of System Average		
3	$1.69	39%
7	$1.84	42%
2	$1.89	43%
4	$2.41	55%
8	$2.44	56%
6	$2.53	58%
1	$2.56	59%
10	$2.58	59%
Between 60% & 80% of System Average		
Between 80% & 100% of System Average		
Above 100% of System Average		
9	$5.09	116%
5	$7.84	179%
22	$9.79	224%
21	$11.73	268%
Average	*$4.37*	*100%*

The majority of routes perform well in this category. Route 3 is the best performing route, followed by Routes 7, 2, 4, 8, 6, 1, & 10. These routes all perform in the category below 60% of average, which is favorable. All other routes are above 100% of system average for this category. Routes 9 and 5 are the poorest performing fixed routes, which indicates that these routes will have to be reviewed to identify potential changes that may strengthen the route. These will be discussed in the route and service design recommendation chapters. Routes 21 and 22, which operate as deviated fixed routes, are expected to perform at lower performance levels than are the radial fixed routes, and as such, they fall at the bottom of this grouping.

6.2 Farebox Recovery

Farebox recovery measures the revenue to cost ratio for each route in the system. The data utilized to develop and analysis of farebox recovery was developed through various information sources. Daily hours were taken from Citilink operating statistics and multiplied by an hourly rate developed through National Transit Database data. Farebox revenue was based on a per passenger fare that was applied to daily ridership on each route. Therefore, this data has been utilized for analysis of Citilink routes and services for this study and should not be utilized as a representative set of data for on-going analysis. Table 6-25 presents farebox recovery for Citilink.

The average farebox recovery ratio was 15%, with a high of 24% and a minimum of 4%. The lowest farebox recovery rates were found on the two deviated service routes and the crosstown route. If these routes are analyzed separately, as is recommended in Chapter 5, the other routes would have a much higher average and be a better representation of Citilink farebox recovery on radial fixed routes.

Route 3 had the highest farebox recovery (159% of system average) ratio for the day sampled, followed by Route 7 (149% of system average). Other routes performing above 100% of the 10% system average were Routes 2, 4, 7, 6, 1, and 10. If service frequency increases are considered as part of service design in later chapters, these routes will be the most likely to provide high return for the agency and will need to be considered for this change. Route 9 performed between 60% and 80% of system average, while Routes 5, 21, and 22 performed below 60% of system average.

Table 6-25: Farebox Recovery

ROUTE	Farebox Recovery	Percent of System Average
Above 100% of System Average		
3	24%	159%
7	22%	149%
2	22%	146%
4	18%	120%
8	18%	119%
6	17%	115%
1	17%	114%
10	17%	113%
Between 80% & 100% of System Average		
Between 60% & 80% of System Average		
9	9%	63%
Below 60% of System Average		
5	6%	42%
22	5%	34%
21	4%	29%
Average	*15%*	*100%*

6.3 Passengers per Revenue Hour

This indicator provides an analysis of ridership levels compared to the level of service provided, based on route level revenue hours. Passengers per hour measures the productivity of each route based on the level of service assigned to each fixed route to gauge the effectiveness of those hours. The Citilink system, for the day surveyed, had a high of 24.72 passengers per revenue hour and a low of 4.48 passengers per hour, with an average of 15.59.

Route 3 was once again the highest performing route, operating at 159% of fixed route system average, followed by Route 7 which operated at 148% of system average. Route 2, 4, 8, 6, 1 and 10 all performed above 100% of system average for this indicator. This accounts for the majority of the routes in the system and is an encouraging factor for the system in that a large share of routes are exceeding the average.

Routes 9 and 5 are not performing as well in this category as other routes, and will need to be considered in this light as the service design phase begins. Similar to other indicators, the crosstown and deviated fixed routes are the poorest performing routes in terms of passengers per revenue hours.

Table 6-26: Passengers per Revenue Hour

ROUTE	Passengers per Revenue Hour	Percent of System Average
Above 100% of System Average		
3	24.72	159%
7	23.14	148%
2	22.67	145%
4	18.65	120%
8	18.45	118%
6	17.93	115%
1	17.75	114%
10	17.62	113%
Between 80% & 100% of System Average		
Between 60% & 80% of System Average		
9	9.77	63%
Below 60% of System Average		
5	6.56	42%
22	5.32	34%
21	4.48	29%
Average	*15.59*	*100%*

6.4 Passenger per Revenue Mile

The total passengers per platform mile indicator analyzes ridership level on a particular route compared to the level of service provided based on daily revenue miles. Passengers per mile measures the productivity of each route based on the level of service assigned to each route and allows Citilink to evaluate the effectiveness of the miles operated. The systemwide average for this indicator is 1.01 passengers per mile. The highest passenger per mile rating is 1.73 on Route 3 and the lowest is 0.37 on Route 22, a deviated fixed route.

Route 8 was the second highest route for this indicator with a passenger per mile rating of 166% of system average. This is excellent for this route that is one of the few routes that operates on 30-minute headways and represents a core route for the system. Routes 6, 2, 4, 1, and 7 also operate well in this category, all ranking above 100% of system average. Routes 10 operates between 80% and 100% of system average while Route 9 operates between 60% and 80% of system average. The remainder of routes operate below 60% of system average and will need to be examined as part of issue development and service design. This will be particularly important for Route 9, which is a radial fixed route that operates poorly.

Table 6-27: Passengers per Revenue Mile

ROUTE	Passengers per Revenue Mile	Percent of System Average
Above 100% of System Average		
3	1.73	171%
8	1.68	166%
6	1.42	141%
2	1.34	133%
4	1.10	109%
1	1.09	108%
7	1.07	106%
Between 80% & 100% of System Average		
10	0.84	83%
Between 60% & 80% of System Average		
9	0.61	60%
Below 60% of System Average		
5	0.42	42%
21	0.38	38%
22	0.37	37%
Average	*1.01*	*100%*

6.5 Ordinal Ranking

This section provides an ordinal ranking of the fixed routes in the Citilink network. Each indicator – farebox recovery, passengers per hour, passengers per mile, and cost per passenger - is given equal weight and the routes are ranked. The scores are then tallied and presented as a final ranking. This ranking provides a guide to overall route performance based on these indicators. This guide will be utilized as a starting point for investigating the system. It must be noted that a low-scoring route will not automatically be modified or recommended for elimination because of a low score. Many factors contribute to overall route performance. Conversely, high scoring routes may still be recommended for modification as part of an overall re-structuring. This information is presented in Table 6-28.

Route 3 is the best performing route for each service indicator, and as such, it ranks the highest in the ordinal ranking. This route will need to be considered for service frequency increases based on these figures. Routes 2 and 7 are the next highest performing routes, and will also need consideration of their role in the system and how they can be used to improve overall service in the area. Routes 4 and 8 also operate well in terms of an ordinal ranking.

The lowest performing radial fixed routes are Routes 6, 1, 10, and 9, which will need to be analyzed for route function, operating deficiencies, improvement modifications, and route

destinations. These functional changes may provide an opportunity for the improvement on these routes and create better system integration. The deviated and crosstown routes which perform poorly when compared to an overall system average will need to be analyzed to ensure that they are performing the function for which they are intended.

Table 6-28: Ordinal Ranking

Ordinal Ranking					
ROUTE	**Net Cost per Passenger**	**Farebox Recovery**	**Passengers per Revenue Hour**	**Passengers per Revenue Mile**	**Ordinal Ranking**
3	1	1	1	1	**1**
2	3	3	3	4	**2 (tie)**
7	2	2	2	7	**2 (tie)**
4	4	4	4	5	**3 (tie)**
8	5	5	5	2	**3 (tie)**
6	6	6	6	3	**4**
1	7	7	7	6	**5**
10	7	8	8	8	**6**
9	8	9	9	9	**7**
5	9	10	10	10	**8**
22	10	11	11	12	**9**
21	11	12	12	11	**10**

6.6 Conclusion

Route diagnostics are an excellent tool for identifying overall route performance based on key performance indicators. This provides the study team with a view of each route and its role in the network. It is not a definitive guide for route modifications or elimination, but rather provides a basis for investigating route function, segment ridership, and service characteristics. The Citilink diagnostic analysis provides an overview of key routes in the system (Routes 3, 2, 7, 4, 8) that serve as the true "backbone" of the route network. The analysis also identifies routes that may benefit from redesign and routes that should be considered unique based on their route function (Routes 5, 22, 21). Diagnostics, when combined with data collection, service standards and congruency analysis provide the key information that will lead to issue development and ultimately service recommendations.