Mechanic Manpower Analysis for Miami-Dade Transit June 2003

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Miami-Dade Transit
Mechanic Manpower Analysis

Introduction

Under an existing agreement between Miami-Dade County (MDC) and the Center for Urban Transportation Research at the University of South Florida (CUTR), Miami-Dade Transit (MDT) requested assistance in developing a methodology to determine future Vehicle Maintenance Mechanic needs.

In response to a recent voter referendum, Miami-Dade Transit is charged with expanding service to a level that will almost double 2002 mileage by 2005. Based upon estimated service requirements outlined in the People's Transportation Plan, the bus fleet directly operated by MDT will grow from 701 to over 1,330 buses, and annual mileage will increase from 30 million to over 55 million miles.

Additional manpower needed to maintain the expanded fleet must be identified. In the current transit environment, work standards for all elements within individual job classifications do not exist. While standards for several specific work activities have been developed by Florida International University pursuant to an agreement with Miami-Dade County, the project is in its beginning stages, and it will be some time before work standards for all significant elements of the vehicle maintenance program are finalized. In the absence of such standards, determination of the level of manpower required to operate effectively and efficiently must be established by an alternative methodology.

Despite the fact that transit agencies lack formal work standards, all transit agencies typically maintain rather detailed records of labor hours expended as well as vehicle related data. Within Miami-Dade Transit, labor hours accrued by all classifications of non-supervisory maintenance staff are recorded, as are vehicle revenue and non-revenue miles.

Mechanic Requirements

Following is a methodology developed by Maintenance managers, using available MDT data, to project transit Mechanic staffing needs. MDT asked that CUTR ascertain the soundness of the methodology as a predictor of maintenance staffing levels.

It is important to note that the methodology used identifies the number of full-time Mechanics required to provide a defined volume of miles. Actual FY 2001 data used for the analysis include 26,481,222 annual vehicle miles, a complement of 162 full-time Mechanics, and 293,559 annual work hours that include overtime hours.

The steps used in calculating Mechanic manpower requirements, listed below, are followed by a detailed description of the methodology employed.

1) Establish mechanic's annual work days = 261 days
2) Establish mechanic's "unavailable" work days = 39 days
3) Calculate mechanic's annual available days = 222 days
4) Calculate mechanic's daily available work hours = 7 hours
5) Translate mechanic's annual available days into annual hours = 1,554 hours
6) Calculate work hours required for each vehicle mile = 0.0111 hours
7) Multiply additional miles by work hours required =
    i. 42,064 hours based on projected miles
    ii. 72,332 hours based on annualized miles
8) Divide additional work hours required by a mechanic's available hours =
    i. 27 Mechanics required based on projected miles
    ii. 47 Mechanics required based on annualized miles
9) Divide total additional miles by the number of required mechanics to determine the number of miles each mechanic can produce = 155,400 miles annually

The process of identifying manpower needs begins with determining the annual availability of a full-time Mechanic. In the current MDT structure, every full-time employee's normal workweek consists of five days. Based on a five-day workweek, each full-time employee's availability totals 261 days annually.

Step 1: Establish Annual Work Days for a Full-time Mechanic

Availability	***Calculation***	***Days***
Available Days		
Calendar Days	Actual Days per Year	365
Work Days	2 Days Off per Week	104
Annual Work Days =	**Actual Days per Year *minus* Days Off**	
	365 Days – 104 Days Off =	**261 Available Days**

While each employee's annual work days total 261, throughout the year employees are granted days off in the form of holidays, sick leave, and annual

leave. Employees are unavailable for duty on those days. Holidays total 13 days annually, and Maintenance staff estimated the use of annual leave to be an average of 14 days and the use of sick leave to be an average of 12 days each year. Unavailable days totaled 39 days annually.

Step 2: Establish "Unavailable" Work Days for Full-time Mechanic

Days Unavailable	*Calculation*	*Days*
Holidays	13 Days per Year	13
Annual Leave	Average 14 Days per Year	14
Sick Leave	Average 12 Days per Year	12
Total Days Unavailable =	**Holidays + Annual+ Sick Leave**	
	13 + 14 + 12 =	**39 Unavailable Days**

Annual available days reduced by 39 unavailable days yields a total of 222 available days for a full-time Mechanic.

Step 3: Subtract Unavailable Days from Annual Work Days to Determine Available Days

Availability	*Calculation*	*Days*
Annual Work Days		261
Total Days Unavailable		39
Days Available =	**Annual Work Days *minus* Unavailable Days**	
	261 Work Days – 39 Unavailable Days =	**222 Available Days**

The workday is based on eight hours each day; however, the total hours worked each day fall short of the eight hours available due to scheduled breaks. From the eight hours scheduled, unavailable periods of time must be subtracted to account for lunch breaks, work breaks, and clean-up periods. A full-time Mechanic is available to work seven of the scheduled eight hours each available day.

Step 4: Calculate Daily Available Work Hours

Availability	*Calculation*	*Hours*
Work Hours	Hours per Work Day	8
Hours Unavailable		
Lunch Break	1 30-minute Break	0.5
Work Breaks	2 10-minutes Breaks	0.3
Work Clean-up	1 10-minute Period	0.2
Total Hours Unavailable		1
Hours Available =	**Daily Work Hours *minus* Unavailable Hours**	
	8 Hours – 1 Hour =	**7 Available Hours**

Over the course of a year, a Full-time Mechanic will generally work 7 hours a day on 216 days for a total of 1,554 hours.

Step 5: Translate Annual Days of Availability of a Full-time Mechanic into Annual Hours

Availability	*Calculation*	*Hours*
Annual Available Hours =	**Available Days *times* Available Hours**	
	216 Days x 7 Hours per Day =	**1,554 Hours per Year**

In two previous projects for Miami-Dade Transit, CUTR incorporated a methodology, quite similar to the process outlined above, for calculating available hours for Metrorail and Metromover Technicians. Based on the methodology, available hours for a Metrorail Technician equaled 1,452 hours, while available hours for a Metromover Technician were 1,442. The use of 1,554 available hours for each full-time Mechanic appears reasonable, given the hours calculated for Rail and Mover Technicians. However, available Mechanic hours exceed Rail and Mover available hours by 102-112 hours per employee per year or approximately 7-8%. The available hours for the Mechanic are probably overstated rather than understated, which could yield a conservative estimate of actual need.

Approximately 293,559 work hours were needed to produce 26,481,222 vehicle miles during fiscal year 2001, which translates into 0.0111 work hours to provide each vehicle mile

Step 6: Calculate Work Hours Required for Each Vehicle Mile

Availability	*Calculation*	*Work Hours Per Mile*
Total Miles	Actual FY 2001 = 26,481,222 Miles	
Work Hours per Mile =	**Total Work Hours / Total Miles**	
	293,559 Work Hours/26,481,222 Miles =	**0.0111 Work Hours per Mile**

Employee requirements to provide projected additional miles are calculated in the following tables. Since each mile requires 0.0111 work hours of labor, the additional miles are multiplied by 0.0111 hours to determine the total additional work hours required.

Step 7: Calculate Additional Hours – Projected FY 04 & Annualized

Reporting Period	*Projected Increase in FY04 Miles*	*Work Hours per Mile*	*Additional Work Hours*	*Annualized Miles*	*Work Hours per Mile*	*Additional Work Hours*
Oct 2003	644,119	x 0.0111	6,441	644,119	x 0.0111	6,441
Nov 2003	807,487	x 0.0111	8,075	880,895	x 0.0111	8,809
Dec 2003	698,232	x 0.0111	6,982	837,878	x 0.0111	8,379
Jan 2004	433,712	x 0.0111	4,337	578,282	x 0.0111	5,783
Feb 2004	233,609	x 0.0111	2,336	350,414	x 0.0111	3,504
Mar 2004	144,586	x 0.0111	1,446	247,862	x 0.0111	2,479
Apr 2004	571,930	x 0.0111	5,719	1,143,860	x 0.0111	11,439
May 2004	214,891	x 0.0111	2,149	515,739	x 0.0111	5,157
Jun 2004	172,635	x 0.0111	1,726	517,905	x 0.0111	5,179
Jul 2004	211,779	x 0.0111	2,118	847,117	x 0.0111	8,471
Aug 2004	35,225	x 0.0111	352	211,352	x 0.0111	2,114
Sep 2004	38,148	x 0.0111	381	457,772	x 0.0111	4,578
FY 04 New Service	4,206,353	x 0.0111	42,064	7,233,195	x 0.0111	72,332

Additional work hours are divided by 1,554 hours, annual available hours of each mechanic, to determine the number of full-time mechanics considered necessary. The methodology for calculating the number of full-time mechanics needed is the same, regardless of the nature of the anticipated miles – Projected FY 04 and/or Annualized FY 04. The number of full-time Mechanics required for new service in FY 04 ranges from 27 to 47, depending on the method used to project miles.

Step 8: Calculate Mechanics Required – Projected FY 04 & Annualized Miles

Reporting Period	*Projected FY 04 Additional Work Hours*	*Available Hours per Mechanic*	*Mechanics Required*	*Annualized Additional Work Hours*	*Available Hours per Mechanic*	*Mechanics Required*
Oct 2003	6,441	/ 1,554	4.1	6,441	/ 1,554	4.1
Nov 2003	8,075	/ 1,554	5.2	8,809	/ 1,554	5.7
Dec 2003	6,982	/ 1,554	4.5	8,379	/ 1,554	5.4
Jan 2004	4,337	/ 1,554	2.8	5,783	/ 1,554	3.7
Feb 2004	2,336	/ 1,554	1.5	3,504	/ 1,554	2.3
Mar 2004	1,446	/ 1,554	0.9	2,479	/ 1,554	1.6
Apr 2004	5,719	/ 1,554	3.7	11,439	/ 1,554	7.4
May 2004	2,149	/ 1,554	1.4	5,157	/ 1,554	3.3
Jun 2004	1,726	/ 1,554	1.1	5,179	/ 1,554	3.3
Jul 2004	2,118	/ 1,554	1.4	8,471	/ 1,554	5.5
Aug 2004	352	/ 1,554	0.2	2,114	/ 1,554	1.4
Sep 2004	381	/ 1,554	0.2	4,578	/ 1,554	2.9
FY 04 New Service	42,064	/ 1,554	27	72,332	/ 1,554	47

Projected and/or annualized miles divided by the number of required mechanics yields 155,400 miles, the number of miles each mechanic is projected to produce annually.

Step 9: Calculate Miles per Mechanic – Projected FY 04 & Annualized Miles

Reporting Period	*Projected Increase in FY04 Miles*	*Mechanics Required*	*Miles per Mechanic*	*Annualized Miles*	*Mechanics Required*	*Miles per Mechanic*
Oct 2003	644,119	4.1	155,400	644,119	4.1	155,400
Nov 2003	807,487	5.2	155,400	880,895	5.7	155,400
Dec 2003	698,232	4.5	155,400	837,878	5.4	155,400
Jan 2004	433,712	2.8	155,400	578,282	3.7	155,400
Feb 2004	233,609	1.5	155,400	350,414	2.3	155,400
Mar 2004	144,586	0.9	155,400	247,862	1.6	155,400
Apr 2004	571,930	3.7	155,400	1,143,860	7.4	155,400
May 2004	214,891	1.4	155,400	515,739	3.3	155,400
Jun 2004	172,635	1.1	155,400	517,905	3.3	155,400
Jul 2004	211,779	1.4	155,400	847,117	5.5	155,400
Aug 2004	35,225	0.2	155,400	211,352	1.4	155,400
Sep 2004	38,148	0.2	155,400	457,772	2.9	155,400
FY 04 New Service	4,206,353	27	155,400	7,233,195	47	155,400

The following formula can be used to determine the number of full-time Mechanics required for projected mileage volumes:

$$\text{\# Full-time Mechanics Required} = \frac{\text{Total Vehicle Miles}}{\text{155,400 Miles per Mechanic}}$$

Body Mechanic Requirements

Following is an analysis of transit Body Mechanic staffing needs. It mirrors the methodology used to calculate full-time Mechanic requirements.

The steps used in calculating Body Mechanic manpower requirements, listed below, are followed by a detailed description of the methodology employed.

10) Establish mechanic's annual work days = 261 days
11) Establish mechanic's "unavailable" work days = 39 days
12) Calculate mechanic's annual available days = 222 days
13) Calculate mechanic's daily available work hours = 7 hours
14) Translate mechanic's annual available days into annual hours = 1,554 hours
15) Calculate work hours required for each vehicle mile = 0.0024 hours
16) Multiply additional miles by work hours required =
    i. 10,167 hours based on projected miles
    ii. 17,483 hours based on annualized miles
17) Divide additional work hours required by a mechanic's available hours =
    i. 7 Body Mechanics required based on projected miles
    ii. 11 Body Mechanics required based on annualized miles
18) Divide total additional miles by the number of required mechanics to determine the number of miles each Body Mechanic can produce = 642,917 miles annually

Based on a five-day workweek, each full-time employee's availability totals 261 days annually.

Step 1: Establish Annual Work Days for a Full-time Body Mechanic

Availability	*Calculation*	*Days*
Available Days		
Calendar Days	Actual Days per Year	365
Work Days	2 Days Off per Week	104
Annual Work Days =		**261**

Unavailable days total 39 days annually.

Step 2: Establish "Unavailable" Work Days for a Full-time Body Mechanic

Availability	*Calculation*	*Days*
Days Unavailable		
Holidays	13 Days per Year	13
Annual Leave	Average 14 Days per Year	14
Sick Leave	Average 12 Days per Year	12
Total Days Unavailable =		**39**

Annual available days reduced by 39 unavailable days yields a total of 222 available days for a full-time Body Mechanic.

Step 3: Subtract Unavailable Work Days from Annual Work Days to Determine Available Days

Availability	*Calculation*	*Days*
Annual Work Days		261
Total Days Unavailable		39
Days Available =	**Annual Work Days *minus* Unavailable Days**	
	261 Work Days - 39 Unavailable Days =	**222 Available Days**

A full-time Body Mechanic is available to work seven of the scheduled eight hours each available day.

Step 4: Translate Annual Days of Availability of a Full-time Body Mechanic into Annual Hours

Availability	*Calculation*	*Hours*
Work Hours	Hours per Work Day	8
Hours Unavailable		
Lunch Break	1 30-minute Break	0.5
Work Breaks	2 10-minutes Breaks	0.3
Work Clean-up	1 10-minute Period	0.2
Total Hours Unavailable		1
Hours Available =	**Daily Work Hours *minus* Unavailable Hours**	
	8 Hours – 1 Hour =	**7 Available Hours**

Over the course of a year, a full-time Body Mechanic will generally work 7 hours a day on 216 days for a total of 1,554 hours.

Step 5: Translate Annual Days of Availability of a Full-time Body Mechanic into Annual Hours

Availability	*Calculation*	*Hours*
Annual Available Hours =	**Available Days *times* Available Hours**	
	216 Days x 7 Hours per Day =	**1,554 Hours per Year**

Step 6: Calculate Work Hours Required for Each Vehicle Mile

Availability	*Calculation*	*Work Hours Per Mile*
Total Miles	Actual FY 2001 = 26,481,222 Miles	
Work Hours per Mile =	**Total Work Hours / Total Miles**	
	64,008 Work Hours/26,481,222 Miles =	**0.0024 Work Hours per Mile**

Employee requirements to provide additional miles are calculated in the following tables. Since each mile requires 0.0024 work hours of labor, the additional miles are multiplied by 0.0024 hours to determine the total additional work hours required.

Step 7: Calculate Additional Hours – Projected FY 04 & Annualized

Reporting Period	*Projected Increase in FY04 Miles*	*Work Hours per Mile*	*Additional Work Hours*	*Annualized Miles*	*Work Hours per Mile*	*Additional Work Hours*
Oct 2003	644,119	x 0.0024	1,557	644,119	x 0.0024	1,557
Nov 2003	807,487	x 0.0024	1,952	880,895	x 0.0024	2,129
Dec 2003	698,232	x 0.0024	1,688	837,878	x 0.0024	2,025
Jan 2004	433,712	x 0.0024	1,048	578,282	x 0.0024	1,398
Feb 2004	233,609	x 0.0024	565	350,414	x 0.0024	847
Mar 2004	144,586	x 0.0024	349	247,862	x 0.0024	599
Apr 2004	571,930	x 0.0024	1,382	1,143,860	x 0.0024	2,765
May 2004	214,891	x 0.0024	519	515,739	x 0.0024	1,247
Jun 2004	172,635	x 0.0024	417	517,905	x 0.0024	1,252
Jul 2004	211,779	x 0.0024	512	847,117	x 0.0024	2,048
Aug 2004	35,225	x 0.0024	85	211,352	x 0.0024	511
Sep 2004	38,148	x 0.0024	92	457,772	x 0.0024	1,106
FY 04 New Service	4,206,353	x 0.0024	10,167	7,233,195	x 0.0024	17,483

Additional work hours are divided by 1,554 hours for a body mechanic to determine the number of full-time body mechanics considered necessary. The methodology for calculating the number of full-time body mechanics is the same, regardless of the nature of the additional miles – Projected FY 04 and/or Annualized FY 04. The number of full-time Body Mechanics required for new service in FY 04 ranges from 7 to 11, depending on the method used to project miles.

Step 8: Calculate Body Mechanics Required – Projected FY 04 & Annualized Miles

Reporting Period	*Projected Increase in FY04 Miles*	*Available Hours per Mechanic*	*Body Mechanics Required*	*Annualized Miles*	*Available Hours per Mechanic*	*Body Mechanics Required*
Oct 2003	1,557	/ 1,554	1.0	1,557	/ 1,554	1.0
Nov 2003	1,952	/ 1,554	1.3	2,129	/ 1,554	1.4
Dec 2003	1,688	/ 1,554	1.1	2,025	/ 1,554	1.3
Jan 2004	1,048	/ 1,554	0.7	1,398	/ 1,554	0.9
Feb 2004	565	/ 1,554	0.4	847	/ 1,554	0.5
Mar 2004	349	/ 1,554	0.2	599	/ 1,554	0.4
Apr 2004	1,382	/ 1,554	0.9	2,765	/ 1,554	1.8
May 2004	519	/ 1,554	0.3	1,247	/ 1,554	0.8
Jun 2004	417	/ 1,554	0.3	1,252	/ 1,554	0.8
Jul 2004	512	/ 1,554	0.3	2,048	/ 1,554	1.3
Aug 2004	85	/ 1,554	0.1	511	/ 1,554	0.3
Sep 2004	92	/ 1,554	0.1	1,106	/ 1,554	0.7
FY 04 New Service	10,167	/ 1,554	7	17,483	/ 1,554	11

Projected and/or annualized miles divided by the number of required mechanics yields 642,917 miles, the number of miles each body mechanic is projected to produce annually.

Step 9: Calculate Miles per Body Mechanic – Projected FY 04 & Annualized Miles

Reporting Period	*Projected Increase in FY04 Miles*	*Body Mechanics Required*	*Miles Per Body Mechanic*	*Annualized Miles*	*Body Mechanics Required*	*Miles Per Body Mechanic*
Oct 2003	644,119	1.0	642,917	644,119	1.0	642,917
Nov 2003	807,487	1.3	642,917	880,895	1.4	642,917
Dec 2003	698,232	1.1	642,917	837,878	1.3	642,917
Jan 2004	433,712	0.7	642,917	578,282	0.9	642,917
Feb 2004	233,609	0.4	642,917	350,414	0.5	642,917
Mar 2004	144,586	0.2	642,917	247,862	0.4	642,917
Apr 2004	571,930	0.9	642,917	1,143,860	1.8	642,917
May 2004	214,891	0.3	642,917	515,739	0.8	642,917
Jun 2004	172,635	0.3	642,917	517,905	0.8	642,917
Jul 2004	211,779	0.3	642,917	847,117	1.3	642,917
Aug 2004	35,225	0.1	642,917	211,352	0.3	642,917
Sep 2004	38,148	0.1	642,917	457,772	0.7	642,917
FY 04 New Service	4,206,353	7	642,917	7,233,195	11	642,917

The following formula can be used to determine the number of full-time Body Mechanics required for projected mileage volumes:

$$\text{\# Full-time Body Mechanics Required} = \frac{\text{Total Vehicle Miles}}{\text{642,917 Miles per Body Mechanic}}$$

Mechanic and Body Mechanic manpower requirements to fulfill needs identified in FY 04 are highlighted in the following table.

Reporting Period	*Projected Increase in FY04 Miles*	*Annualized Miles*	*Based on Projected FY04 Miles*		*Based on Annualized Miles*	
			*Mechanics Required**	*Body Mechanics Required***	*Mechanics Required**	*Body Mechanics Required***
Oct 2003	644,119	644,119	4.1	1.0	4.1	1.0
Nov 2003	807,487	880,895	5.2	1.3	5.7	1.4
Dec 2003	698,232	837,878	4.5	1.1	5.4	1.3
Jan 2004	433,712	578,282	2.8	0.7	3.7	0.9
Feb 2004	233,609	350,414	1.5	0.4	2.3	0.5
Mar 2004	144,586	247,862	0.9	0.2	1.6	0.4
Apr 2004	571,930	1,143,860	3.7	0.9	7.4	1.8
May 2004	214,891	515,739	1.4	0.3	3.3	0.8
Jun 2004	172,635	517,905	1.1	0.3	3.3	0.8
Jul 2004	211,779	847,117	1.4	0.3	5.5	1.3
Aug 2004	35,225	211,352	0.2	0.1	1.4	0.3
Sep 2004	38,148	457,772	0.2	0.1	2.9	0.7
Total FY 04	**4,206,353**	**7,233,195**	**27**	**7**	**47**	**11**

Notes:
**Based on acutal FY01 Mechanic Work Hours per Mile of 0.0111 Hours*
***Based on actual FY01 Body Mechanic Work Hours per Mile of 0.0024 Hours*

In summary:

- The methodology used to determine Mechanic and Body Mechanic manpower requirements appears to be sound
- A critical component in the calculation of manpower requirements is the level of availability of a full-time employee; the reliability of the data can be enhanced in the future through the use of data from multiple years

- The fact that MDT's EMS reporting captured 270,000 of the 293,000 hours (approximately 92%) identified in the analysis of the labor hours reported lends credibility to the analysis

- When compared across other modes within Miami-Dade Transit, the established level of 1,554 hours appears reasonable

- The FY 04 shortage of Mechanics ranges from 27 to 47, depending upon the method by which miles are projected

- The FY 04 shortage of Body Mechanics ranges from 7 to 11, depending upon the mileage projection method used

The next important step in the evaluative process is a comparison of Miami-Dade Transit with comparable transit agencies.

Comparison of Other Transit Properties

The Federal Transit Administration (FTA) maintains the National Transit Database (NTD), a program of information submitted by hundreds of U.S. transportation providers on an annual basis. The NTD facilitates comparisons of various transit agencies because data are formatted in tables relating to a variety of operating and performance factors.

In Data Table 21 of the NTD for year 2000, Miami-Dade Transit reported 27,871 Annual Vehicle Miles and 270.2 million Annual Passenger Miles for bus. CUTR determined that an agency comparable to MDT consisted of an agency that reported annual passenger miles and/or annual vehicle miles for bus similar to those reported by MDT in the NTD 2000. Using Data Table 21, CUTR identified those agencies with annual vehicle miles in the range of 20-30,000 miles and annual passenger miles in the range of 200-300 million miles. Those agencies included:

- San Antonio VIA Metropolitan Transit
- Mass Bay Transportation Authority
- Milwaukee County Transit System
- Metro Atlanta RTA
- San Francisco Municipal Railway
- Portland Tri-County Metro District
- Denver Regional Transportation District
- Baltimore MTA-Maryland DOT
- Greater Cleveland RTA
- Alameda Contra Costa TD
- Port Authority of Allegheny County
- Santa Clara Valley TA

CUTR conducted a cluster analysis to identify those agencies most closely related to Miami-Dade Transit in terms of operating characteristics. Two clusters were identified in the analysis. Nine agencies, including Miami-Dade Transit, formed cluster one, while four agencies fell into cluster two. Cluster one was chosen for further analysis; cluster two agencies were rejected for further analysis.

Cluster analysis classifies a set of observations into two or more mutually exclusive unknown groups, based on combinations of grouping variables. The purpose of cluster analysis is to discover a system of organizing observations into groups, where members of the groups share common properties, given a set of grouping variables.

The main advantage of using cluster analysis is to limit and minimize subjective intervention in selecting objects (in this case the agencies). This operation can be considered a purely statistical moment upon which the researcher is still capable of exerting influence on all phases of analysis.

The generation of clusters is obtained through joining algorithms. The purpose of these algorithms is to join together objects (the initially selected agencies) into successively larger clusters, using some measure of dissimilarity or distance.

The following grouping variables were used to estimate similarities among clusters:

- Annual Passenger Miles/Vehicle Maintenance FTE
- Annual Passenger Miles/Vehicle Maintenance Hours
- Vehicle Maintenance Hours/VOMS
- Annual Passenger Miles/VOMS

To validate the robustness of results, different algorithms and measures of dissimilarity were applied in the analysis, which produced identical results.

The analysis generated two separate clusters, with Miami-Dade Transit belonging to a first cluster of nine agencies. Four agencies formed a separate cluster, indicating a clear difference from Miami-Dade Transit, given the identified set of grouping variables. Cluster one included the following agencies:

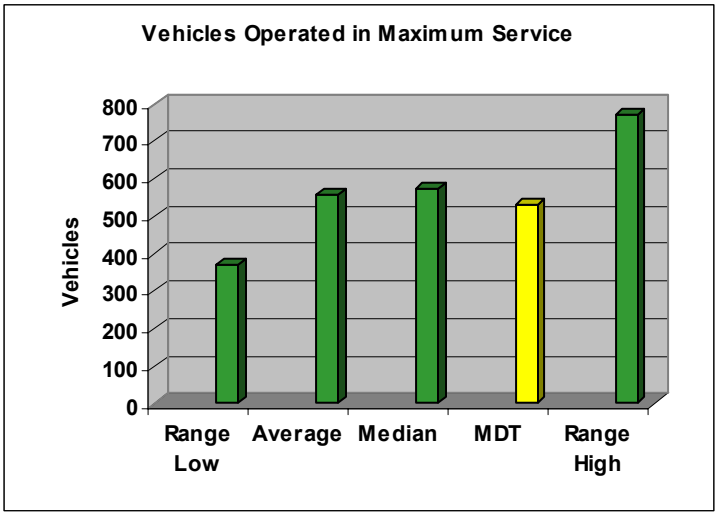
- San Antonio VIA Metropolitan Transit
- Mass Bay Transportation Authority
- Milwaukee County Transit System
- Metro Atlanta RTA
- San Francisco Municipal Railway
- Portland Tri-County Metro District
- Denver Regional Transportation District
- Baltimore MTA-Maryland DOT
- Miami-Dade Transit

A comparative analysis of transit service supplied, full-time vehicle maintenance employees, and vehicle maintenance hours provided was conducted. Following are the results of the analysis:

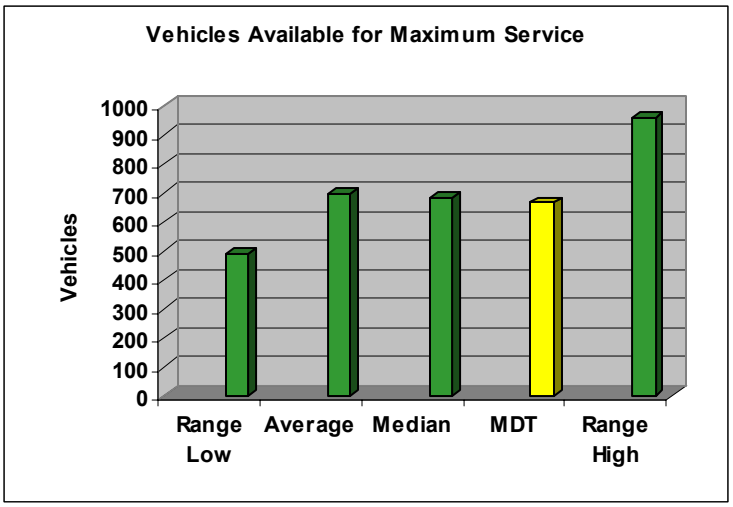
Cluster One	Vehicles Operated in Maximum Service	Vehicles Available for Maximum Service	VOMS/ VAMS	Annual Vehicle Miles	Annual Passenger Miles (000s)	Annual Passenger Miles/ VOMS	Vehicle Maint. Hours	Veh Maint Hours/ VOMS	Annual Pass Miles/ Veh Maint Hour	Vehicle Maint. FTE	Annual Pass Miles/ Veh Maint FTE
2000 National Transit Database											
Milwaukee Cnty Trans Sys	461	557	0.83	22,074	195,917	425	449,387	975	200,980	240	816,323
VIA Metropolitan Transit	421	503	0.84	22,234	171,628	408	389,134	924	185,683	220	780,128
Municipal Railway	372	488	0.76	14,317	207,328	557	611,147	1,643	126,199	294	705,678
Regional Transp District	639	962	0.66	33,875	288,037	451	854,180	1,337	215,476	443	649,609
MTA-Maryland DOT	649	787	0.82	21,597	261,834	403	752,039	1,159	225,959	403	649,389
Metro Atlanta RTA	580	698	0.83	31,853	273,116	471	1,119,544	1,930	141,493	459	595,023
Tri-County Metro District	570	671	0.85	26,554	207,760	364	631,539	1,108	187,516	353	588,557
Mass Bay Transp Auth	769	911	0.84	26,032	250,792	326	952,511	1,239	202,474	445	563,577
Range Low	**372**	**488**	**0.66**	**14,317**	**171,628**	**326**	**389,134**	**924**	**129,199**	**220**	**563,577**
Average	**558**	**697**	**0.81**	**24,817**	**232,052**	**426**	**719,935**	**1,289**	**185,722**	**357**	**668,536**
Median	**575**	**685**	**0.83**	**24,133**	**229,276**	**416**	**691,789**	**1,199**	**194,248**	**378**	**649,499**
MDT	***530***	***666***	***0.80***	***27,871***	***270,213***	***510***	***743,038***	***1,402***	***192,739***	***364***	***742,343***
Range High	**769**	**962**	**0.85**	**33,875**	**288,037**	**557**	**1,119,544**	**1,930**	**225,959**	**459**	**816,323**

Source: NTD 2000 Data Tables 21 & 28

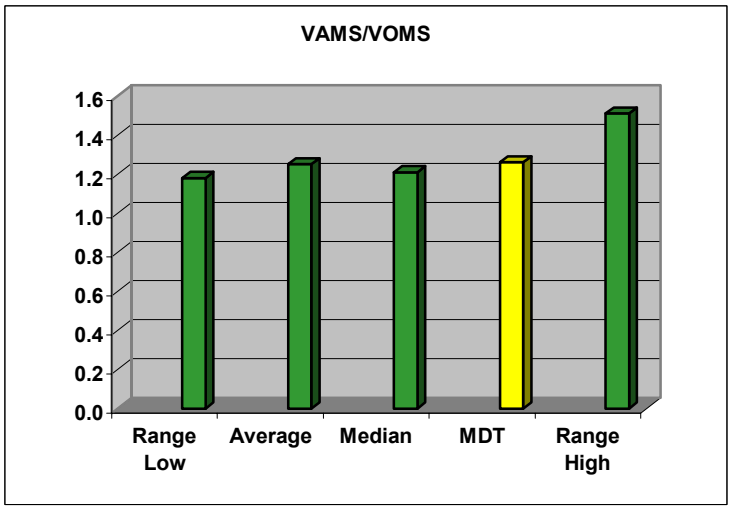
Each factor included in the analysis was charted to show MDT's relationship to the cluster agencies in terms of the range of results as well as the average and the median. Significant observations are noted to the right of each chart.



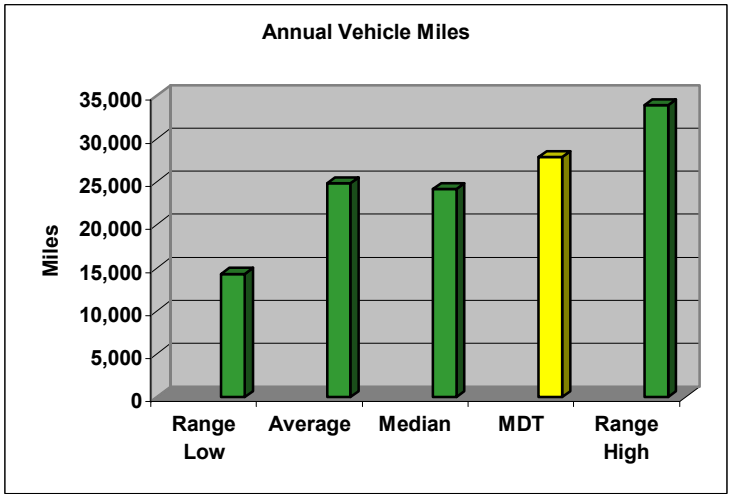
- MDT operates slightly fewer vehicles in Maximum Service



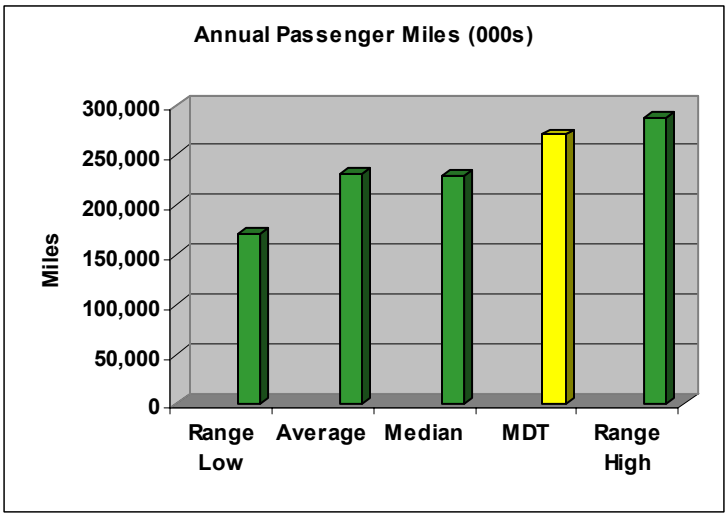
- MDT has slightly fewer vehicles available for Maximum Service



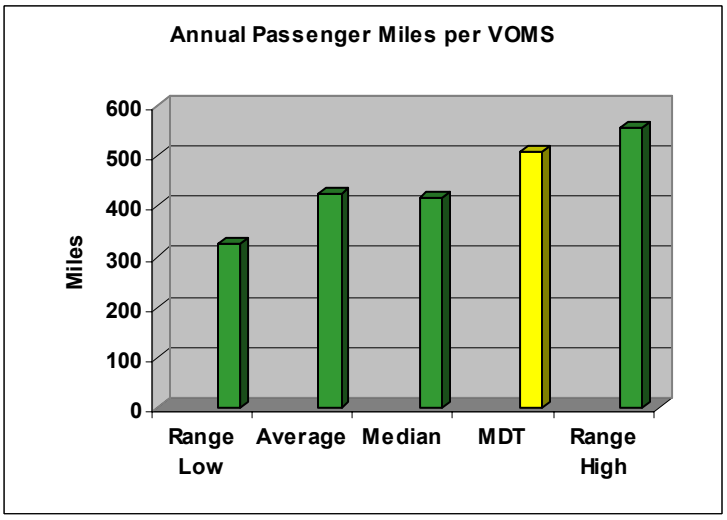
- MDT's ratio of Vehicles Operated to Vehicles Available mirrors the average



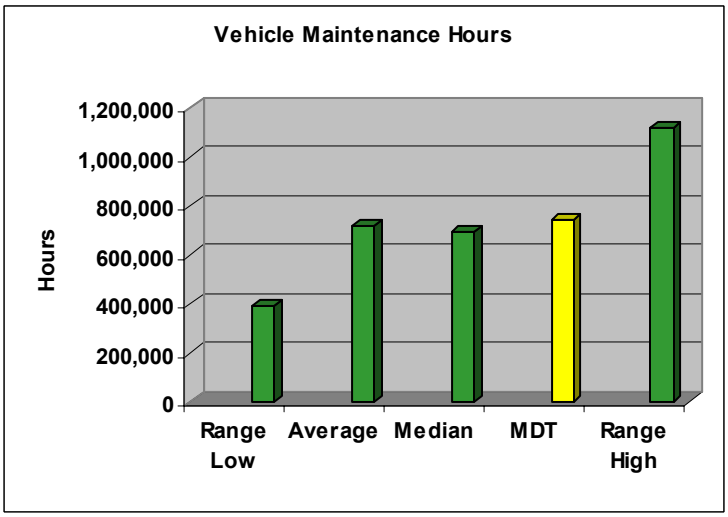
- MDT logs more Annual Vehicle Miles than most comparable agencies



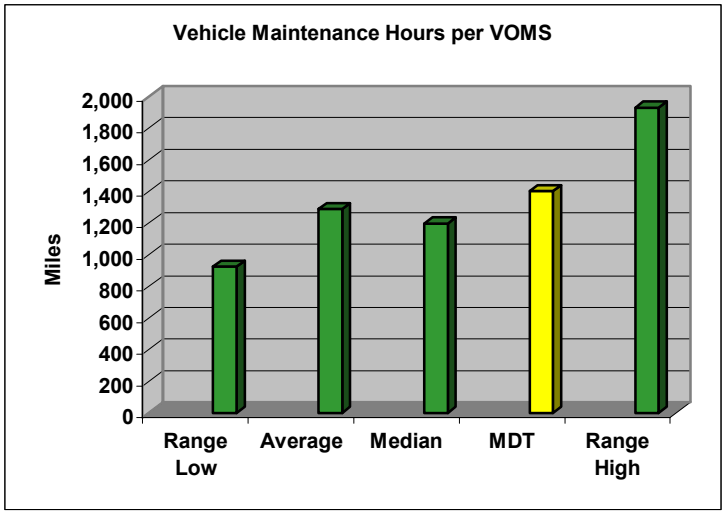
- MDT logs more Annual Passenger Miles than most other comparable agencies



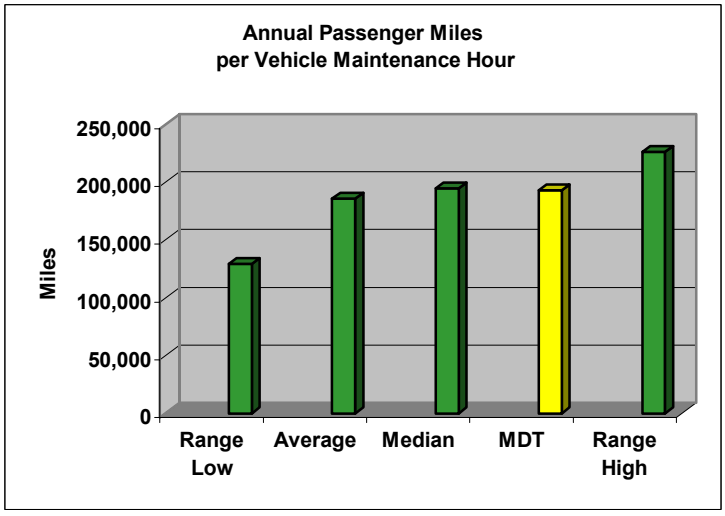
- MDT logs more Annual Passenger Miles per Vehicle Operated than most comparable agencies



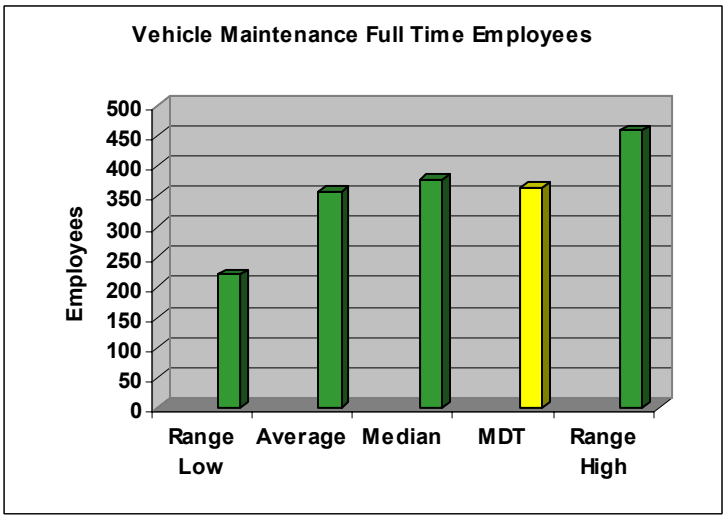
- MDT's Vehicle Maintenance hours exceed the average and median



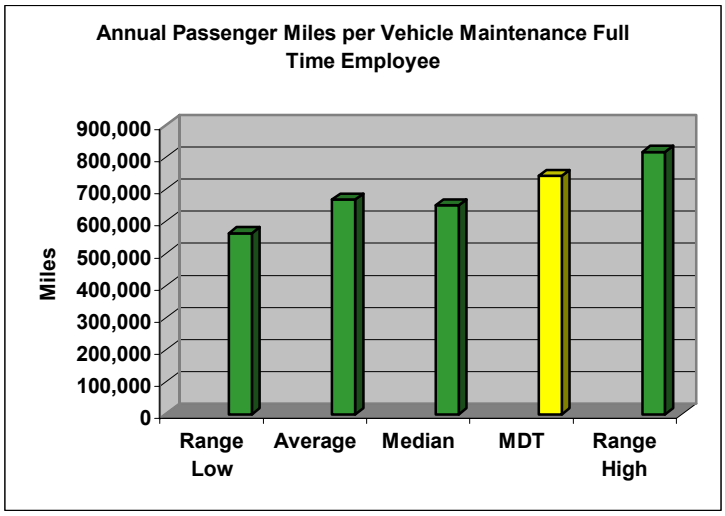
- MDT's Vehicle Maintenance Hours for Vehicles Operated in Maximum Service exceed the average and median



- MDT's Passenger Miles per Vehicle Maintenance Hour equal the median



- MDT has slightly fewer Full-time Maintenance Employees than comparable agencies



- MDT's Passenger Miles per Maintenance Employee are at the high end of the range

In summary:

- In maximum service, Miami-Dade Transit operates fewer vehicles and has fewer vehicles available than comparable agencies while the ratio of vehicles operated to vehicles available equals that of other agencies

- In terms of annual vehicle and passenger miles, MDT exceeds all comparable agencies in the volume of miles logged, including passengers miles, when compared to vehicles operated in maximum service

- Miami-Dade Transit reports more vehicle maintenance hours than comparable agencies both in actual hours, and when compared to vehicle maintenance hours per vehicle operated in maximum service

- The number of passenger miles for each vehicle maintenance hour is similar across the agencies

- MDT reports fewer full-time maintenance employees than comparable agencies; however, the number of passenger miles for each of the employees exceeds comparable agencies

Findings

From a vehicle maintenance perspective, Miami-Dade Transit is quite like other transit agencies that provide similar levels of service. MDT does appear to provide slightly more miles with fewer vehicles. Significant deviation from the average and median was most notable in the final chart, which indicated MDT's ratio of passenger miles to full-time vehicle maintenance employees was higher than most other comparable agencies. Based on the analysis, MDT's staffing for vehicle maintenance appears to be slightly below that reported by other transit agencies providing service at a level similar to that provided by MDT.

The methodology used by Maintenance to determine additional Mechanic and Body Mechanic manpower needs does appear to be sound. The level of availability of a full-time employee is a critical component in the calculation of manpower requirements, and when compared across other modes within Miami-Dade Transit, the established level of 1,554 hours appears reasonable. The completion of the on-going work standards project will provide Miami-Dade Transit with the ability to determine manpower needs based on standard practices. Until that project is completed, MDT should consider using an average of data from multiple years or at a minimum "recalculating" the number of miles per employee annually to ensure manpower levels are consistent with workforce productivity.

Miami-Dade Transit manpower requirements based on additional service miles in FY 04 ranged from 27 to 47 additional Mechanics and 7 to 11 additional Body Mechanics, depending upon the method used to project mileage.