AN ANALYSIS OF MIAMI-DADE TRANSIT'S OPERATING COST EFFICIENCY

VOLUME TWO, REPORT SYNTHESIS

Center for Urban Transportation Research
University of South Florida

Janet L Davis
Stephen L Reich

January 30, 2012

Acknowledgements

The Center for Urban Transportation Research would like to thank staff of the Citizen's Independent Transportation Trust and Miami-Dade Transit for their contributions and assistance during the project.

Table of Contents

Executive Summary

The Citizen's Independent Transportation Trust (CITT) requested assistance from researchers at the Center for Urban Transportation Research (CUTR) located at the University of South Florida (USF) in the conduct of an objective assessment of the relative efficiency of Miami-Dade Transit (MDT). MDT is the largest transit agency in Miami-Dade County (MDC) and operates four transportation modes, including Metrorail, Metromover, Metrobus, and Special Transportation System. The MDT Pro Forma, which has been presented publicly on a number of occasions, looks at long term expenses and revenues projected to be available to MDT. The Pro Forma confirms, as payment expenses for bonds increase, the amount of surtax funds available for MDT operations and maintenance reduces significantly. The draft fiscal year 2012 Pro Forma indicates an operating funding gap of approximately $40 million beginning in 2014.

Financial pressures on all levels of government are a reality in the current economic downturn. The pressures on urban transit operations are no exception, and MDT has struggled with budgetary deficit issues prior to and after adoption of the surtax. Revisions to the original People's Transportation Plan (PTP,) increasing cost pressures and accumulating debt service are just a few of the factors that require MDT to operate as efficiently as practical.

The CITT contracted with CUTR, through an interlocal agreement, to undertake an operating cost analysis to determine how efficiently MDT was running by means of comparing the agency with peer transit organizations and through a review of the recommendations made during previous studies and analyses performed for the agency that identified potential improvements. The effort included collaborative examination of MDT's efficiency from an operating cost perspective with active participation by CITT and MDT personnel.

An Analysis of Miami-Dade Transit's Operating Cost Efficiency: Volume One, Peer Review presented an assessment of MDT's efficiency in relationship to peer transit agencies. Each modal review contained an overview of general service metrics to establish the context for MDT's transit operation in comparison to the peer group as well as a summary of the results of the performance metrics applied to MDT and the peer groups. Individual peer agency data were included to provide context for general service metrics, while performance comparisons were based on the average of the peer group's metrics. Findings in regard to MDT's improved efficiency were summarized at the end of the modal section. An overview of select metrics that provided a side by side look at the performance of MDT's three modes was presented in the final section of Volume One.

In relationship to the established peer group, which consisted of 10 transit bus agencies, Metrobus reported longer average trips, more passengers per load, and a higher farebox recovery in 2009, continuing trends observed prior to that year. Metrobus reported fewer maintenance employee full-time equivalents per vehicle operated and a lower operating cost per passenger mile than the peer group average in 2009, despite a slight upward trend in these factors compared to 2008. Metrobus fell below the 2009 peer group average in attaining revenue miles between failures. In terms of operating costs, Metrobus continued to exceed the 2009 peer group average in cost per revenue hour, cost per passenger trip, subsidy per boarding, cost per vehicle operated in maximum service, and vehicle

maintenance cost per vehicle mile at levels slightly higher than reported in 2008. Based on 2010 data assembled to date, Metrobus reported lower operating costs in all areas; fewer maintenance employee full-time equivalents per vehicle operated; and, growth in average trip length, average passenger load, farebox recovery, and revenue miles between failures compared to 2009.

Metrorail, in relationship to the established peer group, which consisted of 12 heavy rail agencies, reported longer average trips, continuing a trend observed prior to 2009. Metrorail exceeded the 2009 peer group average in maintenance employee full-time equivalents per vehicle operated and fell well below the 2009 peer group average in attaining revenue miles between failures. In terms of operating costs, Metrorail continued to exceed the 2009 peer group average in cost per revenue hour, cost per passenger trip, and subsidy per boarding; although, levels were slightly below levels reported in 2008. Vehicle maintenance cost per vehicle mile fell below the 2009 peer group average as did non-vehicle maintenance cost per transit way mile. Based on 2010 data assembled to date, Metrorail reported lower operating costs per revenue hour and mile, a lower cost per vehicle operated in maximum service, and a lower non-vehicle maintenance cost per transit way mile as compared to 2009. In 2010 compared to 2009, Metrorail reported fewer maintenance employees per vehicle operated in maximum service, more revenue miles between failures, growth in average trip length, and an increase in farebox recovery.

In relationship to the established peer group that included two agencies that operated an automated guideway, Metromover reported longer average trips and more passengers per load in 2009, continuing trends prior to that year. Metromover exceeded the 2009 peer group average in maintenance employee full-time equivalents per vehicle operated and fell well below the 2009 peer group average in attaining revenue miles between failures. In terms of operating costs, Metromover exceeded the 2009 peer group average operating cost per vehicle operated in maximum service and the non-vehicle maintenance cost per transit way mile, continuing trends observed prior to 2009. Metromover operating cost per revenue hour and mile, operating cost per passenger trip and mile, operating cost per capita, and subsidy per boarding fell below the peer group average throughout the entire period. Based on 2010 data assembled to date, Metromover reported lower operating costs per revenue hour and mile, lower operating costs per passenger trip and mile, a lower cost per vehicle operated in maximum service, and a lower non-vehicle maintenance cost per transit way mile as compared to 2009. In 2010 compared to 2009, Metromover reported fewer maintenance employees per vehicle operated in maximum service, more revenue miles between failures, growth in average trip length, and a decrease in subsidy per boarding.

The CITT was interested in examining CUTR's efforts in assisting MDT to establish efficient and effective operations. This report, referred to as *An Analysis of Miami-Dade Transit's Operating Cost Efficiency: Volume Two, Report Synthesis,* presents the findings related to the documentation and review of previous studies.

CUTR previously assisted MDT in development of Fleet Management Plans for Metrorail, Metromover, and Metrobus; conducted manpower assessments within several areas as well as a comprehensive staffing analysis; and, performed materials management, facilities, rail and bus operational reviews. In

order to avoid duplication of effort, this study relied on previous recommendations and findings that were produced over the last ten years.

CUTR scheduled and conducted a project initiation meeting with CITT and MDT management to discuss the project, review the scope of work, and establish a schedule for the conduct of the study, feedback and input. Researchers reviewed previous work performed by CUTR for MDT and identified relevant findings and recommendations. The body of work was classified into three distinct categories: analysis of a specific activity/metric, such as "Technical Memorandum: Fares," that generally produced a summary of findings; development of mandated plans, such as fleet and equipment management plans, that involved technical assistance from CUTR and rarely included findings or recommendations; and operational reviews, such as "Rail Rehabilitation, Phase I – Metrorail," that included significant findings and detailed recommendations.

The following reports, which are directly relevant to the project, are included in the review:

CUTR Reports	
I.	Rail Rehabilitation Report, Phase I Final Report, January 2001
II.	13(c) Strategic Task Force, June 2001
III.	Efficiency Review, September 2001
IV.	Rail & Mover Rehabilitation Report, Phase II Final Report, April 2002
V.	Metrorail Fleet Management Plan, Revision 2, December 2002
VI.	Metrorail Operations Plan, Revision 7, February 2003
VII.	Mechanic Manpower Analysis, June 2003
VIII.	Metromover Fleet Management Plan, Revision III, June 2003
IX.	Metrobus Maintenance Program Review & Recommendations, Phase One, March 2004
X.	Materials Management Analysis & Recommendations, November 2004
XI.	Comprehensive Bus Operational Analysis, Final Recommendations Report, December 2004
XII.	Metrobus Fleet Management Plan, Revision II, January 2005
XIII.	Technical Memorandum: Fares, March 2005
XIV.	Facilities Maintenance Division Equipment & Maintenance Plan, June 2005
XV.	Technical Memorandum: Operating Costs, November 2005
XVI.	Service Standards RTC Presentation, November 2005
XVII.	Facilities Division FY 2004 Work Order Analysis, March 2006
XVIII.	Track & Guideway Division Equipment & Maintenance Plan, April 2006
XIX.	Subsidy Policy Peer Review & Analysis, July 2006
XX.	Metrobus Maintenance Program Review & Recommendations, Phase Two, September 2006
XXI.	Field Engineering Systems Maintenance, April 2007
XXII.	Organizational Review & Peer Comparison, January 2010

CUTR synthesized and organized findings and recommendations from this previous work and shared the results with MDT and CITT management for their review and comment. MDT identified managers and functional staff best suited for follow-up discussions, interviews, and data requests. CUTR conducted a series of meetings with the designated individuals to review previously published recommendations on increasing operational efficiency. The sessions focused on identifying recommendations that had been implemented as well as determining the implications of the adopted recommendations; exploring

alternative actions taken in lieu of recommendations; and, attempting to quantify results of adopted recommendations and alternative actions.

CUTR assembled the findings of the reports, meetings with MDT and CITT staff, and available data collected to produce this document. Each report was reviewed individually and is summarized in chronological order. The original project for which the report was produced is described in detail, followed by a listing of findings and recommendations, if applicable. Adjacent to each recommendation is a statement detailing action, if any, taken to date to implement the recommendation. For those projects that incorporated data analysis, every attempt was made to update the analysis using available data.

CUTR conducted operational reviews of Metrorail, 13(c) Practices, Metromover, Metrobus, Materials Management, Bus Service, Facilities Engineering & Systems Maintenance, and the MDT Organizational Structure. For most operational reviews, a task force composed of select MDT personnel assisted in the evaluation of MDT's performance. Where applicable, MDT performance was reviewed in comparison to peer agency practices and organizational structures. Organizational reviews often generated a variety of recommendations that most frequently involved MDT operating practices and procedures. Recommendations varied in scope from agency-wide reform, such as action necessary to establish minimum qualifications for rail maintenance classifications, to division-specific actions, such as normalizing Metrorail fleet mileage.

Many of the recommendations were accepted and implemented by the agency. Metrorail and Metromover normalized fleet mileage, Materials Management established performance metrics for critical parts, and Metrobus began tracking cost per mile. Some recommendations were accepted by the agency but were not implemented due to a conflicting county policy, as was the case with recommendations regarding expansion of contracting versus in-house service. For some recommendations, MDT chose to accept an alternative action, e.g., Metrobus decided to use a PC-based system rather than a portable, wireless system due to reliability concerns.

CUTR assisted MDT in the development of mandated plans, including the Metrorail Fleet Management Plan, Metrorail Operations Plan, Metromover Fleet Management Plan, Metrobus Fleet Management Plan, Facilities Maintenance Division Equipment & Maintenance Plan, and Track & Guideway Division Equipment & Maintenance Plan. The fleet management plans are essentially a statement of the processes and practices of the division by which MDT establishes current and projected revenue vehicle fleet size and operating spare ratio. The plans are structured to present the demand for service and methodology for analysis of that demand, address the supply of vehicles, explain the balance between the demand for and supply of vehicles, and provide a summary of the maintenance plan. MDT is required to submit an updated plan to the Federal Transit Administration (FTA) when significant change in service occurs.

The equipment and maintenance plan is a statement of the processes and practices by which MDT establishes proper maintenance of facilities, machinery, and equipment. The plan is structured to describe the organization of the responsible division, detail the assignment of responsibility for

maintenance, outline inspections and routine maintenance actions to ensure proper care and maximum useful life, and present the record-keeping system used to maintain permanent records of maintenance and inspection activity. FTA does not routinely require the submission of equipment and maintenance plans.

CUTR produced the following analyses for MDT: Efficiency Review, Mechanic Manpower Analysis, Technical Memorandum: Fares, Technical Memorandum: Operating Costs, Service Standards, Facilities Work Orders, and Subsidy Policy. Each analysis included a summary of findings, which are presented in the overviews along with updated metrics, where appropriate.

Tying CUTR's findings and recommendations to improved efficiency and effectiveness on the part of MDT is highly speculative, given the fact that this body of work spans ten years. Nonetheless, the picture of the agency that emerges today differs significantly from the agency that operated in 2000, and many of the changes are consistent with actions recommended at some point in time by CUTR.

Structural changes undertaken by MDT appear to have achieved the most significant improvement in the organization. MDT restructured the organization and established a Knowledge Management group specifically tasked with evaluating the volumes of data collected. Various performance measures with targets have been established and are tracked in the MDT Scorecard, referenced in the MDT budgets, published in the Transit Services Monthly Report, and posted in the Transit Service office. Metrorail, Metrobus, Metromover, Facilities, and Materials Management actively work to achieve targets. Metromover technicians have immediate access to all data concerning vehicle and wayside performance through the Enterprise Asset Management System (EAMS), which is on track to become functional in other divisions in the near future. Maintenance processes are evaluated using Lean Six Sigma, and maintenance personnel have learned to value trend analysis and its use in improving maintenance. Materials Management tracks and reports stock-outs for critical bus and rail parts and has doubled warranty dollars collected due to defects. Most MDT employees have computer access to a variety of statistical reports as well as MDT policies and procedures.

While MDT has been unable to establish minimum qualifications for maintenance classifications, the agency was successful in achieving a 24-month waiting period for the exercise of 13(c) classification seniority for employees who voluntarily leave a trainee position or are returned for cause by the employer after a 30-day calendar period. In addition, the Transit Workers Union (TWU) participated in a formal incentive program for TWU employees based on improved attendance.

MDT integrated the use of fleet management plans and equipment & maintenance plans into the regular planning process. In the past, the plans were completed to fulfill an FTA mandate. At present, the plans serve to provide the agency with structured maintenance procedures that reflect actual day-to-day processes.

In 2009, MDT formally adopted service standards. With service standards in place, MDT is better positioned to determine service productivity and eliminate and/or add routes based on specific criteria. If minimum system-wide productivity standards are not met, MDT will conduct a thorough evaluation of all routes to identify areas of opportunity to achieve improved productivity and efficiency. Metrobus

and Metrorail consistently achieved the on-time performance service standard. Metromover and Metrorail consistently reported fewer complaints than service standard mandates, and Metrobus accidents decreased to an all-time low.

MDT also established a fare policy that allows for fare increases at regular intervals based on current economic conditions. Farebox recovery rates for Metrobus and Metrorail grew to all-time highs.

MDT's FY 2010 organizational structure reflected a reduction of 519 positions compared to FY 2008; MDT's full-time and part-time employees logged 1.4 million fewer work hours, and total operating expenses fell by $37 million. Reductions in operating costs were noted in all areas with the exception of general administration. Vehicle operations accounted for 70.3 percent of the total reduction.

Over the past ten years scores of recommendations were made and many were adopted, modified or not incorporated into operations. The MDT agency of today is running more efficiently, has cut operating costs, decreased personnel, established service standards, and has incorporated technology.

MDT does appear to be moving in the right direction even though the progression has been slow. Achievement of system-wide efficiency and effectiveness is often a slow process due to external obstacles and internal barriers. With limited resources available, MDT will most certainly be challenged in the future to do more with less. MDT must continue to focus on institutionalizing the commitment to provide quality service that is cost efficient and effective.

Introduction

The Citizen's Independent Transportation Trust requested assistance from researchers at the Center for Urban Transportation Research located at USF in the conduct of an objective assessment of the relative efficiency of Miami-Dade Transit.

Financial pressures on all levels of government are a reality in the current economic downturn. The pressures on urban transit operations are no exception, and MDT has struggled with budgetary deficit issues prior to and after adoption of the surtax. Revisions to the original PTP, increasing cost pressures and accumulating debt service are just a few of the factors that require MDT to operate as efficiently as practical.

The CITT chose to undertake an operating cost analysis to determine how efficiently MDT was running by means of comparing the agency with peer transit organizations and through a review of the recommendations made during previous studies and analyses performed for the agency that identified potential improvements. The use of comparative data and information is important to all organizations. Standings relative to similar peers and to best practices can add valuable context and affirm beneficial practices. Comparative performance projections and peer performance may reveal organizational challenges as well as areas where innovation is required. Comparative information may also support business analysis and decisions relating to core competencies, partnering, and outsourcing.

Through an interlocal agreement, the CITT contracted with CUTR to perform two primary tasks: to complete an objective assessment of the relative efficiency of MDT and to document actions, activities or policies that have been taken or enacted based on prior work done to assist the agency in creating a more efficient operating environment. The effort included collaborative examination of MDT's efficiency from an operating cost perspective with active participation by CITT and MDT personnel.

This report presents findings related to the documentation and review of previous studies. *An Analysis of Miami-Dade Transit's Operating Cost Efficiency: Volume One, Peer Review* presented an assessment of MDT's efficiency in relationship to peer transit agencies.

CUTR previously assisted MDT in development of Fleet Management Plans for Metrorail, Metromover, and Metrobus; conducted manpower assessments within several areas as well as a comprehensive staffing analysis; and, performed materials management, facilities, rail and bus operational reviews. In order to avoid duplication of effort, this study relied on previous recommendations and findings that were produced over the last ten years.

CUTR scheduled and conducted a project initiation meeting with CITT and MDT management to discuss the project, review the scope of work and establish a schedule for the conduct of the study, feedback and input. Researchers reviewed previous work performed by CUTR for MDT and identified relevant findings and recommendations. The body of work was classified into three distinct categories: analysis of a specific activity/metric, such as "Technical Memorandum: Fares," that generally produced a summary of findings; development of mandated plans, such as fleet and equipment management plans, that involved technical assistance from CUTR and rarely included findings or recommendations; and

operational reviews, such as "Rail Rehabilitation, Phase I – Metrorail," that included significant findings and detailed recommendations.

CUTR synthesized and organized findings and recommendations from this previous work and shared the results with MDT and CITT management for their review and comment. MDT identified managers and functional staff best suited for follow-up discussions, interviews, and data requests. CUTR conducted a series of meetings with the designated individuals to review previously published recommendations on increasing operational efficiency. The sessions focused on identifying recommendations that had been implemented as well as determining the implications of the adopted recommendations; exploring alternative actions taken in lieu of recommendations; and attempting to quantify results of adopted recommendations and alternative actions.

CUTR assembled the findings of the reports, meetings with MDT and CITT staff and available data collected to produce this document. Each of the 22 reports was reviewed individually and is summarized in chronological order. The original project for which the report was produced is described in detail, followed by a listing of findings and recommendations, if applicable. Adjacent to each recommendation is a statement detailing action, if any, taken to date to implement the recommendation. For those projects that incorporated data analysis, every attempt was made to update the analysis using available data.

I. Rail Rehabilitation Report, Phase I Final Report, January 2001

The work was intended to assist MDT in documenting its rail rehabilitation needs and develop a plan to address those needs. The assessment included a review of the current condition of the Metrorail and Metromover systems, a comparison with other transit properties' heavy rail and people mover systems, and a recommended plan of action to carry MDT forward into the next five years.

Specific detail was devoted to the provisions of the labor agreements of the comparable transit properties as they related to contracting for outside services and the recruitment, selection and advancement of employees. Specific attention was given to those contract provisions resulting from the provisions of Section 13 (c) of the Urban Mass Transportation (UMTA) Act of 1964.

Phase I of the project began on March 24, 2000 and focused on Metrorail. Phase II commenced on August 25, 2000, upon completion of Phase I, and focused attention on Metromover. The submission date for the Phase I Final Report was November 24, 2000.

The approach to the project included the formation of a Rail Rehab Task Force composed of key personnel within MDT in addition to the project team. Status reports and presentations of data collected to date occurred every 2-3 weeks. FTA 1998 Section 15 data for MDT Metrorail, Baltimore (MTA), Washington (WMATA), Atlanta (MARTA), and Los Angeles (LACMTA) were analyzed and reviewed. Dozens of Metrorail and MDT staff were interviewed, and all divisions were toured. Site visits by the project team and two members of Metrorail staff were made to MTA, MARTA, and WMATA. A "draft" Phase I Report was submitted to the Rail Rehab Task Force, and findings and recommendations were presented to the Rail Rehab Steering Committee.

Of the systems reviewed, Metrorail compared most closely to MTA. Metrorail had fewer rail cars per route mile than MTA, LACMTA, and WMATA but had the second highest ratio of vehicles available for maximum service (VAMS) to vehicles operated during maximum service (VOMS). Metrorail received slightly less of a percentage of MDT funding than its percentage of passenger miles provided. Metrorail's maintenance cost per vehicle was lower than WMATA's but higher than MARTA's and MTA's on a total fleet basis, and Metrorail was significantly less reliable than MARTA and WMATA based on revenue miles between roadcalls.

Updated Peer Review[1]

- Since 2009, MDT has reported more VOMS per route mile than MTA
- MDT's ratio of VOMS to VAMS fell from 2nd in 1998 to 4th in 2004 and fell to 3rd in 2009
- Since 2008, MDT's reported maintenance cost per VAMS has been below the cost reported by MTA, WMATA and LACMTA
- Based on revenue miles between failures, Metrorail continued to be less reliable than MTA, WMATA, MARTA, and LACMTA, despite a reduction in the number of failures reported

[1] Data obtained from the Florida Transit Information System (FTIS), Reports, Directly Operated Heavy Rail: 1998-2010.

VOMS per Route Mile

	MDT	MTA	WMATA	MARTA	LACMTA
1998	1.90	1.84	3.35	1.91	2.40
1999	1.61	1.84	3.34	1.93	1.84
2000	1.90	2.24	3.27	1.93	1.82
2001	2.04	2.24	3.04	1.94	2.19
2002	2.13	2.24	3.21	1.94	2.19
2003	2.13	1.84	3.32	1.87	2.32
2004	2.29	1.84	3.63	1.91	2.19
2005	2.31	1.84	3.58	1.89	2.19
2006	2.31	1.84	3.58	1.91	2.19
2007	2.18	1.84	3.69	1.89	2.19
2008	2.18	1.84	3.92	1.96	2.19
2009	1.87	1.84	4.01	1.89	2.19
2010	1.87	1.84	4.01	1.96	2.19

Ratio of VAMS to VOMS

	MDT	MTA	WMATA	MARTA	LACMTA
1998	1.70	1.85	1.23	1.35	1.25
1999	2.00	1.85	1.22	1.34	1.83
2000	1.70	1.52	1.21	1.34	1.79
2001	1.58	1.52	1.21	1.35	1.46
2002	1.51	1.52	1.22	1.35	1.46
2003	1.42	1.85	1.30	1.62	1.38
2004	1.32	1.85	1.27	1.64	1.49
2005	1.31	1.85	1.25	1.85	1.49
2006	1.31	1.85	1.26	1.50	1.49
2007	1.33	1.85	1.24	1.45	1.49
2008	1.33	1.85	1.31	1.40	1.49
2009	1.55	1.85	1.33	1.86	1.49
2010	1.57	1.85	1.30	1.80	1.49

Maintenance Cost (Vehicle + Non-vehicle) per VAMS

	MDT	MTA	WMATA	MARTA	LACMTA
1998	$179,217	$149,360	$228,660	$134,754	$347,187
1999	$180,300	$164,707	$227,296	$162,890	$176,776
2000	$181,882	$173,692	$266,305	$224,995	$164,057
2001	$202,534	$172,090	$278,736	$275,486	$199,948
2002	$242,693	$191,945	$289,861	$200,726	$239,191
2003	$246,878	$199,769	$273,950	$189,190	$255,880
2004	$215,061	$204,773	$288,799	$173,668	$223,855
2005	$238,476	$195,247	$317,930	$168,826	$275,790
2006	$243,338	$213,227	$327,433	$206,044	$274,835
2007	$263,637	$257,272	$367,070	$260,261	$343,388
2008	$279,358	$309,083	$349,176	$249,799	$373,106
2009	$256,975	$278,051	$320,847	$203,337	$350,544
2010	$248,259	$273,703	$335,339	$209,782	$344,173

Revenue Miles between Failures

	MDT	MTA	WMATA	MARTA	LACMTA
1998	27,602	20,531	58,166	3,816	3,466
1999	23,880	21,602	55,825	10,079	2,210
2000	17,658	19,551	49,582	10,386	1,924
2001	37,499	29,749	69,667	14,291	7,847
2002	3,324	12,901	6,104	15,474	4,326
2003	5,114	12,789	46,287	15,436	3,941
2004	4,806	14,307	66,520	2,011	7,572
2005	4,773	24,690	59,878	1,558	3,998
2006	5,266	20,900	50,140	1,447	3,626
2007	4,777	12,868	77,851	10,666	2,943
2008	4,198	14,840	48,535	11,250	40,840
2009	2,303	7,682	48,320	19,162	37,516
2010	3,051	5,730	39,964	22,216	35,454

2002 NTD reporting change; redefined "failure"

Number of Vehicle System Failures

	MDT	MTA	WMATA	MARTA	LACMTA
1998	220	206	770	5,812	475
1999	253	194	827	2,212	821
2000	339	216	973	2,076	1,854
2001	191	139	740	1,586	706
2002	2,219	355	8,550	1,522	1,377
2003	1,506	355	1,220	1,471	1,519
2004	1,896	317	875	10,964	713
2005	1,958	191	1,038	14,754	1,470
2006	1,840	224	1,268	14,575	1,618
2007	1,749	368	861	2,062	2,034
2008	1,705	350	1,438	2,063	147
2009	2,905	688	1,486	1,282	162
2010	2,199	782	1,669	993	166

2002 NTD reporting change; redefined "failure"

The hiring, selection and training processes in place at the time of the study created hardships for Metrorail, especially in Rail/Mover Maintenance. The requirement to select "qualifiable" candidates eroded productivity, exacerbated turnover, and lengthened time for the development of job proficiency. The promotion of employees based almost entirely on seniority was causing unnatural career movement in the agency.

The practice for approving use of outside vendors was significantly more rigorous than what was called for in the collective bargaining agreement. The interrelationship of the selection/recruitment processes and the contracting issue affected the estimate of manpower needs.

Metrorail was at the low end in the number of hours dedicated to maintaining its vehicles in comparison to other properties.

System condition averages ranged from poor to fair, with obsolescence and car body subsystems driving down the ratings.

MDT's expenditures grew at a rate of 3.8 percent from fiscal year (FY) 1994 to FY 2000; however, on a constant dollar basis, the level of MDT total FY 2000 expenditures was lower than the FY 1994 level. Vehicle operations spending had been decreasing in absolute terms, and vehicle maintenance spending essentially was flat. Metrorail capital investment in facilities was rising, while no significant investment had been made in rail vehicles. Additional capital needs for Metrorail were estimated at $200 million, with $60 million of the $200 million capital needs within the program period.

Rail vehicle overhaul was recommended for a FY 2003 construction start. In addition to the midlife overhaul of the rail vehicles, significant investment in the Train Control and Traction Power systems was included in the capital needs.

Status of Recommendations

Recommendation	Status
Begin dialogue with TWU to procure types of work through contract	MDT attempted to establish a dialogue with TWU

Recommendation	Status
Establish mutually acceptable parameters between "buyers" and "users" to streamline specifications and contracts at the County level	Some component and equipment contracts were awarded to facilitate timely repairs

Recommendation	Status
Establish a process or checklist for use in evaluating new activities or programs under consideration for their potential as in-house versus contracted projects. A sample checklist was provided to MDT. Consider participation in the Rail Car Consortium to leverage the buying power of the group to obtain replacement parts and components at reduced costs	Metrorail maintains component repair shops and operates a motor shop; based on a cost-benefit analysis, a new Metromover Component Shop was established

Recommendation	Status
Pilot a "blended" approach to contracting - a procurement approach that included training Metrorail personnel while ensuring vendor expertise and warranty	All MDT contract-related activity must be managed through MDC Civil Rights Division

Recommendation	Status
Initiate an effort with Human Resources, Labor Relations, Finance, and Metrorail to establish minimum qualifications for rail maintenance classifications.	Transit Services established a 13(c) Strategic Task Force to review MDT's 13(c) recruitment, selection, and training processes to improve efficiency and effectiveness

Recommendation	Status
Develop a system of progressive advancement based on performance in addition to seniority	13(c) Strategic Task Force Report was issued in June 2001 (See Report II)

Recommendation	Status
Organize cross-functional groups to problem-solve common issues	MDT brought together cross-functional groups to assist in program planning and evaluation

Recommendation	Status
Establish methods of performance assessment that provide employees with feedback on their performance	Post benchmark performance metrics in transit areas

Recommendation	Status
Using a recognized management tool take the steps necessary to create an environment that encourages individual units to develop legitimate measures of success within the overall framework of MDT's mission	Metrorail conducts toolbox safety meetings every day on every shift to problem-solve issues and provide employees with feedback on performance

Recommendation	Status
Establish a mechanism to take advantage of the large amounts of data and information collected to discover trends, evaluate results, identify needs, and formulate plans	MDT developed action plans to target goals and track performance; Metrorail prepares detailed monthly performance reports for rail services, vehicle maintenance, rail operations, track & guideway, train control, traction power and warranty recovery using available data; EAMS installed within Metromover and scheduled for Metrorail

Recommendation	Status
Develop feasible work standards for Metrorail and use those standards to benchmark performance	Metrorail incorporated Lean Six Sigma

Recommendation	Status
Re-evaluate restrictions on use of the mainline during revenue service to maximize access to the mainline for maintenance, testing, and training.	Developed Standard Operating Procedure (SOP 81.11-A) to allow vehicle testing on the Metrorail Mainline during off-peak passenger service hours

Recommendation	Status
Remove the remaining two pairs of rail cars from "mothball" status immediately.	The remaining two pairs of rail cars were removed from "mothball" status

Recommendation	Status
Establish a system for selecting vehicles for the G inspection that includes specific criteria as well as a timeline.	Draft Rail Fleet Management Plan (RFMP), Revision 07: November - 58 rail cars had an F inspection and 26 rail cars had a G inspection.

Recommendation	Status
Take action to normalize fleet mileage to ensure that all vehicles within the fleet achieve a 40-year car life.	A fleet mileage normalization program was developed

Recommendation	Status
Establish an annual process to evaluate progress made on the recommendations, if any, which are adopted.	Unknown

Recommendation	Status
Ensure adequate funding for continuation and ultimate completion of the G inspection. Give favorable consideration to Train Control and Traction Power projects that were identified because of parts availability and obsolescence. Plan and start the Rail Car Modernization or Mid-life overhaul in FY 2003. Funding in FY 2001 will be required to perform the preliminary engineering and specification development.	Office of Management and Budget (OMB) committed to pledging a portion of the local option gas tax (LOGT) to issue $140 million in bonds to fund the Metrorail and Metromover Rehabilitation Programs. The 2002 to 2007 capital program included $119 million for the Metrorail vehicle rehabilitation, beginning with planning and engineering funds in FY 2002. In 2010, MDT conducted a cost-benefit analysis regarding rehabilitation of the current railcar fleet and determined that it was cost effective to purchase new railcars. The first new vehicles are scheduled to be received as early as 2014.

Recommendation	Status
Consider a 20-year needs study for Metrorail that would provide executive management with a view beyond the six-year capital program and serve as the pool of projects that feeds the capital program updates.	Unknown

II. 13(c) Strategic Task Force Report, June 2001

The 13(c) Strategic Task Force (Task Force) grew out of MDT's Strategic Plan, formulated by members of a steering council during a two-day retreat in September 2000. The Strategic Plan was intended not only to provide a useful framework to guide fiscal and management decision-making, but also to provide a basis upon which to evaluate progress at year's end. Several events highlighted the need for MDT to engage in pro-active planning to have greater control of their future direction. A one-cent sales tax referendum had recently failed despite favorable public perception of the proposed transportation plan. Discussions by key policy makers regarding the formation of an independent authority for transportation, with a dedicated funding source and autonomous board, had become serious.

A host of issues was identified during the retreat, and participants selected critical issues defined as "primary strategic issues" to be included in the Strategic Plan. Participants developed goals, objectives, and action steps for addressing each of the primary strategic issues and committed to work on those issues throughout the year. One of the six primary issues acknowledged was effective and efficient management of 13(c) Agreement requirements.

In response to the MDT Strategic Plan, the Assistant Director for Transit Services, established a 13(c) Strategic Task Force to review MDT's recruitment, selection, and training processes outlined in various 13(c) agreements and make recommendations to the MDT Director for improvement of their efficiency and effectiveness. The report was prepared by the Task Force, organized by MDT Assistant Director for Transit Services who served as chair of the Task Force, and consisted of representatives of various divisions within MDT, including Human Resources, Transit Services, Office of Fair Employment and Labor Practices, Bus Operations and Maintenance, Rail Track & Guideway and Vehicle Maintenance, and Field Engineering Systems Maintenance. The Task Force undertook an aggressive schedule to complete its report and finalize recommendations to the Director within a period of three months. With staff assistance from CUTR and the Florida Conflict Resolution Consortium (FCRC) at Florida State University (FSU), the Task Force developed their recommendations through a combination of formalized consensus building processes and problem-solving initiatives.

The Task Force relied on detailed information from past and current 13(c) agreements in addition to a comparative analysis of other properties on the issues being addressed, an historical overview of 13(c) from a transit law perspective, and specific examples of the impact of those agreements on MDT.

The Task Force found that in the absence of minimum qualifications, employees competed for positions on the basis of seniority and, subsequently, were trained to qualify for the positions they were awarded. This resulted in extensive recruitment lists that contained a number of minimally qualified candidates and employees lacking the requisite knowledge, skills, and abilities to successfully move into jobs. Furthermore, the technical expertise that qualified workers would normally bring to the job was eroding. MDT staff estimated that it took twice as long to fill a 13(c) position as it did to fill a non-13(c) position. Movement into, across, and out of training positions was excessive as was turnover in the feeder classifications. In many areas, an experienced supervisor directly provided the "qualifiable" training, which negatively impacted supervisor availability for on-site supervision during the course of

the training. Since the same supervisor conducted several of the training programs, training in one area was often delayed while other training was in progress. Training to develop skills beyond becoming qualified, to refresh skills or to become proficient was unavailable due to the heavy demands for the "qualifiable" training.

TWU acknowledged that employees' excessive movement into and out of training positions was a problem as was the inability of junior employees to secure advanced positions despite their qualifications. Additionally, they recognized the need for funding to establish training and a legitimate career ladder to enable their membership to secure technical jobs for which they were qualified.

Status of Recommendations

Recommendation	Status
Present recommendations for action to the MDT Director for approval	Recommendations were forwarded and the Director approved moving forward

Recommendation	Status
Immediately institute a new policy that requires an employee to hold permanent status to be considered for any new "trainee" position	The bargaining agreement precludes this recommendation from being implemented

Recommendation	Status
Invoke a 12-month waiting period for re-application for an employee who previously failed probation for a position	For all 13(c) existing/old job classifications, classification seniority (the date employee entered into his/her current bargaining unit position/classification) will be used. Employees who enter a 13(c) position shall have 30 calendar days from entering trainee status to decide whether to remain as a trainee. If employee returns to last position within the 30 calendar period he shall continue to retain all rights to exercise classification seniority as to other 13(c) job classifications. If the employee voluntarily leaves the position or is returned for cause by the employer after the 30 calendar day period the employee shall not be able to utilize or exercise 13(c) classification seniority over the next 24 month period.

Recommendation	Status
Provide Human Resources with temporary help to expedite the manual data inputting and trial implementation of the 13(c) seniority database	Staff attempted to develop a database but have not been able to automate it

Recommendation	Status
Establish a meeting with TWU leadership to discuss reducing the amount of time that position recruitments are advertised	MDT met with TWU and decided to maintain the two week schedule for advertising recruitment

Recommendation	Status
Immediate dialogue should begin with the leadership of TWU regarding the issue of the "one-bite" rule to establish a policy mandating that TWU seniority and the obligation to qualify a candidate for a new job can be exercised by an employee only once during the life of the project	"It is understood and agreed that existing employees covered by the bargaining unit will be given first opportunity for employment arrangements. (TWU 291/Miami-Dade County – Clarification of July 7, 1981 Claude Rolfe/Ron Tober Letter Establishing Arrangements for Implementing Employment Provisions of Section 13(c) Labor Protective Agreements, November 1, 2002)" MDT must follow "first opportunity – basis of seniority."

Recommendation	Status
Steps should be taken to re-establish or establish appropriate minimum qualifications and implement a career progression with career paths for each individual division	There was a Settlement Agreement reached on December 23, 2008 regarding MDT's attempt to establish minimum qualifications. "Miami-Dade Transit shall withdraw and abolish the pre-testing requirements, and all minimum qualifications, unless previously consented to in writing by the TWU 291, for the following 13(c) classifications: • Rail Vehicle Machinist (8056) • Rail Technician/Train Control (8060) • Rail Technician/Traction Power (8061) • Rail Vehicle Mechanic (8071) • Rail Vehicle Electronic Technician (8068)

Recommendation	Status
A strategic training plan should be developed contingent upon those recommendations regarding recruitment, selection, and training that are adopted	A strategic training plan has yet to be developed

Recommendation	Status
The Training Section, Human Resources, Rail/Mover Maintenance and Transit Facilities Maintenance Divisions need to meet to identify what training can be appropriately provided by local technical institutions and to what extent there is overlap in the basic training required for technical classifications across division lines	Given that TWU does not recognize the knowledge, skills, and abilities (KSAs) of existing employees, the use of local institutions to improve technical abilities appears to be premature

III. Efficiency Review, September 2001

MDT had focused extensive efforts not only to evaluate effectiveness in providing high quality transit services but also to determine financial and organizational needs for the future. MDT engaged the services of CUTR to assist in documenting rail rehabilitation needs and to develop a five-year approach to dealing with those needs. Metrorail's performance was compared with four other heavy rail systems using FTA Section 15 data. Efforts to conduct the same type of evaluation were currently ongoing for Metromover operations.

FTA had established a close working relationship with MDT, and FTA's extensive knowledge and understanding of other transit systems had become a valuable asset in assisting MDT in evaluating progress and charting future direction.

In order to determine what efficiencies might be gained in the present operating environment, the current level of effectiveness needed to be determined. What was MDT's performance based on MDT's internal assessment, and were those existing performance standards realistic? How did MDT's performance compare with that of other agencies? What efficiencies, if any, could be gained based on current available resources?

Internal Assessment

MDT used a variety of tools to measure success not only in meeting customer expectations but also in evaluating MDT's continual improvement. A 1997 study of customer satisfaction found that 80 percent of Metrorail passengers were satisfied or very satisfied with Metrorail service, and Metrobus customer satisfaction was on the increase. Metrobus passenger complaints in 1999 fell below 1997 complaints in all areas with the exception of those regarding fares/transfers; nonetheless, 51 percent of 1997 complaints and 43 percent of 1999 complaints related to service.

MDT also provided a report of system performance on a monthly basis in the form of the Transit Services "Monthly Performance Report," which contained detailed performance information concerning the rail fleet, the mover fleet, special projects/accomplishments, the bus fleet, and individual bus divisions. Several areas of performance were measured against "targets," which MDT developed to gauge quality of performance.

From October 2000 through June 2001, the following performance factors were reviewed in relationship to established targets:

- On-time performance – Metrorail and Metrobus
- Service delivered – Metrorail and Metromover
- Service disruptions – Metrorail (per 1,000 miles of scheduled service) and Metromover (per 1,000 scheduled vehicle hours)
- Weekday Peak Vehicle Requirement (PVR) availability – Metrobus, Metrorail, and Metromover
- Mean miles between roadcalls – Metrobus and Metrorail
- Mean miles between failures – Metrorail and Metromover
- Preventive Maintenance Inspection (PMI) on-time adherence

Transit Agency Performance

In the Rail Rehabilitation Phase I Final Report, CUTR cautioned against direct comparisons of agencies' performance based on "failures," because the difference in the definition of failure from one agency to another, as reported by the agencies, appeared to vary dramatically. Furthermore, National Transit Database (NTD) reporting guidelines did seem to allow subjective interpretation in the definition of a failure. Individual differences in defining a revenue service failure and varying performance specs unique to vehicle type complicate the use of agency versus agency comparisons.

MDT's articulated buses reported the lowest mean miles between failures, while new NABI buses reported the highest mean miles. The full benefit of improved mean miles of new buses would not be felt until the older buses became a smaller percentage of the total MDT fleet.

The situation was even further compounded in Metrorail comparisons with other agencies due to a wider range of mean miles between failures now available in new rail cars. MARTA originally calculated mean miles between failures for the entire fleet; however, the new series cars fell so short of the projected 50,000 miles between failures that the agency reported the new series vehicles individually, and only the older series cars were combined. A similar situation existed at WMATA, where mean miles between failures were established for each of the four series of vehicles and ranged from 36,000 to 78,000 miles, with mean miles between revenue service failures of four or more minutes at 54,000 miles for the fleet.

In the future, MDT will need to rely more on quality of service information from in-house efforts rather than data analysis and trends external to MDT.

MDT's Performance Standards

CUTR recommended in the Rail Rehabilitation Phase I Report that MDT establish a mechanism to take advantage of the large amounts of data and information collected to discover trends, evaluate results, identify needs, and formulate plans. CUTR also indicated a wider distribution of the data and analysis to the operational entities could assist the operating divisions with their planning, scheduling, and most importantly, their decision-making.

Efficiencies

MDT identified the following performance campaigns in the Monthly Performance Report to improve reliability of the Metrobus, Metrorail, and Metromover fleets.

- Transit Engineering began bid specification process to identify a consultant to provide specification development and management services for mid-life overhaul and modernization of Metrorail fleet and Phase I Metromover fleet
- Repower of thirty-seven 9300 series buses with a more reliable electronic engine that will reduce engine-related roadcalls
- Improve aesthetic condition of the buses
- Increase oversight of maintenance activities at all locations to minimize frequency of specific component failures

- Work with vendors to resolve design/manufacturer latent defect challenges and improve vehicle reliability and reduce costs
- Rail Maintenance Control enhancement and re-evaluation of processes used to collect and issue performance and reliability measures
- Implement SWAN System Data Recording to provide for the precise evaluation and identification of major bearing and gear wear failure without time consuming and costly disassembly for inspection
- Review report from Adtranz System-wide Health Check of Metromover
- Maintain Control Failure Analysis to identify trends in equipment failures

MDT made a commitment to FTA to complete an aggressive schedule of short term and immediate corrective actions, which relied heavily not only on development of data collection mechanisms but also on the tracking and analysis of the data collected.

- Reduction of roadcalls to improve mean miles between failures
- Revision of maintenance procedures to avoid recurring maintenance problems
- Accelerate G inspection work
- Identify, control and track deferred maintenance
- Upgrade "Bad" or "Poor" traction components and test, install, and maintain the grounding system
- Monitor status of 90-day vehicle storage program

Specific baselines were to be established for each item, where appropriate, by September 17, 2001, and MDT staff was to track progress, initially on a monthly basis. Gains in efficiency were to be measured and incorporated into the status tracking report.

Status of Efficiencies

MDT expanded performance campaigns identified in the Transit Services Monthly Report to improve reliability of the Metrobus, Metrorail, and Metromover. Examples of specific campaigns detailed in a recent report include:

- Metrobus – Bus Maintenance Reliability Matrix – Issue/Opened/Solution/Status/Update/Group/Expected Date of Completion/Date Completed
  - Optima EGR Codes
  - Muffler isolator failure
  - NABI 40' LFW idle shutdown
- Metrorail – Action Matrix – Description/Action/Status
  - Airbrake valve overhaul
  - Install vinyl seat covers on seats of rail vehicles
  - Glass campaign
- Track & Guideway – Action Matrix – Description/Action/Status
  - Rail fastener replacement
  - Coverboard replacement
  - Seal gland project
- Escalators and elevators

- Rail Operations
  - Calibration schedule compliance
- Warranty
  - Top five failures by mode

MDT followed through on the commitment made to FTA to complete an aggressive schedule of corrective actions, which relied heavily not only on development of data collection mechanisms but also on the tracking and analysis of the data collected. Specific baselines were established for identified items, where appropriate, and MDT staff tracks and reports progress on a monthly basis. Gains in efficiency are measured and incorporated into the Transit Service Monthly Report. MDT also distributes and posts a performance report with results for bus, rail and mover.

Implementation of EAMS, which has been successfully completed within Metromover, throughout MDT should assist the agency in streamlining not only data reporting efforts but also data use efforts. EAMS provides ready access to performance and trend data.

Following are a few of the targeted performance metrics reported in the Transit Services Monthly Report, March 11, 2011:

- On-time performance – Metrorail and Metrobus
- Service delivered – Metrorail, Metrobus and Metromover
- Service disruptions – Metrorail (per 1,000 miles of scheduled service) and Metromover (per 1,000 scheduled vehicle hours)
- Weekday AM and PM Peak Vehicle Requirement (PVR) availability – Metrobus, Metrorail, and Metromover
- Mean miles between roadcalls – Metrorail and Metrobus by Garage
- Mean miles between failures – Metrorail , Metromover, and Metrobus by Garage

IV. Rail & Mover Rehabilitation Report, Phase II, April 2002

The work was intended to assist MDT in documenting its rail rehabilitation needs and develop a plan to address those needs. The assessment included a review of the current condition of the Metrorail and Metromover systems, a comparison with other transit properties' heavy rail and people mover systems, and a recommended plan of action to carry MDT forward into the next five years.

Specific detail was devoted to the provisions of the labor agreements of the comparable transit properties as they related to contracting for outside services and the recruitment, selection and advancement of employees. Specific attention was given to those contract provisions resulting from the provisions of Section 13 (c) of the UMTA Act of 1964.

Phase I of the project began on March 24, 2000 and focused on Metrorail. The Phase I Final Report was completed in January 2001. Phase II commenced on August 25, 2000.

The approach to Phase II of the project included the formation of a Mover Rehabilitation Task Force composed of key personnel within MDT in addition to the project team. Status reports and presentations of data collected to date occurred monthly. FTA Section 15 data for MDT Metromover, Jacksonville Skyway (Skyway) and Detroit Downtown People Mover (DDPM) were analyzed and reviewed. Numerous Metromover and MDT staff were interviewed, and all divisions were toured. The initial plan included site visits to other comparable people mover systems. Given the disparity in size and system-type of the two systems for which Section 15 data were available, the Mover Task Force determined site visits to people mover systems employing vehicles similar to MDT's would be more appropriate. The private concern contracted to operate and maintain those systems was concerned with proprietary information and, therefore, reluctant to provide the project team with any information that could be used to determine operating expenses and manpower requirements. Since those two factors were at the heart of the purpose of the visits, the plan to visit those properties was discarded. Similar vehicle data were not available for comparison.

The project for Metromover was conducted in essentially four phases:

- Assessment of the current state
- Estimation of needs
- Comparison with other systems
- Recommendations for the next five years

During the course of the project, MDT expanded the scope of work to include a more thorough operational review of specific Metromover activities and other operations within MDT. Items directly related to Metromover included the following:

- Metromover staffing
- Wayside replacement schedules
- Allocation of revenue vehicles
- Visits to other properties

Other operations for review included:

- Track & Guideway staffing
- Rail Maintenance Control manpower needs

A Mover Rehabilitation Task Force, composed of MDT Rail Division personnel, met formally four times after the project began to track the progress of CUTR's work, review draft findings, and provide comments and guidance.

MDT Rail Maintenance Control Division assembled much of the data required. In addition, there was heavy reliance on FTA's Section 15 data for Metromover and the other people mover systems. The most recent year for which transit properties reported in a consistent manner was 1998; however, data for Metromover were collected through 1999, and for 2000 in some cases.

Several dozen interviews with MDT executive staff, mover maintenance management, support function supervisors, and working supervisors were conducted over the course of Phase II. The interviews provided a broad perspective and detailed understanding of the challenges and inner workings of the Metromover Maintenance function.

Metromover was completed in its current configuration in May 1994, at an original cost of $381.3 million. With 8.8 miles of guideway, 29 vehicles, a substantial maintenance facility, a central control facility, and associated heavy maintenance equipment, the system represented a significant public investment.

Comparison with Other Systems

After reviewing other people mover systems, CUTR researchers determined that a system comparable to the Metromover system did not exist. Airport people mover systems lacked the complex switching and loop configurations employed at Metromover, and the Skyway and DDPM lacked the breadth and scope of MDT's Metromover. DDPM, the larger of the two systems, was less than half the size of Metromover.

Incident Analysis

- Metromover incidents occurred in no consistent pattern – time of year, day of week, or time of day, although, the time of occurrence had gradually grown to be earlier in the day.
- Although most deboardings occurred at Government Center, the number appeared to be disproportionately high because, when possible, passengers were transported to Government Center for deboarding to facilitate transfer to other destinations.
- In 2000, Third Street Station and Bayfront Park Station showed the highest numbers of deboardings, while most other stations either maintained 1998 and 1999 levels or had few deboardings.
- Stations with the highest numbers of incidents were Government Center, College North Station, Knight Center, Third Street Station, and Omni Station. College Bayside and Bayfront Park, which were not included in this list, recorded high incidents during 1998 and 1999.
- No apparent trends in terms of loops or high incident corridors were identified.

- There was no indication that the Omni Recovery Technician response time was longer than response time for technicians at other locations.
- Over half of the time, service was resumed in one minute or less, and 90 percent of the time, service was restored within ten minutes or less.

Passenger Boardings

- The highest weekday and weekend boardings were reported at Government Center. Boardings at Bayfront Park followed Government Center on weekdays, while Brickell Station boardings followed Government Center on weekends. Government Center and Bayfront Park both served major employment centers. Government Center and Brickell provided connections to Metrorail.
- High volume stations occurred throughout the entire system. The current configuration of five trains per loop provided short headways, frequent service, and met current service needs.

Metromover Wayside

- Hi-cycle switches required more labor, more repairs, and more overhaul than lo-cycle switches.
- While the Wayside did show an increased need for preventive maintenance (PM) and repair labor hours, CUTR and Bombardier Transportation were consistent in their positive analysis of the wayside condition.
- No matter what measure was applied in the wayside overhaul, a "hot spot" that included some combination of Switch 1, Switch 2, Switch 3, Switch 8 and Third Street Station was consistently identified as an area of high need. For rail overhaul, additional high need areas outside of the "hot spot" included: Omni Station, College North Station, and State Plaza Station. While the "hot spot" was in the area of Switch 1, from an overall system perspective, a corridor from Government Center to College North Station emerged not only for the total overhaul but also for the rail overhaul.
- Low rail overhaul costs included Freedom Tower, Park West, Switch 12, Switch 13, Switch 17, Switch 52, Switch 53, Switch 55, School Board, Switch 4, Riverwalk, Fifth Street, Eighth Street, Switch 7, Eleventh Street, Switch 10, Bicentennial Park, Bayfront Park, and Switch 21. Twelve of the nineteen low cost rail overhaul areas were located on the extensions.

Metromover Fleet

- Expansion of the Maintenance Shop was not commensurate with increase in need, when the fleet expanded from 12 to 29 vehicles.
- Since FY 1996, vehicle availability had improved, but was below the high recorded in FY 1994.
- Vehicles average 350,000 miles, with an average of 437,000 miles for Phase I vehicles and 283,000 for Phase 2 vehicles. While the average Phase I mileage was higher, during the study period it was observed that Phase 2 vehicles accumulated mileage at a faster rate. Metromover staff had already initiated a rotation program involving only high mileage Phase 2 vehicles to extend useful life.
- Actual 2001 mileage increased at a rate of 13.8 percent, rather than the 9.8 percent reflected in the mileage projections.
- Vehicle PMs, including G inspections, were not only completed 100 percent of the time but were also completed on time. The decline observed in vehicle repair labor hours coincided with an increase in G inspection and wayside PM during the study period. Phase 2 vehicles outperformed

Phase 1 vehicles. Phase 1 vehicles showed not only a greater range in miles between failures but also greater inconsistency in performance between vehicles. While Phase 2 vehicles were unable to exceed the maximum miles between failures logged by some Phase 1 vehicles, Phase 2 vehicles consistently achieved the Phase 1 minimum miles logged. All 17 Phase 2 vehicles exceeded 400 miles between failures, while only 9 of 12 Phase 1 vehicles achieved that level.

- Mothballing a portion of the fleet reduced vehicle availability; however, recovery from mothballing was faster than Metrorail's recovery.
- No consistent pattern was observed regarding removal of vehicles from service.
- Since 1998, the six most frequent vehicle malfunctions remained the same with similar rates of frequency, and included: Automatic Train Operation, overspeed, no depart, power, and no arrive. Malfunction of the door was the overwhelming leader.
- Vehicle Malfunctions accounted for 84 percent of all incidents in 1998, 80 percent of all incidents in 1999, and 79 percent of all incidents in 2000.
- The condition of the vehicles rated "fair" overall.

Metromover Maintenance Staff

- When the system expanded, Metromover maintenance staffing did not increase commensurately with the increase in complexity added by the extensions.
- Hiring, selection and training processes currently in place created hardships for the Rail Division, especially in Rail/Mover Maintenance.
  - The requirement to select "qualifiable" candidates eroded productivity. Candidates without an aptitude for vehicle maintenance were recruited. Turnover was exacerbated – unnecessary movement resulted from lack of appropriate minimum qualifications. Time for development of job proficiency was lengthened, and efficiency was impeded. The effects of the selection and promotion processes were particularly significant with the Metromover Maintenance Technician due to the broad scope of the technical requirements of the position. The promotion of employees based almost entirely on seniority was causing unnatural career movement in the agency, contributing to high turnover and vacancy rates in "feeder" classifications, while providing little screening of aptitude for what is in some cases a total career change.
- Metromover's vacancy rate was lower than the MDT overall vacancy rate.

Staffing Requirements

Metromover Maintenance

- Metromover was understaffed 19-21 positions based solely on the physical growth of the system.
- Six additional Metromover Technicians were required to operate the Metromover Component Shop during two shifts on a daily basis.
- Metromover Maintenance staffing needs included: 20-22 additional Maintenance Technicians, 4-5 additional Maintenance Supervisors, and 1 Rail Care Cleaner Supervisor to meet the maintenance needs of the existing system and operate the newly established Metromover Component Shop.

Track & Guideway (Metrorail & Metromover)

- Explore the transfer of responsibility for the top of the Metrorail guideway inspection to Transit Engineering and consider contracting graffiti removal and vegetation control. If responsibility for these activities remained within the jurisdiction of Track & Guideway, three additional Rail Structural Repairers were required.
- Complete a cost analysis of contracting the Insert Replacement Program versus completing in-house. If it was cost effective to complete the project in-house, additional staff required for the project included: two crews of one Rail Structure & Track Supervisor and six Track Repairers each, for a total of two supervisors and twelve repairers.
- Increased workloads within Rail Track and Structures dictated the need for four additional Track Equipment Operators, not only to operate equipment but also to maintain and repair equipment that was being used to a greater extent. The addition of one Track Shop Supervisor would provide continuous supervisory coverage for the Track Shop, which operated 24 hours a day, 7 days a week.
- Rail Structure staff required to complete Remedial Action Reports based on time intervals established by the Florida Bridge Inspection Program totaled two Rail Structure & Track Supervisors and eight Rail Structural Repairers. These ten additional positions should be approved based on a funding commitment from the Florida Bridge Inspection Program.
- Additional staffing needs for the new Palmetto Station and rail extension included: two Rail Structural Repairers, two Guideway Inspection Specialists, four Track Repairers, and one Track Equipment Operator.

Rail Maintenance Control

- With an increased emphasis on workload measures, the role of Rail Maintenance Control in tracking and analyzing data had become more critical. Eight additional Rail Maintenance Control Clerks were required to meet Metrorail and Metromover's current needs.
- A significant effort was required to establish correct, viable databases that could be shared across divisions and minimize duplication of data handling efforts. That role would be best filled by a Program Designer & Analyst position as a direct report to the Chief of Rail Maintenance Control.

System Condition

- Using 1987 UMTA Rail Modernization criteria modified for vehicles, wayside, and structures, Metromover staff rated subsystem level conditions on a scale of 1 (bad) to 5 (excellent).
- Vehicle condition averages by phase ranged from "poor" to "fair" with an overall condition rating of "fair" for Phase 1 and Phase 2 vehicles.
  - Differential, Doors, Pneumatic, ATC, and Friction Brakes – 2 (Poor)
  - Electrical, Prop/Dyn Braking, Lighting, HVAC, Guidance, Suspension, Carbody, Communications, and Spring Brake – 3 (Fair)
- Phase 1 wayside and structures overall rated "fair" and Phase 2 wayside and structures rated "good."
  - Power distribution, Phases 1 & 2 – 4 (Good)
  - System-wide Controls, Phases 1 & 2 – 3 (Fair)
  - Structures, Phase 1 – 4 (Good) and Phase 2 – 5 (Excellent)

Financial

- MDT's operating expenditures grew at a rate of 2.3 percent from FY 1994 to FY 2000.
- Since FY 1994, Metromover operating expenditures more than kept pace with inflation and averaged 6.3 percent of the agency's total.
- Metromover ridership represented one percent of the entire MDT system.
- Construction of the Metromover Extensions in FY 1994 consumed over 50 percent of all of MDT's capital spending in 1994 and dropped to less than one percent in both FY 1999 and FY 2000.
- With a capital program of nearly $40 million, including $15 million for the Phase 1 vehicle midlife rehabilitation, MDT made a significant commitment to ensuring the long-term viability of Metromover. If this program came to fruition, the system would be positioned well. The current age of the system required that this reinvestment take place.
- Projected capital, with the Phase 1 vehicle midlife addressed, left few capital requirements not covered for Metromover.

Status of Recommendations

Recommendation	Status
MDT should provide additional Metromover, Track & Guideway, and Rail Maintenance Control staff and operating funds necessary for the identified positions	MDT adjusted staffing allocations based on identified needs and available funding during a major reorganization in 2009

Recommendation	Status
MDT should ensure that sufficient funding continues and hold the schedule on the Metromover Phase 1 vehicle midlife rehabilitation	Phase 1 and 2 Metromover vehicles were replaced with new vehicles

Recommendation	Status
MDT should establish a universal location identification system map for the Metromover wayside to track incidents, repairs, and maintenance	Knowledge Management performs trends analyses though use of EAMS, which is fully functional for Metromover

Recommendation	Status
MDT should have Transit Engineering evaluate the area referred to in the report as the "hot spot" and investigate potential engineering or design solutions in this area to minimize maintenance costs	Metromover in conjunction with Transit Engineering established an accelerated schedule of hi-cycle switch replacement in the area of the "hot spot," which has reduced delay

V. Metrorail Fleet Management Plan, Revision 3, September 2002 - Revisit

CUTR researchers assisted MDT in updating the Metrorail Fleet Management Plan (RFMP). The RFMP was a statement of the processes and practices by which MDT established current and projected Metrorail revenue fleet size requirements and operating spare ratio. The 2002 RFMP (Revision 03) served as an update of the April 2002 RFMP (Revision 02) and included a description of the system, planned revenue service, projected growth of the system, and an assessment of vehicle maintenance current and future needs.

Metrorail's processes and practices, as outlined in the plan, complied not only with FTA Circular 9030.1B, Chapter V, Section 15 entitled, "Fixed Guideway Rolling Stock," but also with supplemental information received from FTA.

The plan was based on current realities and assumptions and was, therefore, subject to future revision. The plan was to be updated on a regular basis to assist in the planning and operation of Metrorail.

The RFMP was structured to present the demand for service and methodology for analysis of that demand; address the supply of vehicles; explain the balance between the demand for and supply of vehicles; and, provide a summary of the maintenance plan.

The 2002 update included the following revisions of and additions to the October 2000 RFMP.

New Service

The Palmetto Station and rail extension was a new 1.4-mile expansion of Metrorail from the previous northern terminus, Okeechobee Station, using existing railroad right-of-way, to the west side of the Palmetto Expressway. The Palmetto Station extension was scheduled to begin revenue service in February 2003. It included a passenger station and a surface parking facility that provided over 700 spaces. Service for the Palmetto Station extension would increase the Peak Vehicle Requirement (PVR) by one six-car train.

New Standard Operating Procedure (SOP) 81.22-A

A new Standard Operating Procedure (SOP 81.11-A) was developed to allow vehicle testing on the Metrorail Mainline during off peak passenger service and was routed for approval. Training of maintenance and transportation personnel was required prior to implementation, which was expected to occur by the end of the first quarter of 2002. Pursuant to the procedure:

- Testing must be accomplished without impact to passenger service
- Off peak hours for the purpose of vehicle testing included the following:
  - Weekdays between 9:30 a.m. and 2:00 p.m. and 7:30 p.m. through 4:00 a.m., when headways were 15 minutes or greater
  - All day on Saturday, Sunday, and major holidays
- Trains with the following anomalies were not tested during revenue service:

  - ATP in Bypass
  - Less than 100% friction braking
  - ATP C Inspections
  - Vehicles requiring doors to be opened at stations
  - Inoperative air compressors
- Test trains were composed of a minimum of four (4) cars and a maximum of six (6) cars.
- The Vehicle Maintenance Supervisor on duty certified one married pair of the consist scheduled for testing as ready for revenue service prior to leaving William Lehman Center (WLC).
- Facilities system maintenance and other non-revenue activities could occur 24 hours a day, 7 days a week.
- Under normal conditions, all stations were serviced. The Tri-Rail Station was not serviced when Tri-Rail was closed.
- After maintenance or any other activity requiring assurance that the guideway was clear and ready for normal operation, Central Control implemented a sweep of any affected area. Train operation was in manual mode not exceeding 28 mph and was a non-revenue (light) train. A copy of *DRAFT SOP 81.48: Metrorail Mainline Sweep Train Procedure* was attached to the FMP as Appendix A.
- Central Control operated 24 hours a day, 7 days a week to ensure supervision, control, communications, and coordination of the Metrorail Mainline Operation. It was responsible for all revenue and non-revenue train movements made on the Mainline, including the Tail Track to the Yard Limits.
- The WLC Yard Tower was staffed 24 hours a day, 7 days a week to ensure supervision, control, communications and coordination of Metrorail Yard Limits Operations. All movement of trains to the maintenance shop and wash area, except for no-signaled/non-powered maintenance of way tracks, was controlled through the Yard Tower.

6-car Train Standard

In late 2000, Metrorail implemented a significant service improvement to address overcrowding during peak periods on workdays. Metrorail reconfigured peak period trains from 4-car trains to 6-car trains. With a 6-minute headway during the peak period and a passenger load factor of 1.00, a 6-car consist could serve more than 7,000 passengers as compared to slightly more than 4,700 with a 4-car consist.

Revised A and B Interval PMI Schedules

In July 2001, the existing A, B, C, and D preventive maintenance schedule, corresponding to 45, 90, 180, and 360-day intervals was revised to 60, 120, 180, and 360-day intervals. The A interval was to be performed every 60 days rather than every 45 days, and the B interval was to be performed every 120 days rather than every 90 days. The C and D intervals remained unchanged.

An analysis of fleet labor hours required per year showed savings of an estimated 4,590 labor hours based on the revised PM schedule. A inspections required would drop from eight to six annually, and B inspections would be reduced from four per year to three. The elimination of the three inspections translated into a savings of 204 maintenance inspections annually with a savings of approximately 7.5 mechanical hours and 15.0 electrical hours for each PMI.

Nearly 45 percent of PMI tasks were A-type tasks and 5 percent were B-type tasks involving routine inspection, cleaning, and minor adjustments. Since these tasks were performed frequently, negligible systems impact was expected by increasing the A interval by 15 days and the B interval by 30 days. The mechanical and electrical items inspected included contact condition, fluid levels, grease lubrication, motor brush wear, and carbody components that do not change rapidly. Most of these items remained in acceptable condition well beyond the inspection intervals, and it was unnecessary to change component wear-out criteria for replacement as specified in the PMI. Feedback from maintenance personnel was to be used to review the revised schedule and adjustments were to be made, if necessary.

PMI labor hour savings could be allocated to other maintenance activities, such as rebuilding low-rated G inspection items. Other potential benefits of the revised PM schedule included the following:

- Possible reduction in overtime expenditures
- One additional married pair for service on most days
- Reduction in yard moves to and from shops for PM purposes and other sequential moves of approximately 20 percent
- Reduction in facilities maintenance due to decreased lift usage for PMIs
- Improvement in mean miles between failures (MMBF) based on increased component repair activity
- Reduction in disposable parts expenditures

Work Plan to Improve MMBF

Maintenance staff developed a work plan to improve MMBF. The action plan included additional allocation of manpower for vehicle repair and maintenance from a variety of sources to reduce in-service failures. Changes in the rail car PMI schedule would provide additional labor hours for repair of G inspection components rated "bad" or "poor." Six Electronic Technician (ET) positions that were eliminated when vehicles were mothballed in 1995 had been restored, and the ETs had already begun work.

Other actions included correcting mean miles/time methodology, defining "failure," establishing an efficient and accurate methodology to measure on-time performance, and recalculation of service disruptions.

In October 2001, Metrorail redefined "failure" for performance reporting. The methodology for measuring MMBF performance for Metrorail in the future will be based on service disruptions equal to or greater than three minutes. Establishing a range of time for service interruptions provided a better indication of disruptions that actually impacted passengers and brought Metrorail more in line with the reporting methodologies common within other transit agencies.

Vehicle Mileage Normalization

Based on an analysis of individual car mileage, MDT recognized that the range between the maximum and minimum miles logged by the rail cars was projected to grow. Given little prospect for the acquisition of additional rolling stock and the existing lease/lease-back arrangement, the need to

maintain the fleet for 40 years was found to be critical. As a result, MDT revised the vehicle storage program.

Under the new storage program, up to six (6) of the highest mileage cars were stored for a period of 90 days, followed by the storage of the second six (6) highest mileage cars. Each vehicle received its regularly scheduled inspection prior to storage and was capable of returning to service immediately at the end of the 90-day storage period after receiving a storage inspection. The high mileage vehicles spent 90 days in storage and then 90 days in revenue service prior to being returned to storage if their mileage continued to rate in the top six (6). The mandatory return to revenue service after a 90-day period in storage eliminated a vehicle from remaining in storage indefinitely. Three married pairs were assigned to storage/rotation.

Mid-life Modernization of Vehicle Fleet

OMB committed to pledging a portion of the LOGT to issue $140 million in bonds to fund the Metrorail and Metromover vehicle rehabilitation programs. The capital program, 2002-2007, included $119 million for Metrorail vehicles overhaul, beginning with planning and engineering funds in FY 2002.

A request to advertise for Consultant Services to develop bid documents for Metrorail and Metromover vehicle fleet modernization was processed through the Expedite Ordinance and was sent to the County Manager's office for approval.

The schedule for the Rail Mid-Life Modernization request for proposal (RFP) process and the preliminary schedule for the modernization were provided as figures in the RFMP.

Field Engineering was planning for a complete rail fleet mid-life modernization to begin in October 2003. Mid-life modernization was intended to:

- Upgrade and modernize systems for improved performance;
- Eliminate increased levels of obsolescence currently being experienced because replacement parts were no longer produced; and,
- Bring the cars to a "like new" condition in preparation for the second half of the fleet life.

Work was to be contracted due to the scope of work to be performed and the nature of the facilities that were required to support the project. Field Engineering was to develop specifications and schedules in conjunction with the Consulting Services Contractor. The estimated time frame to complete modernization, at 2 vehicles per month, was 6 years from the start of the program.

It appeared that an aggressive schedule of rail car modernization would affect the supply of revenue vehicles. A significant amount of coordination would be required to ensure maximum allocation of rail cars for modernization and complete the project in a reasonable time frame while maintaining a high level of consistent, reliable, and frequent customer service. The peak vehicle requirement drove the number of rail cars available for modernization. MDT staff, working in conjunction with the Rail/Mover Rehab Consultants, would develop a schedule that provided maximum allocation of the existing fleet. Samples of various options available to MDT staff to maximize use of the fleet by reducing PVR were

developed. Options included lengthening the headway, reducing the car consist from six cars to four cars, increasing the passenger load, and by combining multiple factors.

Metrorail Fleet Management Plan Update

MDT updated the RFMP in September 2005 (Revision 04). RFMP Revision 04 contained the following major changes: a complete step-by-step calculation of the Peak Vehicle Requirement (PVR) and Operating Spare Ratio (OSR), final determination of the PVR prior to FY 2005 and during the mid-life rehabilitation, and removal of the discussion concerning the mid-life rehabilitation. Major changes included in the April 2007 RFMP (Revision 05) included updated performance measures, future system development and the new car purchase. The RFMP was updated again in June 2008 (Revision 06) to reflect the new car procurement in lieu of rehabilitation and detailed maintenance facility requirements to support the new extensions and rail requirements. A draft RFMP (Revision 07), dated November 2010 was in the process of review at the time of this report.

VI. Metrorail Operations Plan, Revision 7, February 2003

CUTR researchers assisted MDT in the production of the MDT Metrorail Operations Plan, Dadeland South to Palmetto Station (Tail Track to Yard Limit), Revision 7. The operating plan incorporated the newly constructed Metrorail Palmetto Station and delineated the Metrorail Train Verification Testing Procedure. An updated operations plan was required by FTA to address expanded rail operations.

The Palmetto Station and rail extension was a 1.4-mile expansion of Metrorail from the previous northern terminus, Okeechobee Station, using existing railroad right-of-way, to the west side of the Palmetto Expressway. The Palmetto Station extension was scheduled to begin revenue service in February 2003. It included a passenger station and a surface parking facility that provided over 700 spaces. Service for the Palmetto Station extension increased the Peak Vehicle Requirement (PVR) by one six-car train.

Appendix A: Operation Plan, Inclusion of Palmetto Station

The plan provided operational information for the inclusion of the Palmetto Extension in general terms. Information regarding operating service levels, staffing, and a physical description of the new Palmetto Station were covered in the document.

The plan provided detailed information concerning:

- Operating Hours and Service Levels
- Weekday and Weekend Vehicle Requirements
- Mode of Operation
  - Palmetto Station Track 1 (T1) Operation (preferred track for passenger service)
  - Palmetto Station Track 2 (T2) Operation (auxiliary track for service put-ins or lay-ups)
- Vehicle Storage
  - Vehicle Storage during Passenger Service
  - Vehicle Storage during Non-passenger Service
- Electrification
- Rail Transportation Palmetto Station and Service Familiarization
  - Station Familiarization
  - Service Familiarization
  - Rail Training/Pre-Revenue Testing
  - Passenger Service Notification

Appendix B: Inclusion of Metrorail Train Verification Testing Procedure

The purpose of this procedure was to provide a series of coordinated tasks required in conducting vehicle testing on the Metrorail Mainline during off-peak passenger service hours. Off peak hours for the purpose of this procedure were as follows:

- Weekday
  - 9:30 a.m. - 2:00 p.m., when headway was $\geq$15 minutes
  - 7:30 p.m. – 4:00 a.m., when headway was $\geq$15 minutes

- Weekend (Saturday, Sunday and major holidays)
  - All day

Testing had to be accomplished without impact to passenger service. This procedure applied to all employees assigned to the mainline. Coordination between all personnel was required for mainline vehicle testing to be performed in a safe, efficient and productive environment. Each Vehicle Maintenance Technician responsible for testing was required to have completed training on this procedure, operational training to include reading switches and signals, and use of the XA7 module to make efficient use of the test time. A signature sheet was completed for each technician to acknowledge receipt of training.

Trains with any of the following anomalies could not be tested during revenue service: ATP in Bypass, trains with less than 100 percent friction breaking, ATP C inspections, and vehicles requiring doors to be opened at stations or cars with inoperative air compressors. A test train was composed of a minimum of four (4) cars and a maximum of six (6) cars. The plan provided detailed information concerning:

- Associated Materials
- Procedure
  - Maintenance Supervisor
  - Rail Vehicle Maintenance Technician
  - Yard Master
  - Rail Traffic Controller
  - Train Operator

Metrorail Operations Plan, Revision 7, Attachments A & B were incorporated into MDT's most recent Fleet Management Plan.

VII. Mechanic Manpower Analysis, June 2003

MDT requested CUTR's assistance in developing a methodology to determine future Vehicle Maintenance Mechanic needs.

In response to a voter referendum, MDT was charged with expanding service to a level that would almost double 2002 mileage by 2005. Based upon estimated service requirements outlined in the PTP, the bus fleet directly operated by MDT would grow from 701 to over 1,300 buses with an increase in annual mileage from 30 million to more than 55 million.

Additional manpower needed to maintain the expanded fleet had to be identified. In the current transit environment, work standards for all elements within individual job classifications did not exist. While standards for several specific work activities were developed by Florida International University (FIU) pursuant to an agreement with MDC, the project was in its beginning stages, and it would be some time before work standards for all significant elements of the vehicle maintenance program were finalized. In the absence of such standards, determination of the level of manpower required to operate effectively and efficiently had to be established by an alternative methodology.

Despite the fact that transit agencies lacked formal work standards, all transit agencies typically maintained rather detailed records of labor hours expended as well as vehicle related data. Within MDT, labor hours accrued by all classifications of non-supervisory maintenance staff were recorded, as were vehicle revenue and non-revenue miles.

MDT asked CUTR researchers to ascertain the soundness of a methodology developed by Maintenance managers, using available MDT data, to project transit Mechanic staffing needs. The methodology used identified the number of full-time Mechanics required to provide a defined volume of miles. Actual FY 2001 data used for the analysis included 26,481,222 annual vehicle miles, a complement of 162 full-time Mechanics, and 293,559 annual work hours that included overtime hours.

The steps used in calculating Mechanic manpower requirements are listed below.

1. Establish mechanic's annual work days: 365 days – 104 days off = 261 available days
2. Establish mechanic's unavailable work days: 13 holidays off + 14 annual leave days (average) + 12 sick leave days (average) = 39 unavailable days
3. Calculate mechanic's annual available days: 261 available days – 39 unavailable days = 222 annual available days
4. Calculate mechanic's daily available work hours: 8 hours – 30-minute lunch break – 2 10-minute work breaks – 10-minute clean-up period = 7 available hours per work day
5. Translate mechanic's annual available days into annual hours: 216 available days x 7 hours per day = 1,554 hours per year
6. Calculate work hours required for each vehicle mile: 293,559 work hours per year / 26,481,222 vehicle miles = 0.0111 work hours per vehicle mile
7. Multiply additional miles by work hours required
   a. 4,206,353 projected FY 2004 miles x 0.0111 work hours per mile = 42,064 additional work hours

   b. 7,233,195 annualized miles in FY 2004 x 0.0111 work hours per mile = 72,332 additional work hours
8. Divide additional work hours required by a mechanic's available hours
   a. 42,064 projected FY 2004 additional work hours / 1,554 available hours per mechanic = 27 mechanics required
   b. 72,332 annualized additional work hours / 1,554 available hours per mechanic = 47 mechanics required
9. Divide total additional miles by the number of required mechanics to determine the number of miles each mechanic can produce
   a. 4,206,353 projected FY 2004 miles / 27 mechanics = 155,400 vehicle miles per mechanic
   b. 7,233,195 annualized FY 2004 miles / 47 mechanics = 155,400 vehicle miles per mechanic

A similar exercise was conducted for Body Mechanic staffing needs and yielded 642,917 vehicle miles per Body Mechanic.

In summary, the methodology used to determine Mechanic and Body Mechanic manpower requirements appeared to be sound. A critical component in the calculation of manpower requirements was the level of availability of a full-time employee; the reliability of the data could be enhanced in the future through the use of data from multiple years. The fact that MDT's employee reporting system captured 270,000 of the 293,000 hours (approximately 92%) identified in the analysis of the labor hours reported lent credibility to the analysis. When compared across other modes within MDT, the established level of 1,554 hours appeared to be reasonable.

Depending upon the method by which miles were projected, the FY 2004 need for Mechanics ranged from 27 to 47, and the need for Body Mechanics ranged from 7 to 11.

As an important step in the evaluative process, CUTR researchers examined MDT as compared to comparable transit agencies.

Using FTA Section 15 bus data for year 2000, researchers conducted a cluster analysis to identify those agencies most closely related to MDT in terms of operating characteristics. Cluster analysis identified a set of observations into two or more mutually exclusive unknown groups, based on combinations of grouping variables. The purpose of cluster analysis was to discover a system of organizing observations into groups, where members of the groups shared common properties, given a set of grouping variables. The main advantage of using cluster analysis was to limit and minimize subjective intervention in selecting objects (in this case the agencies). This operation could be considered a purely statistical moment upon which the researcher was still capable of exerting influence on all phases of analysis. The generation of clusters was obtained through joining algorithms. The purpose of these algorithms was 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 employee full-time equivalents (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.

Two clusters were identified in the analysis. Nine agencies, including MDT, formed one cluster, while four agencies fell into cluster two. Cluster one was selected and included the following agencies that were used in the comparative analysis:

- 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

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 median.

In summary:

- In maximum service, MDT operated fewer vehicles and had fewer vehicles available than comparable agencies, while the ratio of vehicles operated to vehicles available equaled that of other agencies.
- In terms of annual vehicle and passenger miles, MDT exceeded all comparable agencies in the volume of miles logged, including passenger miles, when compared to vehicles operated in maximum service.
- MDT reported 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 was similar across the agencies.
- MDT reported fewer full-time maintenance employees than comparable agencies; however, the number of passenger miles per employee exceeded comparable agencies.

CUTR researchers found that from a maintenance perspective, MDT was quite like other transit agencies that provided similar levels of service. MDT appeared to provide slightly more miles with fewer vehicles. Significant deviation from the average and median was most notable in MDT's ratio of passenger miles to full-time vehicle maintenance employees, which was higher than most comparable agencies. Based on the analysis, MDT's staffing for vehicle maintenance was slightly below that reported by other transit agencies providing service at a level similar to MDT's.

The methodology used by Maintenance to determine additional Mechanic and Body Mechanic manpower needs appeared to be sound. The level of availability of a full-time employee was a critical component in the calculation of manpower requirements, and when compared across other modes within MDT, the established level of 1,554 hours appeared reasonable. The completion of the ongoing work standards project will provide MDT 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.

Status of Mechanic Manpower Determination

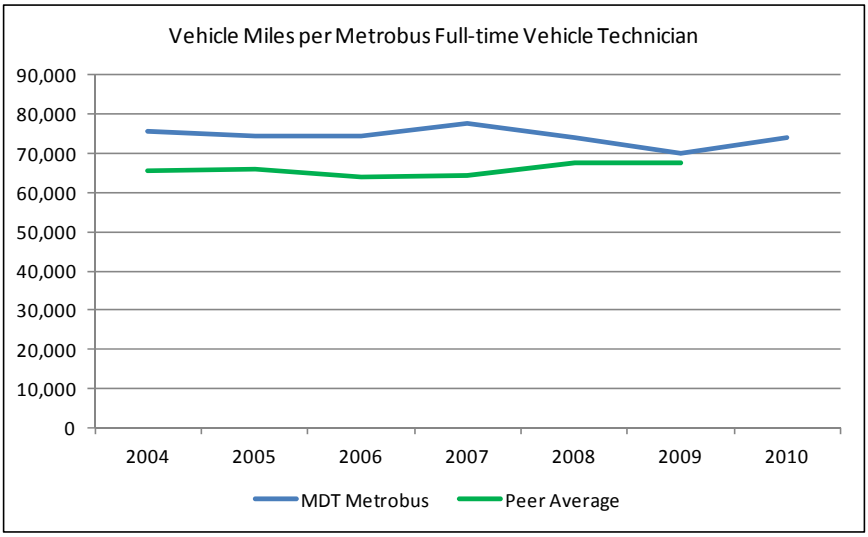
Using actual full-time and part-time employee work hours, an analysis of vehicle miles and vehicle maintenance employee hours from 2004 through 2010 indicated vehicle miles per MDT Metrobus vehicle maintenance full-time equivalent employee (FTE) ranged from 70,118 to 77,664 miles. MDT logged more vehicle miles per FTE than the peer group average (Volume One: Peer Review).

Vehicle Miles per MDT Metrobus Vehicle Maintenance FTE

	Vehicle Miles		Vehicle Maint FTEs		Vehicle Miles per FTE	
	MDT Metrobus	Peer Average	MDT Metrobus	Peer Average	MDT Metrobus	Peer Average
2004	36,037,702	25,955,208	476	397	75,709	65,378
2005	39,901,446	25,070,746	535	381	74,582	65,802
2006	42,890,441	24,625,400	577	384	74,334	64,129
2007	42,016,073	24,771,344	541	386	77,664	64,174
2008	39,113,657	25,398,092	529	377	73,939	67,369
2009	37,092,499	25,877,504	529	384	70,118	67,389
2010	34,345,931		463		74,181	

Source: An Analysis of Miami-Dade Transit's Operating Cost Efficiency: Volume One, Peer Review;

FTE = 2,080 annual employee work hours



VIII. Metromover Fleet Management Plan, Revision III, June 2003

CUTR researchers assisted MDT in updating the Metromover Fleet Management Plan (MFMP). The MFMP was a statement of the processes and practices by which MDT established current and projected Metromover revenue vehicle fleet size requirements and operating spare ratio. The 2003 MFMP served as an update of the October 2000 FMP and included a description of the system, planned revenue service, projected growth of the system, and an assessment of vehicle maintenance current and future needs.

Metromover's processes and practices, as outlined in the plan, complied not only with FTA Circular 9030.1B, Chapter V, Section 15 entitled, "Fixed Guideway Rolling Stock," but also with supplemental information received from FTA.

The plan was based on current realities and assumptions and was, therefore, subject to future revision. The plan is to be updated on a regular basis to assist in the planning and operation of Metromover.

The MFMP was structured to present the demand for service and methodology for analysis of that demand; address the supply of vehicles; explain the balance between the demand for and supply of vehicles; and, provide a summary of the maintenance plan.

The 2003 update included the following revisions of and additions to the October 2000 MFMP.

Use of 2-car Trains as a Service Improvement

Service level drove Metromover operating requirements just as it drove Metrorail's operating requirements; however, while Metrorail relied on service headways and passenger volumes to determine frequency of service and train configuration, Metromover relied solely on passenger volumes. Metromover operated based on a fixed rather than a variable headway. Therefore, service adjustments were driven by the ebb and flow of passenger volumes and were accomplished through the addition or reduction of cars in the train configuration rather than through changes in the frequency of service.

Each car had a normal capacity of 100 customers per car. The seated passenger load was 8, and the standing passenger load was 92. Vehicles were generally operated as single cars, normally referred to as trains but could be coupled as a "two-car" train to meet ridership demands. In FY 2002, two additional trains configured as deuces (two-car trains) were added to the Inner Loop to meet passenger demands. On November 6, 2002, Metromover eliminated all passenger fares and initiated free service for all passengers. As a result, boardings in FY 2003 and FY 2004 were projected to increase to over 6 million annually. In FY 2003, one additional train was added to the Omni Loop in response to passenger complaints of delays and overcrowding.

Vehicle Mileage Normalization

In an effort to minimize mileage within the Phase 2 fleet to ensure a fleet of sufficient size in the future and to maximize the use of the Phase 1 vehicles until their midlife overhaul, Metromover used a short-term storage program where the two (2) highest-mileage Phase 2 vehicles spent a maximum of 90 days

in storage. The vehicles received regularly scheduled inspections prior to storage and were capable of returning to service immediately at the end of the 90-day storage period after receiving a storage inspection. The vehicles spent 90 days in storage and then 90 days in revenue service prior to being returned to storage if their mileage continued to rate in the top two (2) of the Phase 2 vehicles. The mandatory return to revenue service after a 90-day period in storage eliminated a vehicle remaining in storage indefinitely. A 56-day Brake Test PMI was performed prior to vehicles being placed in passenger (revenue) service. Maintenance Control was responsible for scheduling vehicles into and out of storage, maintaining and monitoring the necessary records so as to ensure compliance with the approved PMI program.

In the event of the implementation of 24-hour revenue service outlined in the PTP, all Mover vehicles would be removed from storage, and the storage rotation program would become inactive.

Mid-life Modernization of Vehicle Fleet

Metromover Phase 1 vehicle mid-life modernization was planned when a vehicle reached 734,000 service miles. Assuming similar service schedules in the future, based on cumulative mileage through June 2002 in addition to FY 2001 daily mileage, the average mileage per vehicle within the fleet would reach that point in FY 2011.

It was possible that the mileage projections were somewhat understated given continuous growth in the PVR. Metromover's Inner Loop service would be improved to a 24-hour operation by June 2003. Service improvements as well as any additional PVR requirements would escalate mileage projections.

As the PVR increased, fleet mileage more rapidly approached the 734,000-mile rehabilitation target. Total mileage for Phase 2 vehicles should be higher than Phase 1 vehicles due to the larger inventory of vehicles. Average vehicle mileage, on the other hand, should accumulate at similar rates; however, average mileage figures indicated that Phase 2 mileage was growing at a faster rate than Phase 1 average mileage. Removal of the Phase 1 vehicles from service for rehabilitation along with increased PVRs would cause more growth in Phase 2 vehicle miles, which translated into the movement of the Phase 2 rehabilitation requirement from 2011 to 2009.

The F inspection (4-5-year interval) and G inspection (8-10-year interval) were basic overhauls and were insufficient to maintain the expected performance of the vehicle. Vehicles were scheduled to receive two F inspections and two G inspections prior to a mid-life modernization.

OMB committed to pledging a portion of the LOGT to issue $140 million in bonds to fund the Metrorail and Metromover vehicle modernization programs. The capital program, 2002-2007, included over $15 million for the Metromover Phase 1 vehicle mid-life modernization beginning with planning and engineering funds in FY 2002.

The Department of Procurement Management on January 14, 2002 advertised an RFP for a consultant to develop overhaul specifications for "Metrorail and Phase One Metromover Mid-Life Vehicle Fleet Overhaul and Modernization Project," and the Consultant Selection Process had been completed.

Metromover, unlike Metrorail, had the option of replacing rather than rehabilitating vehicles due to the cost-structure of the Metromover vehicle. As part of the modernization project, the consultant would examine rehabilitation versus replacement of the Phase 1 vehicles. Rehabilitation/replacement of Metromover Phase 1 vehicles (12 cars) would coincide with the Rail Mid-Life Modernization Process. A specific schedule for the Phase One Metromover Mid-Life Vehicle Fleet Overhaul and Modernization Project had not been outlined.

Field Engineering was planning for the complete rail fleet mid-life modernization to begin in October 2003. Mid-life modernization of the Metromover Phase 1 vehicles was intended to:

- Upgrade and modernize systems for improved performance
- Eliminate increased levels of obsolescence currently being experienced because replacement parts were no longer produced
- Bring the cars to a "like new" condition in preparation for the second half of fleet life

Work would be contracted due to the scope of the work to be performed and the nature of the facilities that were required to support the project. Field Engineering would develop specifications and schedules in conjunction with the Consulting Services Contractor. Schedules and time frames for completion would be contingent upon the decision to rehabilitate or replace.

Metromover Fleet Management Plan Update

MDT updated the October 2003 Fleet Management Plan in March 2009 (Revision 04). MFMP Revision 04 included a description of the system, planned revenue service, projected growth of the system, and an assessment of vehicle maintenance current and future needs. Significant changes in the updated plan included the following.

Metromover Fleet

New replacement vehicles were added to the Metromover fleet. In 2009, the Metromover vehicle fleet totaled 29 vehicles: 17 phase 2 vehicles and 12 phase 3 vehicles. The 17 phase 2 vehicles entered service from June 25, 1994 through September 30, 1994. The phase 3 vehicles, which were purchased to replace the original phase 1 vehicles that were decommissioned in 2008, entered service from September 4, 2008 through February 17, 2009.

The seated passenger load for both phase 2 and phase 3 vehicles was 8, while the standing passenger load varied from 87 for phase 3 vehicles (a total capacity of 95) to 92 for the phase 2 vehicles (a total capacity of 100). The PVR increased from 18 (15 trains, 3 of which were deuces) in the previous MFMP to 21 (16 trains, 5 of which are deuces) in the updated plan.

Span of Service

The Metromover span of service matched that of Metrorail. The peak period was designated from 5:00 a.m. until 7:30 p.m., and base service was operated in the evening between 7:31 p.m. and 12:30 a.m. As a result of increased ridership, the Brickell and Omni Extensions no longer terminated service at 10:30 p.m. and matched the service hours of the Inner Loop.

Ridership

Average weekday, Saturday, and Sunday ridership grew steadily from 2003 to 2007. Average Saturday ridership grew by 100 percent and average Sunday ridership grew by 50 percent compared to previous highs recorded in FY 1995. Annual boardings were projected to increase to over 10 million in FY 2009 and FY 2010 as compared to the nearly 7 million projected in the 2003 MRFM for FY 2004.

Cleaning Program

Level one cleaning, which was previously performed on a daily basis, was reduced to three times a day. Level two cleaning, which was performed six times a year, was reduced to a monthly schedule.

Maintenance Management Information System

On October 10, 2005, the EAMS Project started to address problems associated with the management of the volumes of information generated within MDT. Since that time, EAMS has tracked all assets, facilitating scheduling, overhauls/repairs and reliability analysis. All materials are to be tracked and reported.

Reliability Improvement Program

Metromover initiated the following new programs to improve the reliability of equipment through the upgrade of existing components and/or replacement of units:

- Phase 2 vehicle door system overhaul
- Replacement of train control computer, completed in 2005
- Replacement of ATO, MUX, and TX/RX cabinet power supplies
- Replacement of phase 2 vehicles
- Replacement of NUMA LOGIC DTS equipment
- Wayside overhaul to include train control and power distribution equipment

Metromover also implemented the following new improvements to enhance vehicle and system reliability and appearance:

- Hand cleaning of the Metromover guideway
- Replacement of all graffiti or damaged glass on Metromover vehicles with Vandal-Shield added to the new glass to protect against scratching and graffiti
- Replaced carpet floors with vinyl tiles to enhance appearance and cleanliness of the vehicle fleet
- Wrapped all vehicle exteriors with a vinyl coating to enhance the exterior appearance
- Included yearly replacement of speed ramps as part of the PMI program for guideway switches

Metromover System Repairs – FY 2008 versus FY 2001

Following is a comparison of system repairs logged in FY 2001 and FY 2008. While annual vehicle miles grew by 11.8 percent from FY 2001 to FY 2008, Metromover system repairs fell by more than 60 percent. In addition, the frequency of most repairs varied from FY 2001 to FY 2008.

Metromover System Repairs, FY 2008 versus FY 2001

	Number		%/Total		FY08 vs FY01
Systems	FY 2001	FY 2008	FY 2001	FY 2008	+/-
Doors	393	156	17.3%	17.3%	-237
ATC	213	151	9.4%	16.7%	-62
Electrical	441	149	19.4%	16.5%	-292
Drive System	139	81	6.1%	9.0%	-58
Pneumatic System	155	76	6.8%	8.4%	-79
Suspension	77	56	3.4%	6.2%	-21
Prop & Dyn Brakes	98	55	4.3%	6.1%	-43
HVAC	206	47	9.1%	5.2%	-159
Guidance System	121	45	5.3%	5.0%	-76
Car Body	130	33	5.7%	3.7%	-97
Lighting	177	21	7.8%	2.3%	-156
Friction Brakes	53	14	2.3%	1.6%	-39
Communications	28	10	1.2%	1.1%	-18
Miscellaneous	14	6	0.6%	0.7%	-8
Spring Brakes	31	2	1.4%	0.2%	-29
Total Repairs	2,276	902		-60.4%	-1,374
Vehicle Miles	1,004,228	1,122,606		11.8%	118,378

Planned Vehicle Procurement

The original 12 phase 1 vehicles were replaced from April 2008 through February 2009. The 17 phase 2 vehicles were scheduled to be replaced beginning in June 2010.

Metromover Car Procurement Milestones

Metromover Cars				
Report	As of	%	Status	Cost
Phase 1 Car Replacement				
Q1 2008	01/31/08	43%	In progress	
Q2 2008	03/30/08	65%	In progress	
Q3 2008	07/31/08	85%	On hold	
Q4 2008	10/31/08	92%	In progress	
Q1 2009	12/31/08	94%	In progress	
Q2 2009	04/30/09	96%	In progress	
Q3 2009	07/31/09	97%	In progress	
Q4 2009	10/31/09	97%	In progress	
Completed April 2008 - February 2009				
Phase 2 Car Replacement				
Q1 2010	01/31/10	41%	In progress	
Q2 2010	04/30/10	41%	In progress	
Q3 2010	07/31/10	41%	In progress	
Q4 2010	10/31/10	41%	In progress	
Q1 2011	12/31/10	41%	In progress	
Q2 2011	04/30/10	45%	In progress	

IX. Metrobus Maintenance Program Review & Recommendations, Phase One, March 2004

The work described in this report was the first phase of a six-phase project to be completed by CUTR for MDT. The goal of the first phase of the project was to identify, analyze, and summarize the attitudes, concerns, and opinions held by bus maintenance personnel and bus operators at MDT. Upon completion of phase one, Metrobus employee survey, the project was scheduled to continue with a productivity and performance review, a manpower needs assessment, development of an action plan, operational assistance, and an annual review.

The purpose of the overall project was to identify and document MDT's Metrobus maintenance program needs and to assist with the development of a plan of action to address such needs.

Despite continual reinvestment of capital for Metrobus fleet upgrades, MDT experienced a decline in the performance of the fleet. Performance measures, such as MMBF, were considered to be below established standards, and there was a general perception that repeat failures occurred routinely. Criteria used to allocate manpower requirements had been in place for an extended time. Although these measures were based on a combination of the number of vehicles assigned and the total scheduled miles operated, there had not been a revision to the performance measures that accurately reflected the needs of the current, modern fleet.

Bus mechanics (or technicians) often migrated to available 13(c) positions at MDT's Metrorail and Metromover Divisions. These divisions offered higher levels of compensation to technicians. Since the original inception of this project, MDT has taken positive steps to address a variety of personnel issues identified by the 13(c) Strategic Task Force, including the implementation of salary parity. At this point, the long-term benefits of these actions were not completely known, and they most likely had yet to be fully realized within Metrobus.

A Metrobus Maintenance Task Force that was established comprised chiefs, superintendents, and managers from the following MDT divisions: Bus Maintenance, Bus Operations, Bus Maintenance Control, and Information Technologies (IT). The task force included all chiefs and superintendents from each of the four maintenance shops, as well as the general superintendent of maintenance. As users of the equipment and generators of data, it was important that the Operations Division was represented on the task force. Inclusion of the Maintenance Control Division was important because it maintained, tracked, and analyzed available data, and its role within MDT was currently in a process of revision. The IT Division was added to the task force at the suggestion of the Maintenance Control Division based on its ability to adjust computer programs to meet the needs of data users and its ability to identify specific needs that might not otherwise be realized.

The overall goal of phase one was to assist MDT with identification of tools that could be used to motivate employees and improve fleet performance. To meet this goal, CUTR focused on two main objectives: 1) investigation of current attitudes held by Metrobus maintenance and operations

employees and 2) analysis and presentation of this information to the Metrobus Maintenance Task Force.

The first objective was to develop a better understanding of employees' attitudes and concerns about current incentives, benefits, and working conditions at MDT. This objective was accomplished through the development and implementation of a survey of Metrobus maintenance and operations employees. The second objective was to collect and analyze the survey data and report the findings to the Metrobus Maintenance Task Force.

CUTR examined research reports that dealt with transit employee recruitment and retention, employee satisfaction, and employee performance and attendance. The review also included documents from individual transit agencies that had addressed concerns about employee benefits, incentives, and conditions. Specific implementations were examined, and the results, if available, were noted. In addition, CUTR contacted some of the researchers and/or transit agency officials who were previously involved in projects and initiatives related to incentives and benefits.

In order to find out greater details about issues related to the project, CUTR conducted private, one-on-one interviews with each member of the task force. The interview schedule included managers from bus maintenance, bus operations, bus maintenance control, and information technologies. Additional interviews were added to the agenda as they became relevant to the project. The interviews afforded CUTR the opportunity to develop relationships with task force members and to learn details about each individual's duties and responsibilities, as well as their shop and/or office location and function.

Throughout the project period, CUTR coordinated with the task force chairperson to schedule and hold regular task force meetings. The purpose of these meetings was to update members on the project status and to discuss current project-related concerns and information needs. The regular meetings afforded task force members the opportunity to provide input and feedback, as well as discuss necessary next-steps in the process of completing the objectives. In addition, the meetings served as a forum for development of project materials. For example, meetings held during the design and development of the employee survey allowed the task force to participate directly and immediately.

CUTR utilized the results of the literature review and the task force interviews to synthesize and implement an in-depth employee survey. Task force members contributed a great deal of knowledge and experience during the development phase. The survey consisted of over eighty questions and focused on five general areas of concern: awareness of current benefits and incentives offered at MDT, participation in current benefits and incentives offered at MDT, satisfaction with current incentives and working conditions, general interest in potential incentives, and specific interest in sample incentives. The survey also included a section specific to employee job classifications (operator or maintenance personnel). Additional space was provided on the survey form for employees to write-in specific comments. In an attempt to invoke the most honest response possible and to ensure respondents' confidentiality, each survey included a pre-addressed, postage-paid return envelope.

CUTR worked with the task force to promote awareness of the survey and encourage participation among employees. CUTR staff distributed surveys and provided promotional materials to MDT

management. Survey responses were coded and entered into a spreadsheet program to generate an ongoing tally. After the close of the survey period, results were transferred to an advanced statistical package for further analysis.

CUTR prepared a final report that documented the steps taken during phase one, described the survey findings in detail, and included recommendations for remedial action.

Findings

The review of employee incentive programs at other transit agencies provided a wealth of knowledge, as well as a baseline for future evaluation of modifications to the current program. A wide variety of employee incentives were documented, with awards for excellence in safety and attendance among the most common. Cash awards were growing in acceptance as agencies realized the long-term value of a successful program greatly exceeded the short-term investment necessary for implementation. In addition, components of successful incentive programs were found to be consistent among most transit agencies. Positive outcomes were highly dependent upon several key factors, including: strong support at all levels of management, union buy-in, clearly defined criteria and awards, and greater employee involvement in planning and decision-making. Some agencies reported the value of linking program goals to the overall goals and objectives of the agency. Sufficient funding for the incentive and benefits program was found to be critical to its success.

Past studies found that employees had a strong desire for more personal improvement opportunities. In fact, prior reports argued that the lack of such opportunities was a great cause of dissatisfaction, specifically among bus operators and maintenance employees. This deficiency was one of the most commonly cited reasons for high attrition rates in these occupations.

The attitudes and concerns currently held by operators and maintenance personnel at MDT were consistent with prior study results mentioned above. The survey outcome was also consistent with previously conducted focus groups at MDT. In addition to personal growth opportunities, employees sought more input into decisions, improved communications with management and with other types of employees, a safety incentive award for maintenance employees, and revisions to the attendance incentive program. Results of the survey indicated that just over one-third of operators and maintenance personnel were aware of the overall benefits and incentives. Maintenance personnel were generally more aware of current incentives and benefits, more satisfied with working conditions, and more likely to participate in incentives programs. Furthermore, employees who were most satisfied with current conditions were those most likely to be active participants in special programs and events.

One highly relevant case study proved to be an example of what not to do. The transit agency conducted an employee survey similar to that developed by CUTR, but support by upper-level agency management was minimal at best. This lack of interest exacerbated the existing conditions of low morale and high dissatisfaction among employees. The critical lesson was that once a transit agency (or any employer) took the initial step of asking employees how they felt about current conditions, employees developed an expectation that the agency was sensitive to their concerns and would act to

address them. If no results were seen, these expectations could quickly deteriorate, causing further cynicism and dissatisfaction among employees.

Status of Recommendations

Recommendation	Status
Modify the rules governing the use of personal leave - allow employees to trade accrued leave time for its cash equivalent (long-term item)	Negotiating with the unions

Recommendation	Status
Increase employee awareness of current incentives (short-term item)	• MAP Program: 1 extra shop steward for personal issues • Monthly Health & Safety Meetings • Volunteerism spearheaded: Employees Give Back, Habitat for Humanity, and Hands on Miami • Transitnet: PCs in driver rooms/lunch rooms at all garages • Department of Motor Vehicles (DMV) comes to the facilities

Recommendation	Status
Establish focus groups to investigate new employee attendance incentives (long-term item)	MDT established performance targets for department wide unanticipated employee absenteeism; incentive not specified; TWU incentive program established 2%↓ = $1,000 bonus (appears to be 3% reduction) June 1, 2010 – May 1, 2011

Absenteeism Report

Absenteeism Report	As of	Actual	Target	FYTD Actual	FYTD Target
Financial					
Q1 2008	Dec 2007	7.53%	16.50%	7.99%	16.50%
Q2 2008	Apr 2008	9.28%	16.50%	8.53%	16.50%
Q3 2008	Jul 2008	10.00%	16.50%	8.31%	16.50%
Q4 2008	Oct 2008	8.48%	16.50%	8.48%	16.50%
Learning & Growth					
Q1 2009	Dec 2008	9.11%	16.50%	8.85%	16.50%
Q2 2009	Apr 2009	9.78%	16.50%	9.17%	16.50%
Q3 2009	Jun 2009	9.43%	16.50%	9.24%	16.50%
Q4 2009	Sep 2009	11.05%	16.50%	9.74%	16.50%
Q1 2010	Jan 2010	10.51%	16.50%	9.77%	16.50%
Q2 2010	Apr 2010	7.83%	16.50%	9.07%	16.50%
Q3 2010	May 2010	8.78%	16.50%	9.04%	16.50%
Q4 2010	May 2010	8.78%	16.50%	9.04%	16.50%

Absenteeism - TWU Report	As of	Actual	Target	FYTD Actual	FYTD Target
Learning & Growth					
Q3 2010	Jul 2010	19.44%	16.90%	n/a	n/a
Q4 2010	Oct 2010	18.07%	16.90%	18.07%	16.90%
Q1 2011	Dec 2010	17.09%	16.90%	19.03%	16.90%
Q2 2011	Apr 2011	17.93%	16.90%	18.87%	16.90%

Recommendation	Status
Improve shop cleanliness (short-term item)	Painted shops; installed suggestion boxes

Recommendation	Status
Establish a pilot safety incentive program for bus maintenance (short-term item)	Employees are graded based on preventable/non-preventable; provide retraining when employee returns to work (numbers are down); developed new program for maintenance accidents: maintenance specific trainer observed, defensive driving class + county driving class if "on the road," and follow up with positive feedback

Recommendation	Status
Investigate modifying the tuition reimbursement plan to cover 100 percent of costs (short-term item)	County policy dictates reimbursement amount

Recommendation	Status
Investigate methods to make additional technology training available (short-term item)	Operators use training with VIGIL System; FTA dollars are available for simulator; mentoring on own time to learn other jobs - 2 examples: WLC and IT; monitors in garages: detours, SOPs, and Employee Handbook available

Recommendation	Status
Hold at least one employee recognition event (long-term item)	Employee Recognition Program: Employee of month/quarter, formal criteria, and attend quarterly meeting with director

Recommendation	Status
Implement a program that improves communication between bus operators and bus maintenance personnel (long-term item)	Established Yard Duty Supervisor: required to ask every operator how bus performed and passes on feedback to maintenance

Recommendation	Status
Implement methods to increase employee input into decisions (long-term item)	Monthly labor/management meetings increased to 6; 2008 TWU – can send 7 – use a different set of representatives each time; positive outcomes: major change in line-up, changed color of Easycard college passes

X. Materials Management Analysis & Recommendations, November 2004

MDT requested that CUTR conduct an analysis of the current inventory and provide recommendations for inventory improvements and performance goals. The responsibility for inventory within MDT rested with the Materials Management Division. The Division operated eight warehouse and storeroom locations, which varied in size from 5,000 to 30,000 sq. ft. There were 98,265 line items in inventory, which consisted of a wide selection of electronic, mechanical, and chemical commodities. These were spare parts for the Metrorail, Metromover, Metrobus, Communications, Traction Power, Train Control, and Facilities Maintenance Divisions. The inventory value contained at all facilities exceeded $20 million.

An oversight committee was established for the project that included the Chief of the Division of Materials Management as the chair with members that included several of the Division's key personnel, and a representative from each of the following areas:

- Rail Maintenance Division
- Bus Maintenance Division
- Facilities Maintenance Division
- Field Engineering
- Information Technology
- Other functional representatives the Chief designated as appropriate

As a part of the project initiation effort, CUTR began an effort to collect data and document the relevant MDT material management processes and systems. A project initiation meeting with the Oversight Committee was held early in the study to familiarize participants with the nature and scope of the study and to obtain members' assistance and participation in data analysis and decision-making processes. Input from the Oversight Committee was critical in the determination and selection of three peer properties where site visits were conducted to collect relevant information on inventory types and values along with relevant procedures employed for inventory valuation.

A review of best practices was undertaken, and a thorough literature review was conducted. The review included the transit industry and other related industries. In addition, emerging trends in the general area of materials management were researched and documented for presentation to the Division and the Oversight Committee.

Two transit agencies, Cleveland RTD, and Maryland MTA, were identified as most similar to MDT by both bus operations and bus equipment cluster analysis, while Denver RTA was identified as most similar by the bus equipment cluster analysis. All three agencies met the multi-modal test as they all operated light rail systems in addition to bus, and Cleveland RTA along with Baltimore MTA operated heavy rail systems. The Oversight Committee concurred with site visits to the following peer agencies:

1. Maryland Transit Administration; Baltimore, Maryland
2. Regional Transit District; Denver, Colorado
3. Greater Cleveland Regional Transportation Authority; Cleveland, Ohio

Prior to the site visits, the organizational structure of each agency was examined. During the site visits, those structures were reviewed with staff and specific tables of organization were assembled to identify reporting relationships and determine the nature and numbers of staff responsible for materials management functions. Researchers also explored the most recent data available for each agency provided in the 2002 NTD and completed an analysis of performance measures.

Researchers used a standardized list of questions during the interviews conducted at the peer properties as well as with MDT Materials Management staff. Those standardized questions used by the researchers during the site visits were translated into specific areas of discussion. Information obtained as a result of the interviews was assembled under appropriate headings. Agency responses were reviewed in terms of their relationship to common agency practices, to material gleaned during the literature review, and to materials management best practices that had been identified.

Findings from Site Visits

- MDT's structure was unique in relationship to peer agencies, which were more closely aligned with state or regional government.
- MDT provided more efficient service and more cost effective service when compared to Baltimore MTA, Cleveland RTA, and Denver RTD, but fell behind all three agencies in providing effective service.
- MDT and the peer agencies attempted to meet the best practice regarding inventory management through utilization of advanced technology.
- Best practice inventory tools in place or planned included hand-held devices and bar codes.
- Agencies studied differed substantially in the area of outsourcing. Best practices mandated consideration of outsourcing.
- MDT and each of the peers engaged in one or more uses of advanced technology to deal with inventory supply.
- Performance monitoring was somewhat limited at most of the study sites. Peer agencies primarily relied on stock-out rate and/or turnover rate.
- Both MDT and Denver RTD periodically rotated personnel.
- MDT was the only agency that staffed its storerooms continuously.
- The best practice of decentralization was seen at each peer agency. In addition to a central warehouse facility, each agency had at least three satellite storerooms.
- MDT was the only agency of the four where all storeroom staff reported directly to the Materials Management Division.
- In some instances, inventory items were shipped directly to the satellite location that generated the order.
- While each of the four transit agencies compared in this study reported similar technologies in use, security actions varied widely in practice. The peer agencies had differing and somewhat complex methods for valuing rebuilt parts.
- Cycle counts, an accepted best practice, were clearly the most common among peer agencies.

- While methods differed from agency to agency, each peer transit agency had well-established and detailed methods for dealing with obsolete stock. Best practices dictated that outdated items be dealt with in a timely fashion.
- The overall management philosophy of each agency seemed to be reflected in the standards established for managing inventory.
- Peer agencies were all actively engaged in pursuing technology upgrades, maintaining turnover goals, and encouraging time-saving and moneysaving practices.
- Peer agencies were at various stages in implementing or developing methods to qualify vendors, monitor their performance, develop stronger relationships with them, and identify new products and new vendors.
- While specific details varied by agency, peers generally handled procurement based on item cost.
- Procurement staff was usually grouped according to the financial threshold.
- No peer agencies actively engaged in procurement activities involving the use of the internet.
- Differences in staff allocation caused the overall number of materials management employees to appear much larger at MDT.
- The four agencies were split in how they allocated items to the inventory.

Findings from Inventory Analysis

- Since the Blue Ribbon Task Force Report, Rail, which included Metrorail, Metromover and the Radio Shop, had almost doubled its percentage of the inventory allocation, from 34 to 64 percent, while Central Warehouse and the Bus Divisions fell to 24 percent and 12 percent, respectively.
- In terms of the value of the dollar, inventory growth occurred only in the area of rail. All bus divisions and the Central Warehouse reflected a decline in value.
- The current inventory cost per rail vehicle was almost $72,000, while inventory costs per mover vehicle were approaching $131,000. Both costs were expected to increase in the near term.
- The current inventory cost per bus was about $3,700 at the garages (including Central Support) and $11,500 including the entire Central Warehouse inventory. Since 1986, the inventory per bus declined 22-47 percent.
- Central Operating & Inspections (O&I) Division consistently reported the highest turnover rates and exceeded a turnover rate of 6 during 4 of the months presented. Northeast O&I never reported a rate less than 4. Coral Way O&I and Central Support both showed improvement in turnover rates during the last 4 months of the reporting period. The Central Warehouse generally stayed within a turnover rate of 2-3. Metrorail and Metromover failed to achieve a turnover rate of 1, while the Radio Shop's turnover rates were sporadic, ranging between .26 and 1.70.
- During the recent fiscal year, the average turnover rate more than doubled the rate reported by the Blue Ribbon Task Force in 1986.

Recommendations

1. Warehouse & Stores

A Warehouse & Stores Goal was to re-label 50 percent of the 98,265 bins with barcode labels to accompany the new computerized Materials Management System by September 30, 2004. The

remaining 50 percent were to be re-labeled by September 30, 2005. The objective of this goal was to increase efficiency and accuracy throughout the warehouse and storeroom locations within MDT.

Computerization and implementation of advanced technology was an identified best practice. In order to take full advantage of the new computerized system, bar code technology needed to be incorporated into the existing system.

This was an excellent goal from several perspectives. It was proactive, in that, future requirements had been anticipated. Completion of re-labeling should ease transition to the new computerized system and provide staff with the opportunity for hands-on contact of all inventory items.

Measures of performance were the quantities re-labeled. Suggested follow-up measures included:

- Calculate progress to date to ensure that completion dates were realistic and achievable
- Post the results on some type of mechanism (board, graph or chart) in the warehouse to help show warehouse staff the degree of progress to date
- Progress toward completion could also be reported in the Materials Management Division's Monthly Report

2. Warehouse & Stores

A Warehouse & Stores Goal was to maintain a 2½ percent vehicle down for parts ratio through September 30, 2004. The objective of this goal was to maximize storage capacity.

While this was an excellent goal, it appears to have been achieved at a rate lower than 2½ percent since November 2000. If the performance measure was to be retained, the rate of 2½ percent should be re-evaluated.

Expressing the performance measure as a percentage of the fleet masked the actual number of buses unavailable for service due to lack of parts. Despite achieving rates well below 2½ percent, in every case the actual number of buses down for parts was 2 or 3 times the maintenance projected number of buses down for parts. The average number of buses down per day was different than the maximum number of buses down per day and impacted on vehicle availability.

Researchers recommended a series of actions to improve performance in this area:

- A cooperative effort involving Materials Management and Bus Maintenance was required to increase the number of buses available for service
- Materials Management and Bus Maintenance Supervisors should explore the details surrounding unavailable parts and develop a list of the 5 most common unavailable parts that keep buses out of service. A separate list should be compiled for each of the three divisions
- The number of buses not available for service each day, which was a better measure of inventory performance than the average number of buses down throughout the month, should be tracked and reported by the Materials Management Division and Bus Maintenance in Monthly Reports
- Materials Management and Bus Maintenance Supervisors should classify the common unavailable parts as "critical" parts within each division

- Materials Management should intensify efforts with vendors to accomplish timely delivery of the critical parts
- As progress was made in making critical parts available, the cycle should continue with the next 5 most common parts identified and added to the list

In order to further the goal of maximizing storage capacity, researchers recommended a detailed review of the current inventory. The inventory analysis showed a significant increase in the allocation for rail with a corresponding decrease for bus. Given the issue with buses down for parts and the inventory trends observed, it was possible that inventory composition was weighted too heavily towards rail.

While researchers acknowledged inventory problems caused by high-value, low turnover rail and mover parts, review of what was actually in the inventory could help eliminate all unnecessary items. Toward that end, researchers recommended the following additional actions:

- Conduct a thorough review of all rail, mover, and radio parts in the inventory and dispose of items that are no longer tied to the current fleets
- Establish concrete deadlines for the complete inventory review at each of the rail, mover, and radio shop storerooms (Measures of Performance)
- Report percentage of progress completed in the Monthly Report along with results achieved

3. Warranty Administration

A Warranty Administration Goal was to maximize the level of compensation for defective parts and services received by MDT. The percentage of honored claims had ranged from around 70 to 84 percent in the past 4 years, while the recent percentage of dollars claimed had reached an all-time high of 95 percent.

The Materials Management Division should:

- Establish performance targets to ensure continued improvement
- Because the number and value of claims fluctuates from year to year, measures of performance should be framed in the relationship between claims submitted and honored as well as the relationship between dollars claimed and dollars honored
- Realistic targets for performance must be developed based on the history established to date. Given the high level of performance already established, growth in performance will probably be minimal

4. Inventory

An Inventory Goal was to reduce the vendor backorders from an average of 90 days to a 45-day margin. The objective of this goal was to improve delivery of materials and supplies to MDT.

The Blue Ribbon Task Force indicated that procurement staff "should have input to rid vendor lists of unqualified vendors or those whose products or services prove unsatisfactory." Failure to fill orders in a timely fashion could certainly be defined as unsatisfactory service. Toward that end, backorders should be viewed as unsatisfactory vendor performance and should be tracked and routinely reported in the

Materials Management Division's monthly report. Procurement guidelines should be strengthened, if necessary, to identify delay in providing parts as grounds for nullification.

Actions recommended for improvement in this area included:

- A "critical part" designation that defined mandated delivery criteria for service critical parts should be established
- Vendor backorders should be tracked and tied to "critical parts," "stock-outs," and "buses down for parts"
- Materials Management staff should explore procurement guidelines with the county for managing vendors. Such guidelines should include consequences for unsatisfactory vendor performance, particularly in the area of "critical parts"
- Performance measures should be established for reduction of backorders
- Materials Management staff should look at what other agencies have done to improve vendor performance. Denver RTD developed a vendor rating program that rewarded vendors for supplying the right parts on time. It could serve as an example for Miami-Dade Transit.

5. Procurement

A Procurement Goal was to develop a real-time report of procurement requisitions with the objective of improving workload distribution and evaluating employees.

Upon completion of the necessary reporting mechanisms, performance measures should be established for buyers. Appropriate performance measures in the form of Purchase Order processing targets should be established.

Critical components in the determination of the performance measures for buyers included:

- Timeliness – speed at which items were processed
- Level of expertise required
- Nature of the procurement items

Status of Recommendations

Recommendation	Status
Label storage bins with bar-coding labels by September 30, 2005 to increase efficiency and accuracy throughout the warehouse and storeroom locations within MDT. Suggested follow-up measures included: • Calculate progress to date to ensure completion dates were realistic and achievable • Post results on some type of mechanism in the warehouse to help show warehouse staff the degree of progress to date • Report progress toward completion in the Materials Management Division's Monthly Report	• Instituted EAMS for inventory control and the purchase order process • EAMS is helping to build technology • Parts received are tracked upon receipt and enable life cycle tracking of parts • Trying to eliminate the T-99 category of miscellaneous parts • Defined asset as anything that could be rebuilt and started expanding use of asset numbers • Received items are sent to EAMS and tracked • Threshold = dollar value or importance

Recommendation	Status
Calculate an average number of buses down per day as a target or, if decide to maintain current measure, re-evaluate the rate. Researchers recommended a series of actions to improve performance in this area: • Include Bus Maintenance in process • Develop a list of the 5 most common unavailable parts that keep buses, trains, and mover vehicles out of service • Track and report the actual number of buses not available for service each day	• Target is less than 3% of the fleet down for parts • Has been holding at 1% for several months • Executive intervention and competition helped cement improvement in vendor and customer relationship • Bus down for parts: NABI gets a report of "bus down for parts" twice a day, share monthly report with NABI, should help NABI be better • MDT Internal Performance Goal for Materials Management: maximize parts availability at MDT stockroom locations and ensure administering vendor contracts effectively to support operations

Bus down pending parts

Buses Down/Pending Parts				FYTD	FYTD
Report	As of	Actual	Target	Actual	Target
Q2 2008	Mar 2008	2.1	3.0	n/a	n/a
Q3 2008	Jul 2008	2.4	3.0	n/a	n/a
Q4 2008	Oct 2008	1.3	3.0	1.3	3.0
Q1 2009	Jan 2009	2.6	3.0	1.9	3.0
Q2 2009	Apr 2009	2.2	3.0	2.1	3.0
Q3 2009	Jun 2009	1.75	3.00	2.03	3.00
Q4 2009	Sep 2009	2.97	3.00	2.14	3.00
Q1 2010	Dec 2009	1.93	3.00	1.97	3.00
Q2 2010	Apr 2010	2.10	3.00	2.25	3.00
Q3 2010	Jun 2010	2.51	3.00	2.24	3.00
Q4 2010	Oct 2010	1.18	3.00	1.18	3.00

Recommendation	Status
In order to further the goal of maximizing storage capacity, researchers recommended a detailed review of the current inventory. The inventory analysis showed a significant increase in the allocation for rail with a corresponding decrease for bus. Given the issue with buses down for parts and the inventory trends observed, it was possible that inventory composition was weighted too heavily toward rail.	• In the process of reducing obsolete inventory • Explored vendor managed inventory, but it does not exist for all • Looking at managed inventory by commodity not by vehicle: exploring giving a vendor a 2-3 year contract for filtration system - 6 filters, purchased and stocked at each division, $0 inventory because not charged until issued, and integrated with EAMS; division inputs and vendor has read-only access

Recommendation	Status
To maximize compensation for defective parts and services, the Materials Management Division should: • Establish performance targets to ensure continued improvement • Measures of performance should be framed in the relationship between claims submitted and honored as well as the relationship between dollars claimed and dollars honored • Realistic targets for performance should be established based on past performance	• Last 2 years doubled warranty dollars • Established time limits for each step: paperwork, logistics and transfer • Successfully reduced to one month • Dedicated one person to handle delayed claims

Recommendation	Status
To improve delivery of materials and supplies, the Materials Management Division should: • Establish a "critical part" designation that defines mandated delivery criteria for service • Track and tie vendor backorders to "critical parts," "stock-outs," and "buses down for parts" • Explore procurement guidelines with the county for managing vendors. Such guidelines should include consequences for unsatisfactory vendor performance, particularly in the area of "critical parts" • Establish performance measures for reduction of backorders • Look at what other agencies have done to improve vendor performance	• Materials Management defined critical parts and established targets • Materials Management tracks and reports stock-outs for critical bus and rail parts • County-wide contracts are more responsive • Department of Procurement Management (DPM) can call in vendors: meet to discuss and/or apply sanctions • DPM could be more aggressive • Current problem: Metrorail fleet must be maintained until 2016 • MDT Internal Performance Goal for Materials Management: maximize parts availability at MDT stockroom locations and ensure administering vendor contracts effectively to support operations

Percent Stock-outs for Bus Critical Parts, Monthly

Bus Critical Parts/Stock-outs				FYTD	FYTD
Report	As of	Actual	Target	Actual	Target
Q1 2008	Jan 2008	12.76%	n/a	15.46%	n/a
Q2 2008	Apr 2008	12.28%	n/a	13.91%	n/a
Q3 2008	Jul 2008	15.61%	n/a	14.05%	n/a
Q4 2008	Oct 2008	17.17%	15.00%	17.17%	15.00%
Q1 2009	Jan 2009	15.09%	15.00%	14.45%	15.00%
Q2 2009	Apr 2009	11.14%	15.00%	13.84%	15.00%
Q3 2009	Jul 2009	4.72%	15.00%	12.65%	15.00%
Q4 2009	Sep 2009	4.63%	15.00%	11.38%	15.00%
Q1 2010	Dec 2009	4.94%	15.00%	4.75%	15.00%
Q2 2010	Apr 2010	4.11%	15.00%	4.86%	15.00%
Q3 2010	Jun 2010	3.11%	15.00%	4.53%	15.00%
Q4 2010	Oct 2010	2.94%	15.00%	2.94%	15.00%

Percent Stock-outs for Rail Critical Parts, Monthly

Rail Critical Parts/Stock-outs				FYTD	FYTD
Report	As of	Actual	Target	Actual	Target
Q1 2008	Jan 2008	6.51%	15.00%	9.40%	15.00%
Q2 2008	Apr 2008	11.57%	15.00%	9.05%	15.00%
Q3 2008	Jul 2008	5.04%	15.00%	8.06%	15.00%
Q4 2008	Oct 2008	10.55%	15.00%	10.55%	15.00%
Q1 2009	Jan 2009	12.68%	n/a	8.45%	n/a
Q2 2009	Apr 2009	3.06%	15.00%	6.72%	n/a
Q3 2009	Jul 2009	1.41%	15.00%	5.18%	n/a
Q4 2009	Sep 2009	4.47%	15.00%	5.12%	n/a
Q1 2010	Dec 2009	1.89%	15.00%	1.89%	n/a
Q2 2010	Apr 2010	2.36%	15.00%	2.66%	n/a
Q3 2010	Jun 2010	4.01%	15.00%	2.83%	n/a
Q4 2010	Oct 2010	3.54%	15.00%	3.54%	15.00%

Recommendation	Status
A procurement goal was to develop a real-time report of procurement requisitions with the objective of improving workload distribution and evaluating employees. Upon completion of the necessary reporting mechanisms, performance measures should be established for buyers. Appropriate performance measures in the form of Purchase Order processing targets should be established.	• Still a challenge; buyer = Purchasing Specialist; fuel – county-wide contract at market price +; DPM approves list of vendors ($1 million without BOCC); MDT must purchase off contract through bid – can ask for 24 hour response; only when no contract- $10,000/ year small purchase and issue report at end of year: and everything must be approved by the CITT (24% PTP funds) • Stay within ceilings

XI. Comprehensive Bus Operational Analysis, Final Recommendations Report, December 2004

With the adoption of the PTP, an ambitious sequence of bus service improvements and system expansion was programmed for MDC. Through new routes and system expansions, the system service hours, route miles, and bus fleet were planned to increase dramatically. Efficient service improvements needed to be based on sound and up-to-date service planning information and monitoring systems, yet the last system-wide survey performed by MDT occurred in 1993. Updated system information was critical to the success of the PTP, if service enhancements were to both meet community needs and provide increased system efficiency.

The Comprehensive Bus Operational Analysis (CBOA) provided the planning information and monitoring baseline data from which planned PTP improvements could be fine tuned, new improvements could be determined, and implemented improvements could be monitored for their utilization.

The CBOA provided three large bodies of primary data:

1. A system-wide ride check to provide route and segment level operational performance data for every route;
2. A system-wide on-board passenger survey to determine trip characteristics, ridership profiles, community needs, and passenger satisfaction for each route; and,
3. A survey of bus operators regarding schedule and operational improvements at a route and segment specific level.

In addition to providing much needed data for ongoing system and operations planning for MDT, the CBOA provided a route and route segment-level analysis of the operational efficiency. The analysis for the development of the service recommendations included nine basic components:

1. Duplication – alignment and service characteristics were compared to other routes along a similar corridor to consider consolidation
2. Purpose – consideration of branches, deviations, and end segments of a route being consistent with the target market service of the route
3. Travel Patterns – origin/destination patterns along with trip purposes and transfer results
4. Productivity – consideration of direct operating recovery ratio and net cost per passenger trip to identify inefficient routes
5. Schedules– identification of problem segments for delay, poor productivity due to slow travel speeds, poor service, and fluctuating loads due to bunching
6. Route Length – to determine possible candidates for combination and to look for problems in conjunction with scheduling due to long segments without recovery
7. Land Use – to determine and corroborate data showing poor utilization and to identify potential conflicts with residents' quality of life
8. Service Span – to identify loads showing potential to be shorted or the need to extend
9. History – consideration of MDT staff institutional knowledge regarding particular community needs and recommendations that have been tried before.

Through coordination of the route-level analyses and recommendations for service improvement, the CBOA included various recommendations for increasing system efficiency and improving service quality to the County's transit customers. The detailed recommendations for improving and balancing transit service efficiency and quality were provided in three deliverables:

1. Schedule recommendations, based on ride check data, for 22 routes in the November 2004 line-up to improve on-time performance and service reliability
2. Schedule recommendations, based on ride-check data, for all remaining routes in the April 2005 line-up to improve on-time performance and service reliability
3. System-wide operational recommendations for all routes, as necessary, to improve the quality of service and system efficiency of resource utilization.

The last set of recommendations included possible service improvements for increasing system efficiency, improving service to the County's transit customers, and providing better service to attract new ridership. The types of recommendations are listed below.

- Schedule Adjustments
- Headways/Frequency Adjustments
- Alignment Changes, including recombination of one segment to another, route extension, or route truncation
- Service Deletion
- New Service
- Route Combination

The service recommendations had two basic results:

1. Enhanced service would be realized at a route and system level through increased coverage, faster and more reliable service, enhanced connectivity, fewer transfers, increased service span, or improved frequency/headway.
2. System efficiency would be realized by enhanced service in conjunction with equipment savings from contraction and reallocation of unproductive services.

Most recommendations were intended to be implemented directly, while others supported already scheduled PTP improvements; some suggested monitoring poorly performing routes with subsequent discontinuation after additional marketing.

CBOA Efficiencies

The sum of the impact of additive and contractive service recommendations for the recommended implementation generated savings of 19 buses and $4.5 million in annual operating costs for reallocation to more productive community needs.

On-going Monitoring Recommendations

The CBOA comprehensively considered current and planned operations to develop recommendations; however, improvements needed to be monitored and information needed to be obtained to adjust service to ever evolving community needs. The monitoring had to balance information needs with the costs to obtain such information and achieve a more timely process for collecting and using information

so that planning and service changes could be incremental and on-going. This would also help to avoid large single-year costs for studies of the breadth and scope of the CBOA.

With the exception of scheduling, most of the new data collected during the CBOA was useful for a planning horizon of about 5 years. As the information became more obsolete with each passing year in a dynamic community as Miami-Dade County, by the fifth year much of the new data would be unreliable for detailed planning purposes. Going forward from this point, four components of a monitoring system needed to be put into place.

Scheduling

Updating schedules to maintain service reliability, incrementally improve equipment utilization, and provide a high customer satisfaction to induce new ridership requires up-to-date on-time performance data. MDT reschedules three times per year, and while the CBOA's data set was very comprehensive, it unfortunately was the most perishable data in terms of its usefulness over time. The data's short life was exacerbated by two other conditions, 1) schedule changes had be made conservatively and gradually over several line-ups so that the disruption to existing ridership was minimized, and 2) in a highly congested and rapidly expanding and redeveloping area as Miami-Dade County, scheduling was continuously challenged by construction delays, detours, and rapidly increasing and variable traffic congestion patterns.

The fact that schedule data were so perishable was compounded by that reality that this was the most expensive data collection effort of all of those the CBOA undertook. Scheduling, as well as boarding and debarking data were collected by a manual process called a ride check. At the sample levels used (80% for weekdays, 75% on Saturdays, and 50% on Sundays for each route), 11,750 surveyed trips and over 15,000 survey hours were required to collect over 1-million stop and time point records. Including analysis, the cost of this survey was approximately $700,000 of the CBOA costs, which translated into about $800 per average daily system pullout (876), or $112 per average system one-way trip.

MDT ran an automatic vehicle locator (AVL) system in its fleet; however, because the system polled at 2 minute intervals and had some coverage "holes," the AVL system was not capable of being used effectively by MDT operations planning and scheduling staff.

In order for MDT to monitor activities beyond the CBOA, Automatic Passenger Counters (APCs) should be used to monitor schedule adherence and ridership. While minimum requirements could use sampling with about 10 percent of the fleet, having APCs for the whole system will provide a richer and more comprehensive data set that can be used to analyze, plan, and make well-informed operations planning decisions. Progressive transit agencies such as Tri-Met in Portland, Oregon use approximately 72 percent APCs on their fleet, and are including APC specs in all new buses toward a goal of a 100 percent APC-equipped fleet.

MDT was pursuing the goal of 100 percent APC-equipped buses. In order to have check and balances and to ensure that the APC system was working properly and the data captured were accurate, another system needed to be in place. CUTR reviewed the Trapeze Plan software and recommended that a pilot

be conducted to assess its capabilities. This system was a module of the existing Trapeze software used by MDT and allowed for data collection using Personal Digital Assistants (PDAs).

Recommendation 1: For on-going scheduling monitoring purposes, periodic system-wide ride check surveying should be replaced with daily data flow from an APC system. The system should be implemented within 3 to 5 years to avoid CBOA-level ride check survey.

Recommendation 2: Implement a pilot program to assess and verify the capabilities of APCs, by using a separate system that uses the existing scheduling software (Trapeze) and data collection using PDAs.

Recommendation 3: In addition to schedule monitoring through the APC system, a formal feedback loop with the operators should be established regarding schedule problems on their routes. Periodic surveys or other means may be appropriate.

Route Capacity

Planning bus route capacity (vehicle size and frequency) to meet increasing loads at a route and segment was necessary to maintain and improve quality of service as well as improve the efficiency of equipment utilization. Capacity planning required up-to-date boarding and debarking at a stop level by route, time-of-day, day-of-week. MDT collected ridership data monthly for its Section 15 reporting; however, these data, aggregated by trip, could not provide segment activity or load levels. In addition, the system depended on coordinating manual count activation by the driver and fare box revenue and was vulnerable to operator error.

Similar to the scheduling data, collection was very expensive, and the data were perishable in that usefulness for planning purposes would not last through the planning horizon of the PTP. New data need to be available to continue with monitoring and operations planning. As for scheduling data, an automated system was preferable for budgeting, staffing, quality of data, and timeliness of data.

Recommendation 4: For on-going capacity monitoring purposes, periodic system-wide passenger on and off counts should utilize an APC system.

As discussed above, MDT committed to procuring an APC system for installation on 100 percent of its fleet over the next 5 years. The APC system would provide daily information regarding time into and out-of time points, as well as boarding and debarking counts at every stop.

Alignment Planning

Review of the utility of current route alignments was a major focus of the CBOA. While looking at the system all at one time was advantageous for balancing the impacts of changes across routes, it was also true that implementing these changes was best done gradually to minimize disruptions to current transit passengers. With this in mind, alignment planning and data collection should be done at shorter intervals, allowing more incremental and smaller changes to achieve the same effect.

Alignment planning, for the most part, depends on four bodies of data:

1. Boarding and debarking at a stop and segment level

2. Transfer analysis
3. Route-level passenger origin/destination and trip purpose data
4. Land use analysis of the alignment.

The boarding and debarking data needs will be more than adequately met by the APC system as it comes on line. Land use analysis was based on the Miami-Dade County Comprehensive Development Master Plan (CDMP) data that were amended at five-year intervals (not including biannual and small-scale land use amendments). The process to collect passenger origins and destinations, trip purpose, multi-modal connections, and MDT transfer data, could only be performed by an on-board passenger survey. Balancing the dual needs for providing timely data and controlling planning costs, and considering that the CDMP (including its transportation element and transit sub-element) was based on a 5-year horizon, a 5 year interval for collecting trip characteristics was appropriate.

Recommendation 5: System-wide alignment planning should be scheduled for a five-year interval and be scheduled to use updated analysis data for the County's CDMP amendments.

To provide the transfer analysis, route-level passenger origin/destination and trip purpose data, an on-board passenger survey must be performed. The on-board survey performed as part of the CBOA was administered to a target sample rate of 8 percent of the weekday ridership at a route level. A survey of similar scope would need to be performed. The cost of this component of the CBOA, including data entry, origin/destination coding, and all analysis was approximately $190,000, which translated to about $216 per average daily system pullout (876), or $30 per average system one-way trip.

Recommendation 6: To provide the trip characteristics data (origin/destination, trip purpose, multi-modal connections, and MDT transfers) as an input to alignment review and planning, a system-wide on-board passenger survey should be performed at 5-year intervals.

Community Needs

Recommendations one through five addressed monitoring system components that concerned operational issues and the provision of efficient service to meet the needs of the populations already using transit. The final component was to assess the needs of the community at large, both transit users and all others through four mechanisms:

1. Survey transit passengers regarding their needs, preferences, and satisfaction.
2. Survey transit passengers' demographic characteristic by route, and compare with the characteristics of communities along the routes' service area to determine what markets the route is serving, and if there are potential transit markets left under served.
3. Survey samples of the community (non-transit riders and transit passengers) regarding their travel characteristics, demographics, needs, preferences, and satisfaction.
4. Schedule community meetings to receive input regarding needs and attitudes toward proposed improvements.

The first two mechanisms were easily added to an on-board passenger survey, as was done for the CBOA. The demographic analysis between the community at large and specific bus routes was to be addressed by District Transit Needs Assessments, the first of which was a pilot study for District 13 that

was already under way. MDT intended to request the other 12 Commission District Transit Needs Assessments upon the completion of the pilot study and review of its output.

Recommendation 7: To determine passenger needs, attitudes and preferences, and to compare route passenger demographics with those of the communities that they served so that underserved markets were identified, questions regarding passenger demographics, attitudes, and preferences should be added to the five-year, system-wide on-board passenger survey of Recommendation 6.

In order to better understand the needs, attitudes, and preferences of the community at large (non-transit users as well as transit passengers), a telephone survey, broken down by specific communities, should be performed, and the results analyzed to provide insights as to how to better serve the community and how to increase transit use. Finally, one of the best ways to obtain open-ended, qualitative information is to hold public workshops by community to gain an understanding of their needs, attitudes, as well as to obtain feedback to planned improvements.

Recommendation 8: A series of transit needs assessments should be performed, according to Commission District to analyze demographics to identify underserved markets in the communities. This information should be community needs assessments for specific communities.

Status of Recommendations

Recommendation	Status
Recommendation 1: For on-going scheduling monitoring purposes, periodic system-wide ride check surveying should be replaced with daily data flow from an APC system. The system should be implemented within 3 to 5 years to avoid CBOA-level ride check survey.	• Pursuant to MDT's Service Standards, adopted on November 4, 2009, ridership data are collected using APCs and via manual ride checks. • APC is a technology installed on transit vehicles that counts the number of boarding and alighting passengers at each stop, while also noting the time. Passengers are counted using either pulse beams or step treadles located at each door. Stop location is generally identified through use of either global positioning systems (GPS) or signpost transmitters in combination with vehicle odometers.

Recommendation	Status
Recommendation 2: Implement a pilot program to assess and verify the capabilities of APCs, by using a separate system that uses the existing scheduling software (Trapeze) and data collection using PDAs.	Unknown

Recommendation	Status
Recommendation 3: In addition to schedule monitoring through the APC system, a formal feedback loop with the operators should be established regarding schedule problems on their routes. Periodic surveys or other means may be appropriate.	Unknown

Recommendation	Status
Recommendation 4: For on-going capacity monitoring purposes, periodic system-wide passenger on and off counts should utilize an APC system.	APCs are used to monitor on-going capacity.

Recommendation	Status
Recommendation 5: System-wide alignment planning should be scheduled for a five-year interval and be scheduled to use updated analysis data for the County's CDMP amendments.	• MDT continuously evaluates the performance of its services • Major service changes are implemented in June or November of each calendar year, per the Collective Bargaining Agreement with TWU • The service planning process targets only short-range plans (6-8 months into future) • The MDT Transit Development Program (TDP) update provides a 10-year service plan (RSP) for all existing modes within MDT. RSP FY 2011-2021 identifies service improvements scheduled to be completed by 2021 and includes all improvements in the PTP. The RSP service improvements identified in the TDP are contingent upon MDC receiving the appropriate federal, state and local funding for implementation. • Long-range plans, such as the Transportation Improvement Program (TIP) and the Long-Range Transportation Plan (LRTP), are incorporated into the short-range planning process to align long-term visions with short-term goals. • If minimum system-wide productivity standards are not met, MDT conducts a thorough evaluation of all routes to identify areas of opportunity to achieve improved productivity and efficiency.

MDT achieved minimum system-wide productivity for average weekday, average Saturday, and average Sunday boardings per hour from 2008 through 2009. Average weekday productivity fell slightly in 2010.

Metrobus System-wide Productivity, 2004-2010

Metrobus Boardings/Hour	2004	2005	2006	2007	2008	2009	2010	Service Standard
Average Weekday	31	29	28	29	31	30	29	30
Average Saturday	28	30	31	31	36	30	31	25
Average Sunday	23	22	23	22	28	25	25	25

Source: FTIS.Org/INTDAS/B10, Form S10-Transit Agency Service, 2004-2009; MDT 2010 data

Recommendation	Status
Recommendation 6: To provide the trip characteristics data (origin/destination, trip purpose, multi-modal connections, and MDT transfers) as an input to alignment review and planning, a system-wide on-board passenger survey should be performed at 5-year intervals.	A system-wide on-board passenger survey was last completed in 2004.

Recommendation	Status
Recommendation 7: To determine passenger needs, attitudes and preferences, and to compare route passenger demographics with those of the communities that they serve so that underserved markets may be identified, questions regarding passenger demographics, attitudes, and preferences should be added to the five-year, system-wide on-board passenger survey of Recommendation 6.	A system-wide on-board passenger survey was last completed in 2004; tracking studies that examined transit usage, satisfaction and image among riders and non-riders in Miami-Dade were conducted in 1997, 2000, 2006/2007 and in 2008 by Behavioral Science Research under contract to MDT; the September 2011 Metrobus Fleet Management Plan indicates that an in-depth survey is conducted every three years to assess the public's perception of how the organization is doing and to solicit the public's attitudes toward system safety programs to encourage usage and recommend improvements; past studies focused on: changes in ridership, ridership patterns and demographics, customer satisfaction, shifts in non-rider and potential rider populations, and attitudes toward the organization and how well the organization performs

Recommendation	Status
Recommendation 8: A series of transit needs assessments should be performed, according to Commission District to analyze demographics to identify underserved markets in the communities. This information should be community needs assessments for specific communities.	Unknown

XII. Metrobus Fleet Management Plan, Revision II, January 2005

CUTR researchers assisted MDT in updating the Metrobus Fleet Management Plan (FMP). The FMP represented a statement of the processes and practices by which MDT established current and projected Metrobus revenue vehicle fleet size requirements and operating spare ratio. The 2005 FMP served as an update of the October 2000 FMP and included a description of the system, planned revenue service, projected growth of the system, and an assessment of vehicle maintenance current and future needs.

Metrobus processes and practices, as outlined in the plan, complied not only with FTA Circular 9030.1, 9030.1, and 5010.1 that govern Vehicle Fleet, but also with supplemental information received from FTA.

The plan was based on current realities and assumptions and was, therefore, subject to future revision. The plan was scheduled to be updated on a regular basis to assist in the planning and operation of Metromover.

The FMP was structured to present the demand for service and methodology for analysis of that demand; address the supply of vehicles; explain the balance between the demand for and supply of vehicles; and, provide a summary of the maintenance plan.

The 2005 update included the following revisions of and additions to the October 2000 FMP.

Integration of Former "A" and Division "B" Fleets

New minibuses were placed in service on low-density routes to provide service at a reasonable cost (special requirements on new minibuses mirrored those of the 40' buses).

Expansion of Operating & Inspection Divisions

Preventive maintenance, corrective maintenance, cleaning and storage of vehicles were performed throughout Miami-Dade County at three maintenance facilities operated by MDT:

- Central O&I
- Coral Way O&I
- Northeast O&I

MDT subsequently contracted with Penske Truck Leasing to operate an additional O&I division, referred to as Medley O&I Division. Maintenance operations at the Medley O&I Division differed slightly from the other division, where preventive MDT A, B and C inspections were replaced with Penske BC1 and BC3 inspections. The Penske BC3 inspection at a 60,000-mile interval encompassed all of the requirements of the MDT B and C inspections.

Metrobus Preventive Maintenance Schedule

Inspection Type	Inspection Interval	Time to Complete (hrs)
Daily Safety & Operating	Daily	0.3
A (MDT)	6,000	4.0
B (MDT)	18,000	8.0
C (MDT)	54,000	16.0
BC1 (Penske)	6,000	6.0
BC3 (Penske)	60,000	8.0

Modification of the Fleet Management Plan

The format of the plan was modified to include the following to facilitate analysis and presentation, and procedures were updated to reflect current Metrobus performance and maintenance practices.

- Overview of current Metrobus fleet and operating practices
- Quality of Service
  - Average monthly customer complaints
  - On-time performance
  - Safety
- Recommended PTP service plan improvement
  - New routes
  - Alignment adjustments
  - Service frequency improvements
- Scheduling and operating strategies used to reduce in-service failures
  - Road call Reference Guide
- Preventive maintenance inspections and forms
- Maintenance philosophy
- Sample operating rules

System and Route Load Factors

Ridership data obtained during the ongoing CBOA were reviewed to develop estimated passenger load factors for the overall weekday system of bus routes. Six major bus routes in the system were identified. A mathematical relationship between the maximum load factor per trip and the average load factor was created using a sample of weekday ridership data collected. This factor was applied to the average load factor for the system and the six major routes. The average load factor was derived from the average trip length per passenger and the average boardings per revenue mile. The average trip length was calculated from 2002 NTD information for bus. The source for the average boardings per revenue mile was the September 2003 MDT Ridership Technical Report.

PTP Commitment/Transit Development Program

The 2004 TDP update provided a five-year service plan for all existing modes within MDT. The 5-year RSP covering FY 2005-2009 for Metrobus identified service improvements as new routes, alignment adjustments, service frequency, or capital improvements that were scheduled to be completed by the

fifth year of the RSP (2009). The RSP included all improvements in the PTP. The RSP service improvements, identified in the TDP, may be implemented over the next five years (to the year 2009), given funding availability. The impact on the PVR was identified in the TDP update. A summary of operating service levels for the new routes was included in the FMP and followed by a description of each of the new routes.

Service Truck Operation

When service was interrupted, restoration of service with minimal disruption was of primary concern to MDT. Starting in FY 2005, Metrobus increased the number of service trucks available on Monday through Friday between the hours of 6:00 a.m. and 10:00 p.m. from four (4) to six (6). The service trucks were stationed throughout the service area and worked under the direction of Central Control. There were three (3) service trucks available as needed by Central Control after 10:00 p.m. from the O&I Divisions. On weekends, three (3) service trucks were operated from 6:00 a.m. to 10:00 p.m. For special events, additional buses were allocated and service trucks may be assigned as needed.

Metrobus Fleet Management Plan Update

MDT incorporated the FMP into maintenance operations. The FMP was updated in March 2009 and again in September 2011 (Revision 01). Metrobus FMP Revision 01 included a description of revenue service plans to accommodate growth in Metrobus ridership, as well as an assessment and projection of needs for bus vehicle maintenance. MDT intended to update the plan on a regular basis and to expand the use of the plan to become a part of MDT's capital and operating budget preparation. Significant changes in the updated plan include the following:

Operating Practices

In addition to the 96 routes that MDT operated, MDT contracted with a private bus operator to provide two routes from far south Miami-Dade to Monroe County and another private operator to provide service twice a week in NE Miami-Dade County.

MDT no longer operates the Medley O&I Division that had been managed by Penske Truck Leasing under contract to MDT.

All new buses are received at the Support Service Division, where a post-delivery inspection is performed in accordance with the MDT Inspection Plan. Vehicles are released to the O&I Divisions only after acceptance. A Quality Assurance Division (QAD) was established to perform random quality assurance (QA) audits on inspection records to ensure compliance with the post delivery inspection plans and preventive maintenance activities.

Metrobus Service Planning

The Metrobus FMP defines two types of service comprising the Metrobus network. The first type, which represents the majority of Metrobus service, is "demand driven." The quantity of service (headway) is determined by passenger loads on respective trips, routes and lines and is driven by ridership demand at the maximum load point on the line. All service is monitored on a regular basis to balance supply and demand and to make adjustments for changing demographics and congestion. Consideration of vehicle

size is applied to demand driven service requirements, and vehicle size mix and availability are matched against specific service needs.

Service Planning and Scheduling specifies the number of buses required for the prepared schedule by time of day. Upon receipt of the Service Plan and Metrobus schedule, Bus Operations and Knowledge Management prepare an Operational Plan, which includes distribution of the total vehicle fleet to each of the O&I divisions based on assigned service requirements.

Knowledge Management is a new unit that includes Transit Maintenance Control and the Reliability and Warranty Sections. Knowledge Management is an independent management division responsible for:

- Directing and establishing plans, programs and policies designed to provide effective and efficient operations and maintenance for the Metrobus, Metrorail and Metromover systems
- Meet current and future department training needs
- Ensure adequate control measures are established and maintained for repair process
- Implement reliability and maintainability programs required to monitor, evaluate and maintain established transit system performance

The second type of basic service is "policy driven." Ridership is not high enough to provide an "adequate" headway on a policy driven route if demand driven criteria were used. Rather, it is established by policy that the service will be provided and that a specific or minimum level of service will be operated. Examples of policy driven services include night and weekend service when ridership is typically light and new routes or innovative services for which demand is emerging or developing. The vehicle requirements for policy driven routes are determined by the same parameters used for demand driven service.

Load Factor

The maximum allowable load factor was reduced from 175 percent in 2005 to 160 percent in 2001.

Service Planning Model

The span of service for Metrobus is 24 hours per day on 11 routes compared to 6 routes in 2005. Morning and afternoon peak periods remained unchanged.

Bus Route Efficiency and Productivity Guidelines

On routes where level-of-service is driven by passenger demand, MDT defined efficiency of the route as the degree to which the scheduled number of buses is able to satisfy the existing passenger demand. The primary objective of the scheduled headway is to provide enough service to permit every waiting passenger to board the first bus going in the passenger's desired direction of travel.

Service Plan Improvements

MDT delineated 6 new routes, 19 alignment adjustments, 11 service frequency changes, and planned elimination of 2 routes in the Metrobus FMP Revision 01.

Service Truck Operation

MDT expanded weekday service truck coverage to 24 hours.

Transit Maintenance Control Section (Component of Knowledge Management)

Transit Maintenance Control Section provides for the collection, reporting and analysis of maintenance information with respect to the subsequent major functions for the following maintenance divisions:

Transit Maintenance Control

Major Functions	Assignments
Maintenance scheduling	Metrobus Maintenance
Equipment status	Vehicle Maintenance
Failure analysis	Metromover Maintenance
Performance reporting	Track & Guideway Maintenance
	Train Control Maintenance
	Traction Power Maintenance
	Facilities Maintenance
	Field Engineering & Systems Maintenance

- All pertinent information is routinely recorded
- Maintenance activity and record keeping are accomplished by means of a Computer Maintenance Management Information System (TEA)
- Shop managers utilizing TEA are able to track all preventive and corrective maintenance actions
- Hard copies of all repair orders are maintained by Knowledge Management

Reliability and Warranty

The Reliability and Warranty Section is responsible for the effective tracking of warrantable components. All warranty related events are registered and tracked in EAMS. Warranty recovers money and/or agency resources by efficiently and expediently identifying and processing viable warranty claims for components, vehicles and services that have failed during their respective warranty cycles. The section evaluates and authorizes expenditures of no-warrantable repairs, investigates and resolves claim disputes and recovers warranty claims from vendors by means of checks, credits, no cost replacement parts and/or no-cost repairs. The Warranty Section provides input for contractual language relevant to warranty and applies contractual agreements toward resource recovery.

MDT's decision to "purchase with warranty" has essentially eliminated rebuild shops within bus maintenance, and parts consumption has fallen every year.

The Reliability component is responsible for monitoring and evaluating bus, rail and mover equipment failures. This section offers reliability and predictive maintenance management services, which concentrate on developing life cycles for asset tracked components. Subsequently, this information is used in the proactive identification of substandard component quality and identifies vendor performance, which results in the cost effective procurement of the highest quality replacement parts. Additionally, this section coordinates the oil analysis program that enables corrective action to be taken to prevent potential fleet failure conditions. The Reliability section is also responsible for processing/resolution of bus maintenance related community complaints (serves as the liaison between 311 Call Center and Bus Maintenance).

These services are used to set achievable in-service performance standards, resulting is high quality components with maximized life cycles.

Fleet Specific Preventive Maintenance Program

Preventive maintenance checklists are generated on a mileage interval with specific tasks associated with life-to-date mileage of the individual bus. All PMI checklists are available for printing in Transitnet. The PMI program is designed to sustain bus reliability by detecting potential defects and enabling them to be corrected prior to the failure occurring.

- Type O
  - Base level PMI scheduled at a 3,000-mile interval for ERG buses
  - Aimed at preventing the most common problems
- Type A
  - Scheduled at a 6,000-mile interval
  - Includes all the requirements of the Type O inspection
  - Adds more detailed checks of the engine, transmission, brakes, and electrical systems
  - Addresses mileage driven components through the use of attachments

Preventive Maintenance Inspection Mileage Management

Every bus in the MDT fleet is equipped with a Vehicle Information Transmitter (VIT). When a bus passes through the fuel island service lane, VIT transmits the bus number and current mileage to a fuel control terminal, which in turn logs the data in MDT's server. Every night, the mileage information for each vehicle is exported to MDT's TEA. Every weekday, bus maintenance logs into the PMSK8 report, which is located in MDT's special maintenance reporting tool (SMART), a group of menus for ad-hoc reporting for TEA. The report depicts the current mileage of each vehicle and the amount of time (in date and miles) until the next scheduled PMI is due. A repair order in TEA is opened for the PMI. Once the PMI is completed, the bus maintenance control clerk enters all pertinent information on the repair order in TEA. The mileage field in the repair order in TEA defaults to the last mileage reading based on the date entered when the PMI is completed. After the information is entered, the PMI will capture the mileage for the specific date entered.

Mean Distance between Failures (MDBF)

The average miles between failures is a ratio of miles operated to the number of failures during the period and is calculated by dividing the number of bus vehicle miles by the number of mechanical service interruptions of five or more minutes.

Mean Distance between Failures

Metrobus MDBF Report	As of	Actual	Target	FYTD Actual	FYTD Target
Q1 2008	Dec 2007	3,935	4,000	3,589	4,000
Q2 2008	Mar 2008	3,432	4,000	3,669	4,000
Q3 2008	Jul 2008	3,901	4,000	3,745	4,000
Q4 2008	Oct 2008	3,413	4,000	3,413	4,000
Q1 2009	Dec 2008	3,677	4,000	3,667	4,000
Q2 2009	Apr 2009	4,017	4,000	3,888	4,000
Q3 2009	Jun 2009	4,171	4,000	3,932	4,000
Q4 2009	Sep 2009	3,654	4,000	3,951	4,000
Q1 2010	Dec 2009	4,727	4,000	4,467	4,000
Q2 2010	Mar 2010	5,758	4,000	4,844	4,000
Q3 2010	Jul 2010	5,601	4,000	5,080	4,000
Q4 2010	Oct 2010	5,012	4,000	5,012	4,000
Q1 2011	Dec 2010	4,294	4,000	4,655	4,000
Q2 2011	Apr 2011	5,204	4,000	4,738	4,000
Q3 2011	Jul 2011	4,881	4,000	4,787	4,000

- MDT reported MDBF by fleet type in the FMP
- This measure is specific to MDT and differs from the common metric referred to as revenue miles between failures based on NTD data

Contingency Fleet

MDT will maintain a contingency fleet of six buses. The contingency fleet consists of older buses that are beyond their useful service life (i.e., more than 14 years old or greater than 500,000 miles) that would not be suitable for regular passenger service, except in an emergency. The contingency fleet would be used to respond in emergencies, such as supplementing the active fleet in a hurricane evacuation or if a Metrorail or Metromover line is put out of service for an extended period. The contingency fleet could also be made available to respond to a large number of active vehicles involved in a catastrophic event, such as a flood at an operating division. The contingency fleet will be stored, maintained and documented in accordance with a contingency fleet plan, which will be updated as necessary.

Alternative Fuels

MDT will maintain its commitment to clean diesel fuel, while increasing the use of hybrid bus technologies as a bridge to the future. MDT is currently transitioning its bus fleet to hybrid buses to benefit from the environmental and energy efficient hybrids. These will replace old buses ready for retirement. To date, MDT has replaced 43 diesel powered buses with hybrid electric buses.

XIII. Technical Memorandum: Fares, March 2005

The Director of Miami-Dade Transit asked that CUTR conduct a quick review of available information relating to transit fares, including recent increases in other metropolitan areas, the passenger makeup of MDT riders and the concept of zone fares.

The results of this one-week initiative were summarized. The fare information was gathered from the American Public Transportation Association's (APTA) Transit Fare Database, interviews with selected agencies and MDT revenue data.

Transit Fare Analysis

For the MDT system, the fare structure is fairly straight forward with a $1.25 "base fare" for a one-way trip. There are myriad discount and pass programs that reduce that fare for many of the system's customers. Conversely, there are premium fares for express service. This technical memorandum focused on fares and addressed:

- Timing of Last Increase
- Comparisons with other U.S. Transit Agencies
- MDT Ridership by Types of Fares
- Estimated Revenue of an Increase

Timing of Last Fare Increase & Fare Comparison

MDT had recently discussed the possibility of a fare increase, and the financial forecast, since January 2004, assumed a $.25 rail and bus base fare increase in FY 2007 and increases in transfers, special transportation services fares, and prepaid monthly and discount passes. The forecast also assumed that fares would be adjusted every five years from 2012 to 2022. MDT's base fare was last increased in December 1990.

To determine how often other transit providers adjusted fares, CUTR reviewed and summarized information published in the APTA Transit Fare Database, which contained data collected from survey respondents representing 235 U.S. bus systems and 11 large heavy rail systems. Agencies selected for fare comparison were taken from the APTA 2004 Transit Management Compensation Report.

Rail

Of the 11 U.S. large heavy rail systems reporting, 7 had a base fare higher than MDT's $1.25. Fares ranged from three that were equal to MDT at $1.25 to two at the high end of $2.00. It is important to note that the data were reported for an adult fare (a person older than a university student and younger than a senior, generally between the ages of 21 and 65, and not disabled). Further, the "base" fare was defined as "the minimum cash fare for a single trip paid by an adult, excluding transfer, distance or zone, speed, time-of-day, and parking surcharges."

All other agencies reported an increase in fares since MDT's last fare increase. Cleveland was the only rail system that had not increased its base rail fare since the 1990's (February 1993). Five systems implemented increases in 2004, and four reported their last increase in calendar year 2003.

Looking at the base fare alone is misleading because many of the rail systems employed various surcharges that were mentioned above. While the average base fare for the 11 systems was $1.54 compared to Miami's $1.25, when zones and peak hour charges are considered, the average ranged from a minimum of $1.67 to a maximum fare of $2.55. As an example, although Washington, D.C. reported a base rail fare of $1.35, a morning rush hour trip from a suburban terminal station to downtown (with no transfers) cost $3.90. At least 3 of the 11 peer cities were known to have distance-based zone fares that were not included in the average of $1.54. For these cities, fares increased nearly 17 percent from 1997 to 2004 and 30 percent from 1993 to 2004, on average. This average included two systems with no increases (0%), Cleveland, where the last fare increase was in 1993, and Miami.

The base fare for an adult to ride the bus or rail system in MDC was last raised from $1.00 to $1.25 in December 1990, over 14 years ago. Prior to that increase, fares were periodically adjusted in 1978, 1980, 1981, and 1987. Had the $1.25 fare that was instituted in 1990 kept pace with inflation, it would be about $1.78 per trip. (Source: CUTR/ U.S. Bureau of Labor Statistics, Consumer Price Index (CPI), Southeastern U.S. Average Urban Consumers).

Bus

Using the APTA Fare Database, bus fares were examined. The database included 235 U.S. bus systems. CUTR reviewed the data to determine which bus systems had raised their base fares in calendar years 2003 or 2004. Of the 235 bus systems reporting to APTA, 49 cities had a higher base fare than Metrobus, and 45 had the same $1.25 base fare. Of the systems reporting, 47 systems raised the base bus fare in 2003, and 26 systems did so in 2004.

Looking at large agencies (with over 2,500 employees), bus fares increased 50 percent from 1993 to 2004, on average. The average included MDC and Cleveland at zero percent, as their last reported increases were in 1990 and 1993, respectively. CUTR found that since 1997, for the same 20 agencies, fare increases averaged nearly 28 percent. The average base bus fare for these transit systems was $1.41, not including additional charges for traveling during peak times or other surcharges. At least 12 of the 20 peer cities were known to have distance-based zone fares and/or peak hour and/or express limited surcharges that were not included in the average of $1.41. Including these surcharges, the average rate would range from $2.26 to $4.54.

MDT Ridership by Types of Fares – Estimated Revenue of an Increase

In order to estimate the impacts of a fare increase, even at this cursory level, an understanding of the current fare structure and those passengers that use the various discount and free passage programs was necessary. While there were myriad programs to access discounted transit fares, the fare structure was straight forward. There were full fares, discounted fares, fees to transfer and free passage programs.

MDT customers had access to several reduced fare programs. Some programs allowed passengers that met certain criteria to ride for free and others allowed access to discounted fares through enrolling in a specific program.

To assess the impacts of a fare increase proposal on the passenger population and on the agency's revenues, the mix of riders and customers that took advantage of the discount programs needed to be understood. MDT provided CUTR with data on Metrobus passenger boardings and revenue. Summary level data were provided for the period from October 2002 to August 2004, and detailed data were available for the period April 2004 to August 2004 to enable researchers to perform a quick analysis of the composition of fare types and estimate the impact of a potential fare increase on revenues from Metrobus.

The ridership trend for Metrobus was positive and grew during the time frame analyzed. From October 2002 to March 2004, Metrobus weekday ridership showed improvement, while weekend boardings remained relatively flat.

For the period studied, several trends were apparent. First, most types of boardings showed growth from October 2002 to March 2004. Exceptions were the discount fare and token boardings. The other noticeable trend was that the Golden Passport boardings were growing faster than other types. While full fare ridership was growing, it was not growing at the rate of other types of riders. The full fare rider seemed to be a shrinking percentage of the Metrobus market.

For the period October 2002 to March 2004, Golden Passport boardings nearly doubled from 637,000 to 1,266,707 per month. The expansion and marketing of the program as a part of the PTP seemed to have been successful. However, when considering a base fare increase, it was significant that the full fare increase would apply to an increasingly shrinking segment of the ridership without considering future MDC demographics.

In summary, as a percentage of all boardings, full fare boardings were shrinking, Golden Passport use was growing, token boardings were holding steady, and passes were stable.

CUTR was not able to complete any forecasts of fare increase scenarios given the short duration of the analysis. However, researchers were able to estimate what increased revenues might have occurred in August 2004 had higher fares been in place. An increase was applied at various levels to the different types of riders to perform the estimation. This exercise was illustrative only and did not include any data for Metrorail fares. Further, it did not take into account any fare elasticity issues. Although there has been a "rule of thumb" used in the industry for many years that predicts a 4 percent drop in ridership for every 10 percent increase in fares, recent research work in this area indicated that this was too gross a prediction method for revenue estimation. More up-to-date work on fare elasticity was found in the Transit Cooperative Research Program's *"TCRP Report 95, Traveler Response to Transportation System Changes, Chapter 12- Transit Pricing and Fares."*

Based on August 2004, an additional $1 million per month would have been generated with a fare structure of:

- $0.25 increase in base fare
- $0.25 increase in discount fare
- $0.05 increase in student transfer
- $0.10 increase in regular transfer

- 20% increase in regular pass fee
- 20% increase in discount pass fee
- 20% increase in daily pass
- 20% increase in reduced fare permit
- $0.45 increase in token
- 20% increase in STS fare

These calculations did not take into account any drop in ridership due to an increase and did not include any fare increase estimates associated with Metrorail. It should also be noted that August was a particularly high revenue month of the four months for which CUTR had data. In addition, if the discount fare were to be raised, the County would probably not want to raise the discount pass fee or the discount permit fee. This would reduce the monthly total for August 2004 to a net $963,000 as opposed to $1,002,265.

Fare Policy Update

On October 1, 2008, MDT increased the transit fare for Metrobus and Metrorail to $2.00.

MDT Fare Increase

Service	2005 Full Fare	2008 Full Fare	2005 Reduced Fare	2008 Reduced Fare
Metrobus & Metrorail	$1.25	$2.00	$0.60	$1.00
Express Bus	$1.50	$2.35	$0.75	$1.15
Shuttle Bus	$0.25	$0.25	$0.10	$0.15
Metromover	*Free*	*Free*	*Free*	*Free*

MDT is authorized to raise fares every three years based on the use of a CPI adjustment.

MDT and Peer Agency Average Bus Fares, 2004-2009

Average Bus Fares							
Agency	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**
MDT	$0.77	$0.95	$0.85	$0.85	$0.84	$1.04	$1.12
Peer Average	$0.62	$0.64	$0.67	$0.68	$0.73	$0.76	
DART	$0.42	$0.48	$0.50	$0.52	$0.69	$0.68	
BCT	$0.47	$0.48	$0.49	$0.49	$0.62	$0.63	
WMATA	$0.66	$0.66	$0.80	$0.80	$0.80	$0.83	
MARTA	$0.73	$0.71	$0.73	$0.74	$0.76	$0.71	
ACCT	$0.69	$0.67	$0.71	$0.74	$0.77	$0.86	
Houston	$0.57	$0.59	$0.56	$0.56	$0.58	$0.89	
Muni	$0.48	$0.50	$0.57	$0.60	$0.63	$0.58	
HART	$0.76	$0.77	$0.81	$0.81	$0.86	$0.86	
BiState	$0.70	$0.80	$0.76	$0.78	$0.83	$0.88	
MTA	$0.71	$0.77	$0.75	$0.79	$0.72	$0.65	

MDT and Peer Agency Average Rail Fares, 2004-2009

Average Rail Fares							
Agency	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**
MDT	$0.64	$0.67	$1.14	$0.77	$0.71	$0.86	$1.01
Peer Average	$1.10	$1.12	$1.13	$1.13	$1.22	$1.26	
SEPTA	$0.82	$0.82	$0.83	$0.83	$0.87	$0.88	
MARTA	$0.63	$0.60	$0.67	$0.66	$0.62	$0.60	
LACMTA	$0.55	$0.45	$0.60	$0.58	$0.73	$0.74	
MTA	$0.93	$0.97	$0.92	$0.94	$0.88	$0.82	
PATC	$2.04	$2.04	$2.03	$2.02	$2.05	$2.20	
MBTA	$0.61	$0.75	$0.73	$0.87	$1.05	$1.08	
PATHC	$1.22	$1.23	$1.15	$1.15	$1.26	$1.26	
CTA	$0.91	$0.90	$1.08	$1.04	$1.36	$1.14	
GCRTA	$0.68	$0.59	$0.35	$0.72	$0.82	$1.12	
WMATA	$1.29	$1.44	$1.45	$1.46	$1.59	$1.71	
SIRTOA	$1.32	$1.32	$1.33	$0.73	$0.76	$0.80	
BART	$2.25	$2.35	$2.47	$2.58	$2.68	$2.77	

MDT Fares Schedule

Fares Schedule Effective December 13, 2009		
Service	**Fare**	**Discount Fare****
Bus Fees		
Metrobus	$2	$1
Express Bus	$2.35	$1.15
Shuttle Bus	25¢	15¢
Bus-to-Bus Transfer	FREE*	FREE*
Bus-to-Express Bus Transfer	50¢+35¢ upgrade*=85¢	25¢+15¢ upgrade*= 40¢
Bus-to-Rail Transfer	50¢*	25¢*
Rail-to-Bus Transfer	50¢*	25¢*
Shuttle Bus-to-Bus or Rail Transfer	25¢+$1.75 upgrade* = $2	15¢+85¢ upgrade* = $1
Shuttle Bus-to-Express Bus Transfer	25¢+$2.10 upgrade*=$2.35	15¢+$1 upgrade*=$1.15
Rail Fees		
Metrorail	$2	$1
Metrorail daily parking fee	$4	Not applicable
Metrorail monthly parking permit	$10 (with purchase of monthly pass)	Not applicable
Discounts		
1-Month Pass	$100	$50
1-Month Pass - Group Discount 4-99 passes	$90	Not applicable
1-Month Pass - Group Discount 100 or more passes	$85	Not applicable
7-Day Pass	$26	$13
1-Day Pass	$5	$2.50
College/Adult Education Center Monthly Pass	$50	Not applicable
Golden Passport or Patriot Passport	Free	Free
Special Transportation Service (STS)	$3	Not applicable
Other		
Metromover	Free	Free
EASY Card	$2	Not applicable
EASY Ticket	Free	Not applicable

* Above-listed transfer fees are for passengers using an EASY Card or EASY Ticket only. Passengers paying with cash must pay the full fare each time they board a bus.

**Discount fare is available for Medicare recipients, most people with disabilities, and local students in grades K-12 when using the EASY Card for discount-fare riders.

XIV. Facilities Maintenance Division Equipment & Maintenance Plan, June 2005

CUTR researchers assisted in the development of the inaugural MDT Facilities Maintenance Division Equipment & Maintenance Plan (FEMP). The FEMP was a statement of the processes and practices by which MDT established proper maintenance of facilities, machinery, and equipment through the Facilities Maintenance Division. It described the organization of the Facilities Maintenance Division, detailed the assignment of responsibility for facility and equipment maintenance, outlined inspections and routine maintenance actions designed to ensure the proper care and maximum useful service life of facilities and equipment, and presented the record-keeping system used to maintain permanent records of maintenance and inspection activity for buildings and equipment.

Facilities Maintenance Division processes and practices, as outlined in the FEMP, complied with FTA Circular 5010.1C, Chapter II, 3e(5) and Circular 9030, Chapter V 5e.

The plan was based on current realities and assumptions and was, therefore, subject to future revision. The plan was scheduled to be updated on a regular basis to assist in the planning and operation of MDT Facilities Maintenance Division.

The FEMP was structured to present an overview of MDT Facilities Maintenance Division followed by a discussion of current operating practices for facilities and equipment in terms of preventive maintenance, rehabilitation and renovation, and replacement. Identified demands translated into maintenance manpower requirements were included along with warranty recovery maintenance plan requirements, including identification, recovery and enforcement.

The March 2009 update included the following revisions of and additions to the June 2005 FEMP.

Reporting Relationship

In 2007, responsibility for management of the Facilities Maintenance Division, which had operated under the direction of Rail Operations, was transferred to the newly created division of Infrastructure Engineering & Maintenance (IEM). Activities of the Facilities Maintenance Division are directed by the Chief of Facilities Maintenance, who reports to the Chief, Infrastructure Engineering & Maintenance.

Maintenance of Facilities and Fixed Equipment

- Paratransit Regulation and Services was removed from the inventory.
- The number of Miami-Dade Busway stations increased from 30 in 2005 to 59 in 2009.
- The OMNI Terminal Bus Bay, a new bus terminal, was established.
- County-wide bus stops increased by 300 to 9,500 stops in 2009.
- Adjusted PMIs were based on safety and security related priority equipment

Modification of the Equipment and Maintenance Plan

- The FEMP is updated every two years for use within the agency.
- The Property Value section was eliminated from the FEMP.

- The Table of Organization was restructured with a new reporting relationship to IEM.
- All PMI requirements for equipment and equipment calibration are scheduled by Knowledge Management rather than Rail and Bus Maintenance Control.
- The scheduled maintenance program no longer includes a daily facility PMI.
- Completed elevator and escalator inspection reports are signed by the Chief of Facilities Maintenance rather than by the Manager, Contracts and Maintenance.
- A new MDT Facilities Maintenance Work Order Generation and Prioritization Procedure was approved.
- Sections delineating the Facilities Maintenance Division Maintenance Plan, continuous improvement objectives and implementation monitoring are no longer included in the FEMP.

Facilities Manpower

- The division was reduced by 6 to 10 positions.
- Some functions, such as lift maintenance, have been privatized. The division is evaluating contracting other functions such as landscaping, asphalt, concrete, roofs and glass.
- As detailed in the FEMP, the Facilities Maintenance Division uses an established procedure to determine effective manpower allocation for PMIs and repairs; Facilities Maintenance is striving for a 70/30 split for PM/repair.
- All work orders are now documented and 90 percent of all hours are accounted for.
- All aspects of lighting are under evaluation, including in-house versus contract, monitoring, and preferred replacement alternatives. Civil Rights & Labor Relations are involved in the planning process.

Facilities Maintenance Funding

- Rehabilitation prioritization is based on safety and security.
- Many Facilities Maintenance activities are dependent upon and driven by the 30-year Infrastructure Resource Program (IRP).
- Facilities Maintenance is looking to FTA and TSA for grants; MDT received $60 million ARRA funds, 20 percent of which is committed to the municipalities.

Performance Metrics

Elevators and Escalators

Facilities Maintenance reported Metrorail and Metromover elevator and escalator availability in the MDT Scorecard from December 2007 through April 2009:

Elevator and Escalator Availability

		Elevator Availability				Escalator Availability			
				FYTD	FYTD			FYTD	FYTD
Report	As of	Actual	Target	Actual	Target	Actual	Target	Actual	Target
Q1 2008	Dec 2007	98.2%	96.0%	97.9%	96.0%	90.8%	95.0%	91.2%	95.0%
Q2 2008	Mar 2008	98.4%	96.0%	98.0%	96.0%	91.0%	95.0%	91.3%	95.0%
Q3 2008	Jul 2008	98.7%	96.0%	98.1%	96.0%	93.1%	95.0%	91.5%	95.0%
Q4 2008	Oct 2008	98.1%	96.0%	98.1%	96.0%	94.7%	95.0%	94.7%	95.0%
Q1 2009	Dec 2008	96.9%	96.0%	97.6%	96.0%	91.1%	95.0%	92.6%	95.0%
Q2 2009	Apr 2009	98.0%	96.0%	97.9%	96.0%	97.1%	95.0%	94.5%	95.0%

The Facilities Division also provides detailed overviews of elevator and escalator performance in the Transit Services Monthly Report. Monthly reporting includes percentage of time available (presented below), top five failures by equipment, and breakdowns presented in a 12-month rolling format.

Elevator and Escalator Percentage of Time Available

	Elevator Availability		Escalator Availability	
Report	Rail	Mover	Rail	Mover
Oct 2010	98.76%	97.87%	97.11%	98.29%
Nov 2010	98.97%	98.82%	96.25%	97.98%
Dec 2010	98.89%	99.22%	96.53%	95.49%
Jan 2011	99.04%	98.93%	97.12%	97.29%
Feb 2011	98.32%	98.92%	96.17%	97.33%
Mar 2011	98.99%	98.80%	98.19%	96.75%

Preventive Maintenance Inspections

The Facilities Division reports preventive maintenance completion in the Transit Services Monthly Report. Based on the March 2011 report, Facilities accomplished the following PMIs for bus facilities and rail/mover facilities from October 2010 through March 2011.

Preventive Maintenance Completion

	Bus Facilities		Rail/Mover Facilities	
Report	Actual	Target	Actual	Target
Oct 2010	100.0%	90.0%	100.0%	90.0%
Nov 2010	100.0%	90.0%	100.0%	90.0%
Dec 2010	100.0%	90.0%	100.0%	90.0%
Jan 2011	100.0%	90.0%	100.0%	90.0%
Feb 2011	100.0%	90.0%	96.7%	90.0%
Mar 2011	100.0%	90.0%	99.8%	90.0%

XV. Technical Memorandum Operating Costs, November 2005

The MDT Director asked that CUTR review operating costs for Metrobus and Metrorail and compare them to other transit agencies in the U.S. The data used for the cost comparisons were obtained from FTA's NTD and were not verified with the reporting agencies.

Operating Cost Analysis

Due to the expedited nature of this response, CUTR relied on NTD data. While there are fairly elaborate guidelines and instructions for agencies that report annually to FTA, experience has shown that, invariably, agencies interpret the instructions somewhat differently and may not report in an entirely consistent manner. MDT could be compared to other transit agencies at the macro level to look for anomalies and determine whether MDT was roughly in the "ballpark" when it comes to costs.

The cautions mentioned above were particularly relevant when looking at operating costs. The operating costs reported were categorized by:

- Vehicle Operations
- Vehicle Maintenance
- Non-Vehicle Maintenance
- General Administration

The analysis conducted for both rail and bus was expressed in both ***operating cost per vehicle mile*** and ***operating cost per passenger mile***. The operating cost per vehicle mile provided some insight into the efficiency of MDT's maintenance and operating practices, while the cost per passenger mile combined a measure of efficiency with the productivity of the system. For example, an agency could have the most streamlined and efficient maintenance program with too much unused service being provided. In that case, the agency would compare favorably to its peers on a cost per vehicle mile basis. When viewed on a cost per passenger mile, however, the operation would not rate nearly as high. The researchers at CUTR recommended considering both measures.

The most recent data set available on a national level was 2003. For purposes of the analysis, CUTR used NTD data for 1999, 2000, 2001, 2002, and 2003. To select peer systems for comparison, CUTR attempted to identify agencies with bus operations that most closely resembled MDT. For the rail comparison, since only 13 other agencies operated a heavy rail system in the U.S., all rail systems were included in the analysis. For the peer agencies for the bus comparison, 13 agencies were selected for consistency with the number used in the rail comparison. CUTR selected the bus systems based on the number of buses that an agency reported having operated in the peak service period during 2003.

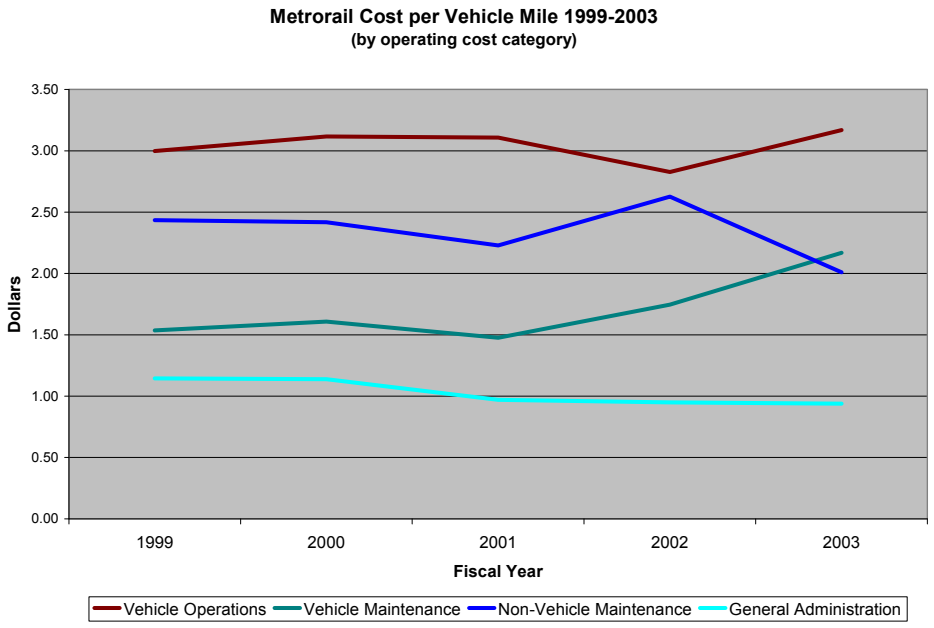
Rail Operating Cost Summary

During the 5-year analysis period, MDT's number of rail cars operated in maximum service (VOMS) rose from 68 in 1999 to 96 in 2003. The selected peer rail agencies with selected operating characteristics for FY 2003 are presented below.

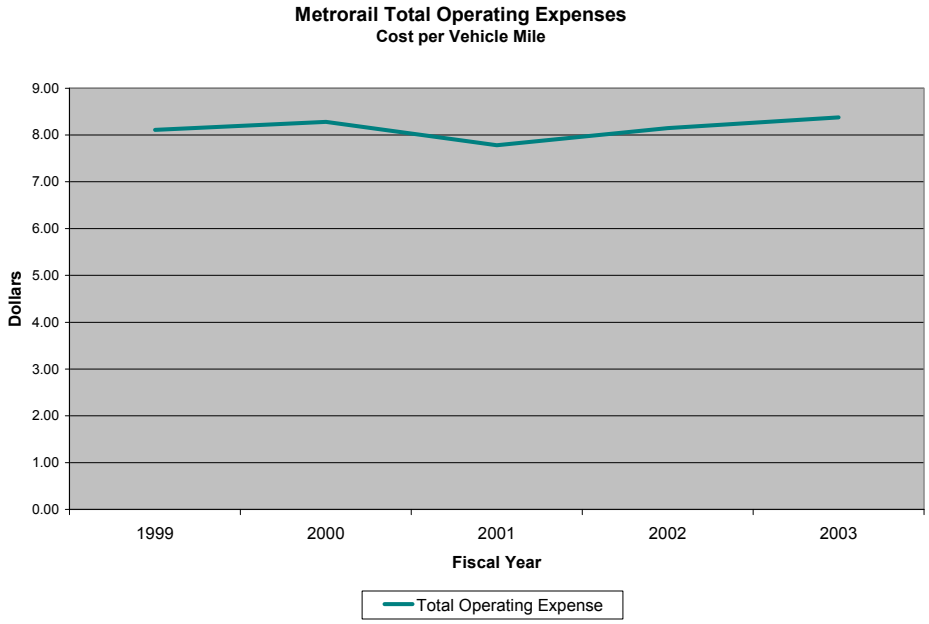
Transit Agency - Heavy Rail	2003 VOMS	2003 Vehicle Miles (000s)	2003 Passenger Miles (000s)	2009 VOMS	2009 Vehicle Miles (000s)	2009 Passenger Miles (000s)
MTA New York City Transit (NYCT)	5,102	344,916	7,820,492	5,388	363,509	9,972,779
Chicago Transit Authority (CTA)	1,004	63,998	1,060,355	1,002	69,076	1,201,136
Washington Area Metropolitan Transit Authority (WMATA)	686	58,683	1,451,857	850	72,876	1,667,900
San Francisco Bay Area Rapid Transit District (BART)	483	60,637	1,147,852	534	69,477	1,442,124
Massachusetts Bay Transportation Authority (MBTA)	320	21,570	537,033	334	23,028	568,976
Southeastern Pennsylvania Transportation Authority (SEPTA)	276	16,742	382,138	278	17,141	422,988
Port Authority Trans-Hudson Corporation (PATH)	259	12,057	254,003	266	12,884	341,196
Metropolitan Atlanta Rapid Transit Authority (MARTA)	180	23,510	487,349	182	25,449	527,023
Miami-Dade Transit (MDT)	96	7,866	109,219	84	6,910	132,770
Port Authority Transit Corporation (PATCO)	96	4,388	76,420	84	4,703	90,016
Los Angeles County Metropolitan Transp Authority (LACMTA)	74	6,200	151,901	70	6,276	227,657
Maryland Transit Administration (MTA)	54	4,738	55,736	54	5,500	88,047
Staten Island Rapid Transit Operating Authority (SIRTOA)	44	2,360	21,682	46	2,590	42,612
The Greater Cleveland Regional Transit Authority (GCRTA)	22	2,206	50,160	22	1,832	31,420

Vehicle Mile Basis

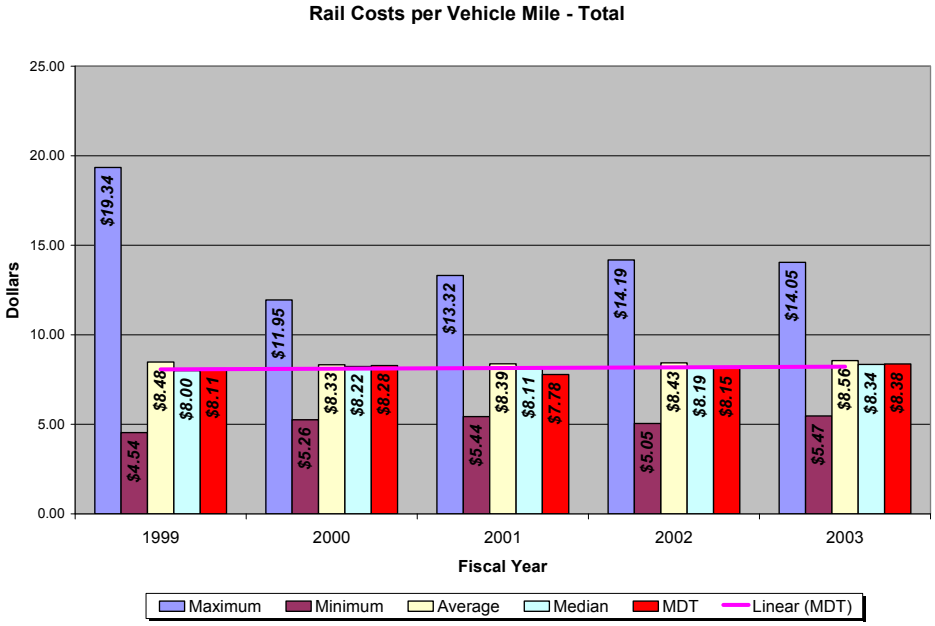
MDT Metrorail operating cost per vehicle mile for the years 1999 to 2003 by operating cost type showed that general administration had been flat and non-vehicle maintenance was dropping. It seemed understandable that costs directly associated with vehicle operations and maintenance would rise based on increasing energy and labor costs as well as the fact that the fleet has reached an age when a mid-life rehabilitation was being planned.



The next graph illustrated total operating costs on a vehicle mile basis for the same time period.

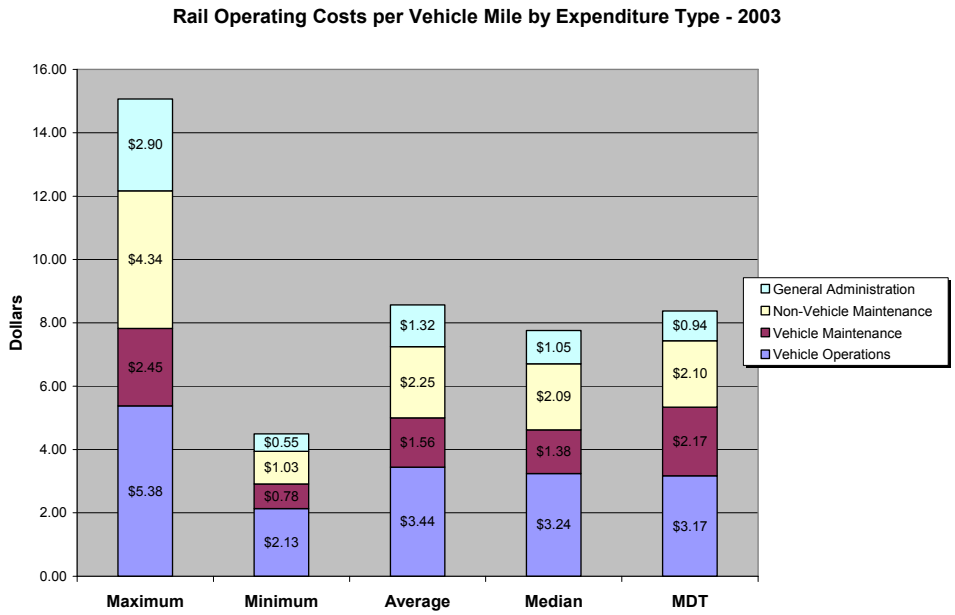


Metrorail operating cost on a vehicle mile basis increased from $8.11 per mile in 1999 to $8.38 per mile in 2003. The increase measured in this manner seemed modest. An analysis of all of the 13 peer rail agencies illustrated the highest cost, the lowest cost, the median and average for all of the agencies, and the actual costs for MDT.



What was apparent from this comparison was that MDT's rail operating cost, on a vehicle mile basis, was well below the highest cost agency ($8.38/mile versus $14.05/mile in FY 2003) and was in line with both the median and average for the 13 other U.S. rail agencies. The lowest cost reported was $5.47/mile.

The next graph illustrated the comparison of rail operating cost components of MDT with other agencies (again on a vehicle mile basis). Data from 2003 by operating expenditure type were presented. The highest, lowest, average and median costs were compared with MDT. Note: the costs presented for a particular grouping (e.g. "highest") could come from more than one agency. For example, if City "X" reported the highest operating cost for the "vehicle operations" category and City "Y" was highest in "general administration," then the bar labeled "highest" would report costs from at least two different agencies.

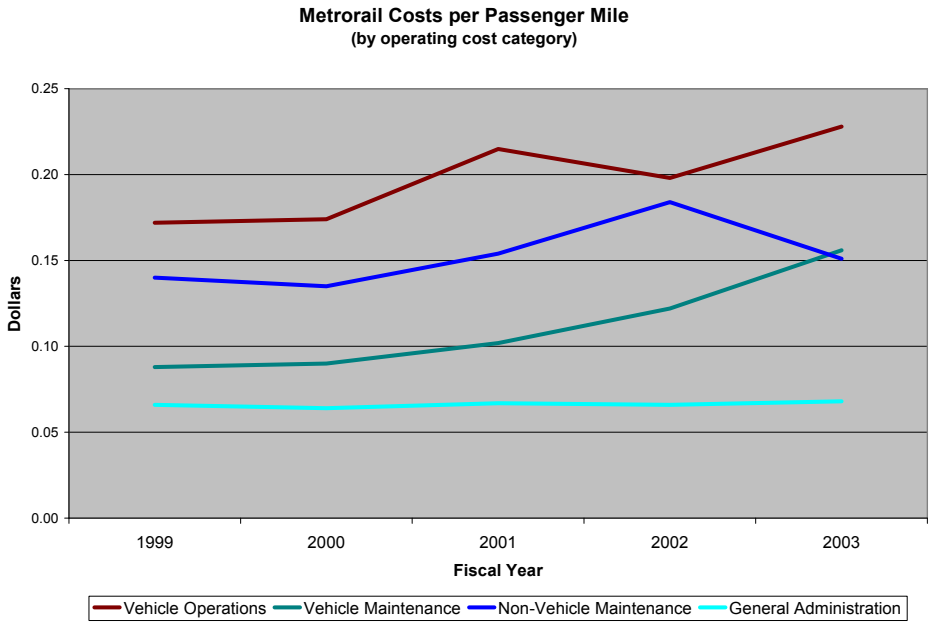


MDT costs on a vehicle mile basis by expenditure type were close to the median costs in three of the four expenditure type categories. Vehicle Maintenance at $2.17 per vehicle mile was higher than the $1.38 per vehicle mile median cost.

Passenger Mile Basis

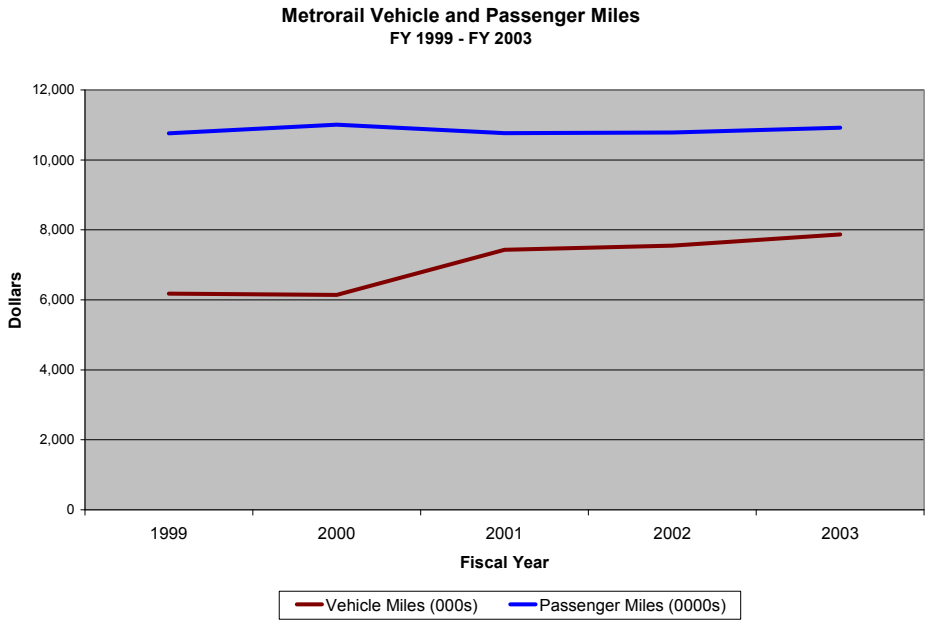
Another way to compare the operating costs was on a passenger mile basis. This view of costs took into consideration both the efficiency of the operation as well as the effectiveness of the system. As more passengers were served, costs were spread over more passenger miles and were lower than for a system that served fewer customers.

The following graph showed Metrorail operating costs over the 5-year period by type of expenditure on a passenger mile basis.

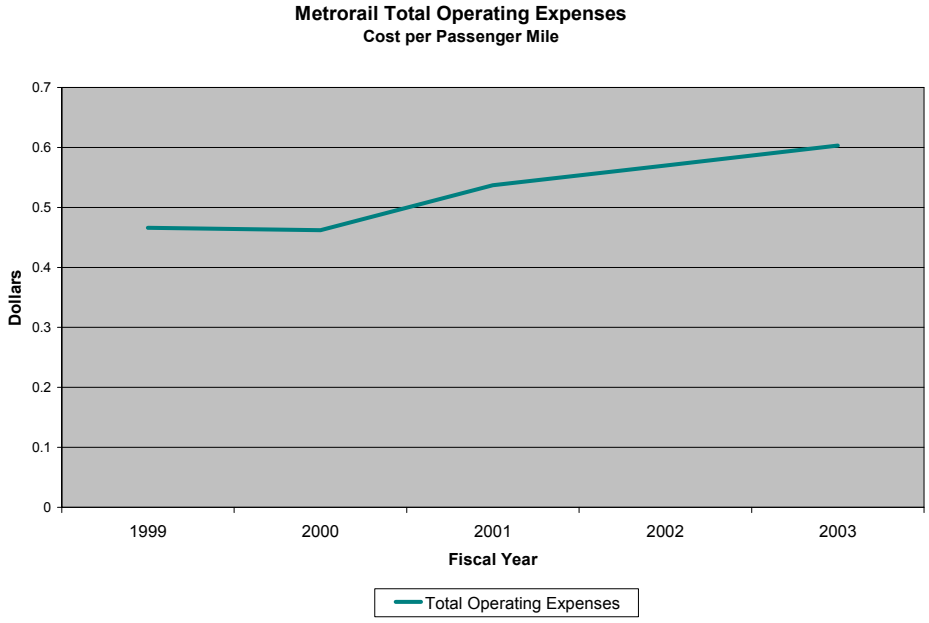


On a passenger mile basis, the distribution of costs looked similar to the graph based on vehicle miles, except that the growth rates were higher. This was most likely explained by ridership growth not keeping pace with cost growth at even a modest annual rate.

The next graph showed increases in passenger and vehicle miles for the study period. Ridership was relatively flat, while vehicle miles increased. The increase in vehicle miles in FY 2003 could be partially explained by the introduction of 24-hour Metrorail service as a part of the PTP. The service expansion appeared to have had no positive impact on ridership, and the suspension of the 24-hour service appeared to have been a positive move from an efficiency standpoint. Vehicle miles were expressed in thousands and passenger miles in tens of thousands in the graph to compare the trends on the same scale.

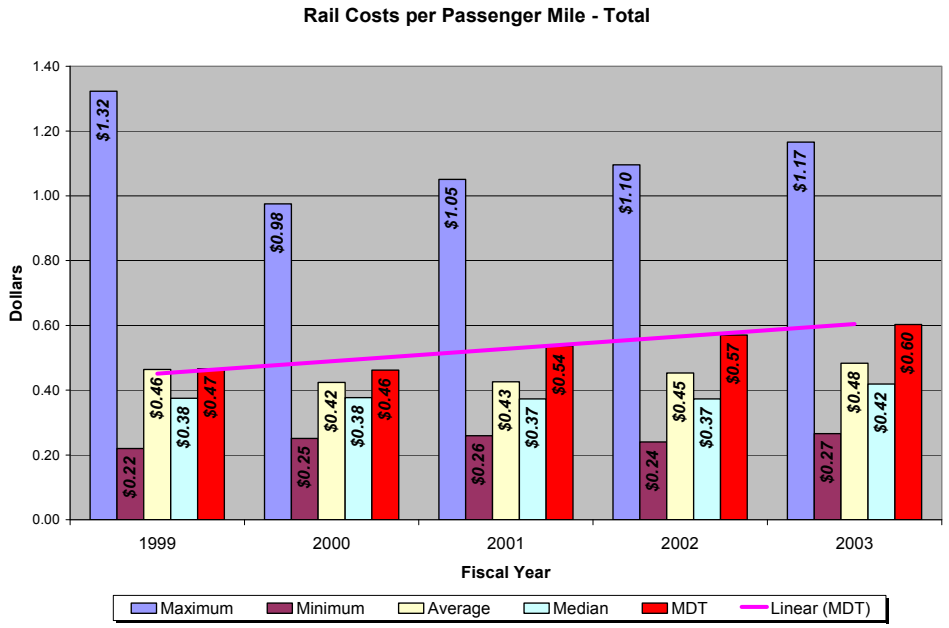


Not surprisingly, operating costs on a passenger mile basis in total grew at a faster rate than on a vehicle mile basis from 1999 to 2003. The total operating costs based on passenger miles are presented below.

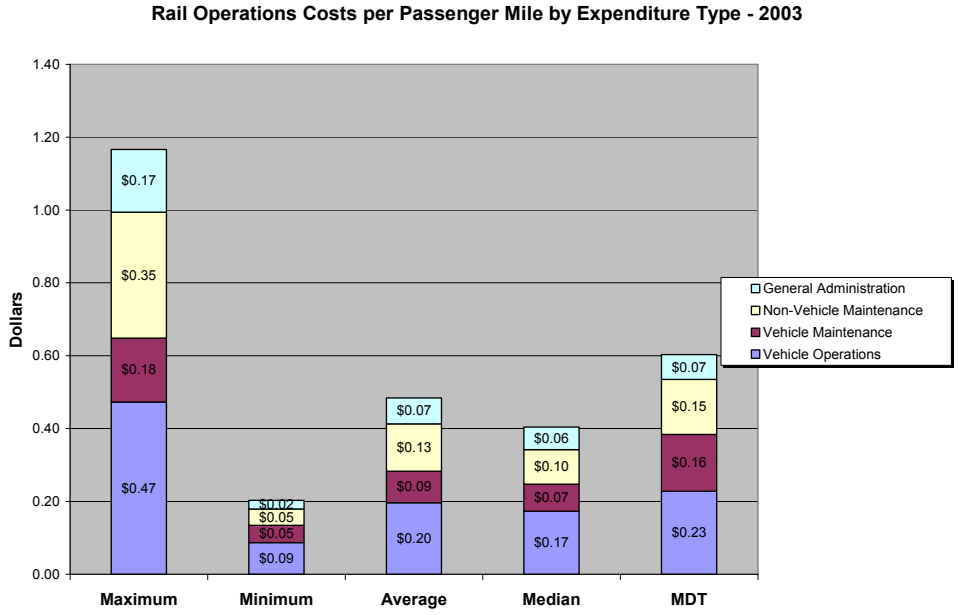


The cost per passenger mile rose from $0.466 in 1999 to $0.603 in FY 2003. Again, the elimination of the 24-hour service should have a positive impact on this measurement factor in future analyses.

The next graph compares this cost trend with peer heavy-rail agencies. As with the previous graph on vehicle miles, the illustration plotted the highest, lowest, median and average costs for the 13 other transit agencies against MDT Metrorail.



MDT's costs were still closer to the average than they were to the highest cost when viewed in this manner. In FY 2003, MDT was at $0.603; the average was $0.483, the median $0.419, the lowest $0.266 and the highest $1.166. Stated differently, the MDT Metrorail cost per passenger mile was 56 cents lower than the highest cost system, 12 cents above the average and 18 cents above the median in 2003.



MDT's rail operating costs, on a passenger mile basis, were higher than the median costs reported by peer agencies in all categories in 2003. Still, the MDT costs for vehicle operations were half of the highest cost, and general administration was equal to the average of peer rail properties.

Bus Operating Cost Summary

The next section of the report followed the same format as the rail operating cost summary, examining the operating costs for Metrobus. The analysis was conducted in the same manner, looking at costs on both a vehicle and passenger mile basis and comparing MDT to other systems in the U.S. Data were taken from the same source, the NTD, for the same time period, FY 1999 to FY 2003. Given that there were over 300 systems reporting nationally, 13 peer transit properties were selected by CUTR on the basis of the number of VOMS, passenger miles and vehicle miles.

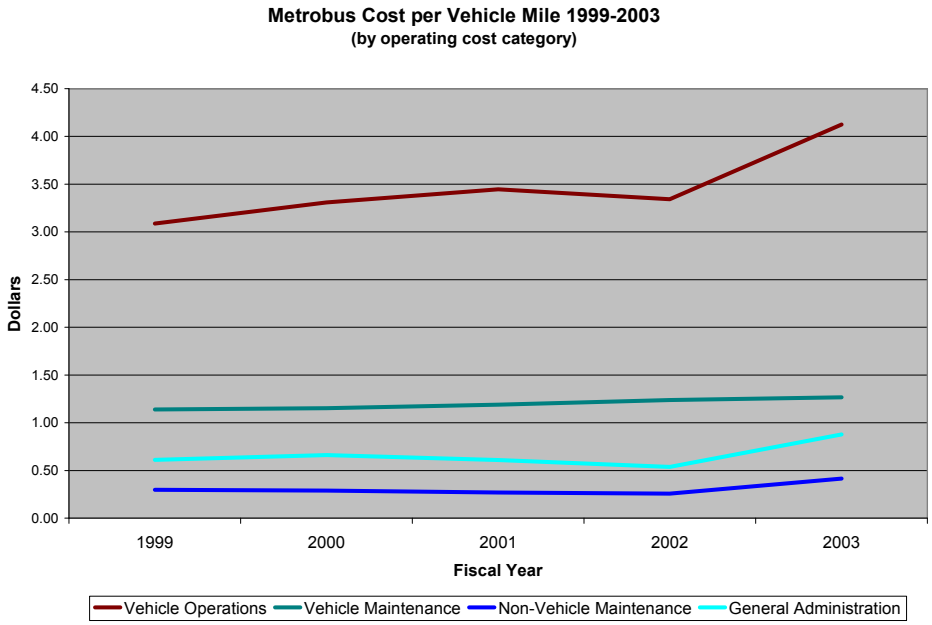
The following table lists the peer systems used in this analysis and some selected characteristics for FY 2003.

		2003			2009	
Transit Agency - Bus	VOMS	Vehicle Miles (000s)	Passenger Miles (000s)	VOMS	Vehicle Miles (000s)	Passenger Miles (000s)
Washington Area Metropolitan Transit Authority (WMATA)	1,262	48,003	447,551	1,273	51,751	418,039
Southeastern Pennsylvania Transportation Authority (SEPTA)	1,145	46,268	480,306	1,192	45,906	529,799
Port Authority of Allegheny County	828	36,745	273,195	711	31,006	259,208
Metro Transit	774	30,969	284,715	746	28,709	268,891
Massachusetts BayTransportation Authority (MBTA)	770	26,117	313,903	772	26,317	222,164
Maryland Transit Administration (MTA)	633	22,156	260,831	533	22,876	279,790
Denver Regional Transportation District (RTD)	589	30,115	226,012	528	25,615	243,596
Tri-County Metropolitan Transp District of Oregon (Tri-Met)	562	27,468	237,345	540	26,439	252,790
Metropolitan Atlanta Rapid Transit Authority (MARTA)	555	30,197	234,557	507	30,992	285,048
The Greater Cleveland Regional Transit Authority (GCRTA)	548	25,458	189,098	424	19,993	132,224
Miami-Dade Transit (MDT)	506	32,076	279,411	716	37,092	391,313
Pace - Suburban Bus Division (PACE)	472	22,027	181,705	495	21,805	183,819
Orange County Transportation Authority (OCTA)	452	25,535	251,392	477	26,350	248,484
City and County of Honolulu Department of Transp Services (DTS)	427	21,483	302,239			

While Miami-Dade Transit ranked lower based on VOMS in 2003, it was clearly in the mid-range of the group when considering passenger and vehicle miles. Passenger and vehicle miles were reported in thousands.

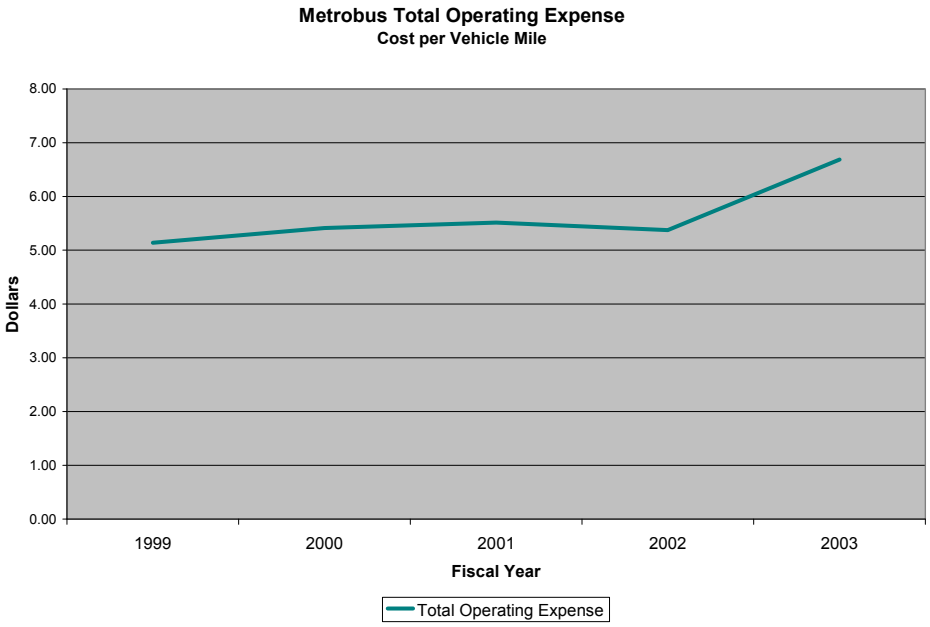
Vehicle Mile Basis

The following graphs summarized Metrobus operating costs on a vehicle mile basis. The first looked at the cost components that made up the total operating costs.

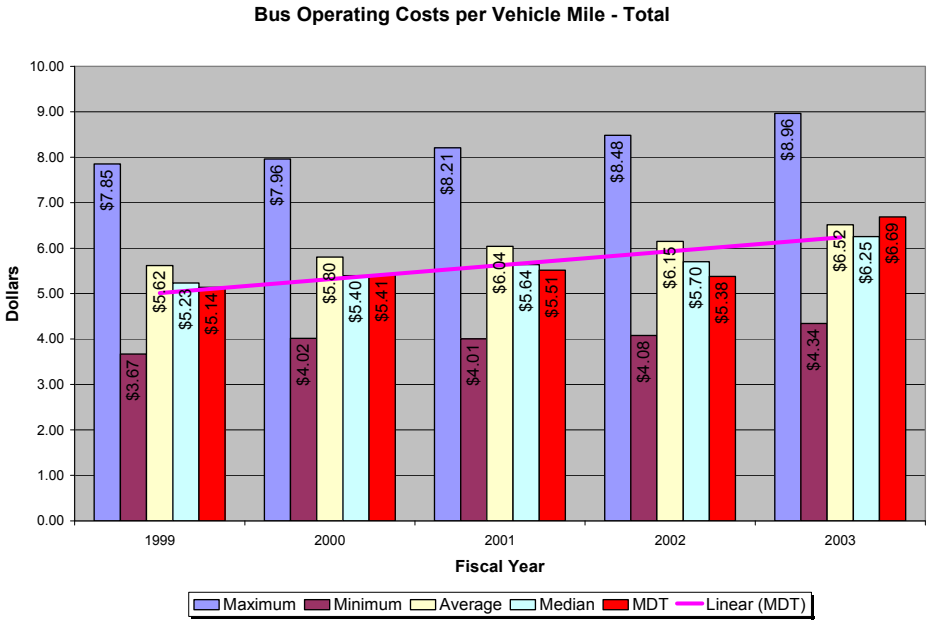


Vehicle operations made up the bulk of operating expenses. Unlike Metrorail, non-vehicle maintenance was a small portion of the Metrobus operating costs because of the absence of guideway and station infrastructure. The cost growth in three of the four factors was modest from 1999 to 2003. The most obvious trend on the graph presented above was the sharp increase in vehicle operations on a cost per vehicle mile basis. CUTR attributed this increase to the "ramp up" of operating personnel in anticipation of the additional service committed in the PTP. The reported number of VOMS did not change from 2002 to 2003, but additional bus operators were being trained as the fleet and bus service were about to increase significantly. In addition, rising fuel costs could have played a role in the increase for the last year analyzed.

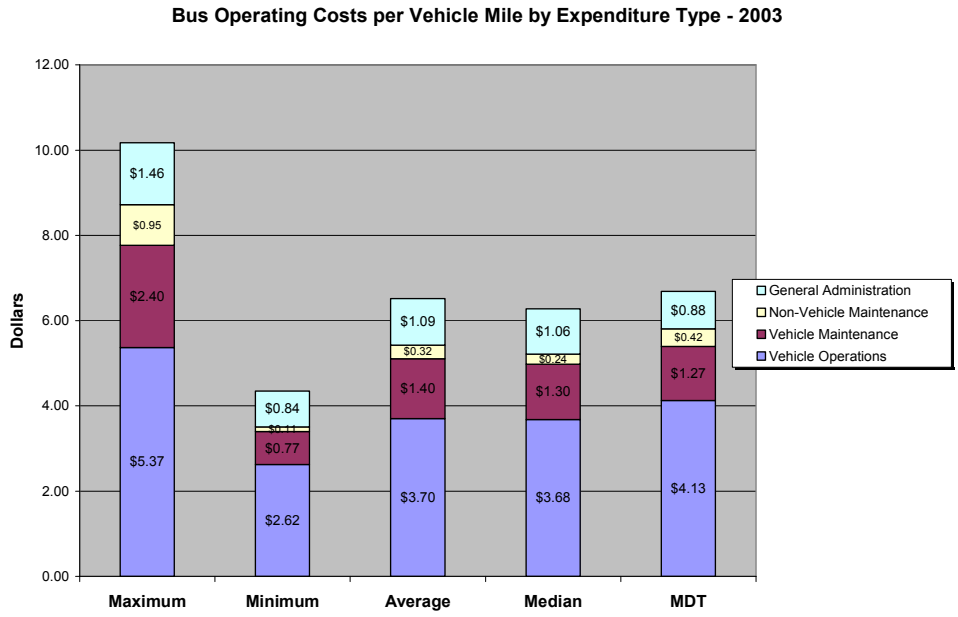
On a total operating cost per vehicle mile basis, costs decreased from year 2001 to 2002. The 5-year Metrobus operating cost per vehicle mile trend is shown on the graph below.



MDT Metrobus operating costs per vehicle mile compared favorably against peer bus systems during the period of 1999 to 2003. The peer comparison is summarized in the next graph.



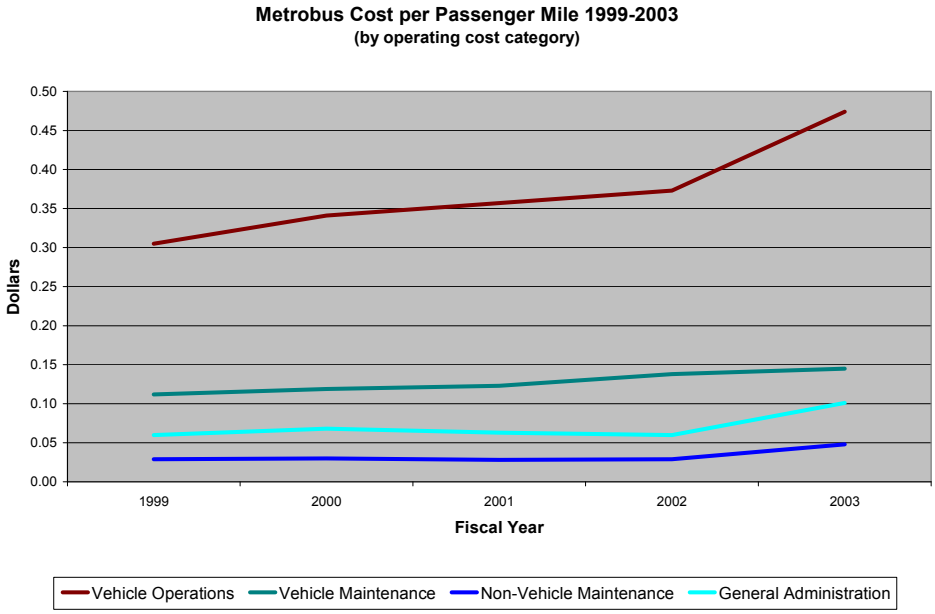
Measured in dollars per vehicle mile, MDT Metrobus was generally below both the average and the median cost of the 13 peer bus properties from 1999 to 2002. In 2003, the MDT cost was calculated at $6.69 per mile—$2.38 per mile lower than the highest peer agency, and 17 cents higher than the average.



When comparing MDT operating costs by expenditure type, the agency compared favorably on a vehicle mile basis to both the median and average costs reported by the peer bus systems for the year 2003.

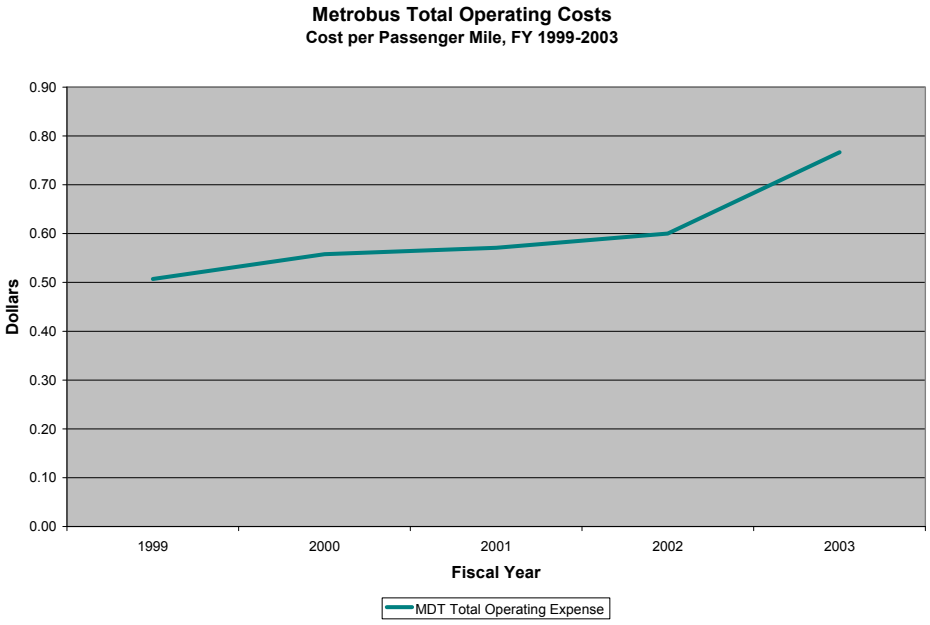
Passenger Mile Basis

The next several graphs illustrated the Metrobus operating cost trends on a passenger mile basis. The first, by operating category, showed an almost identical picture to that of the vehicle mile calculation. Of the 77 cents per passenger mile, less than 5 cents was spent on non-vehicle maintenance and 10 cents on general administration in 2003.

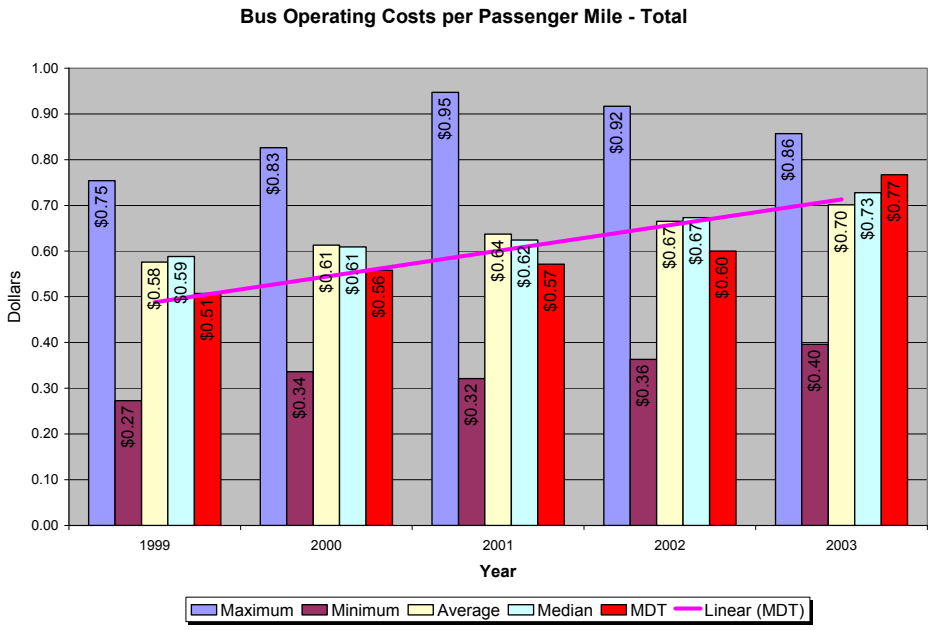


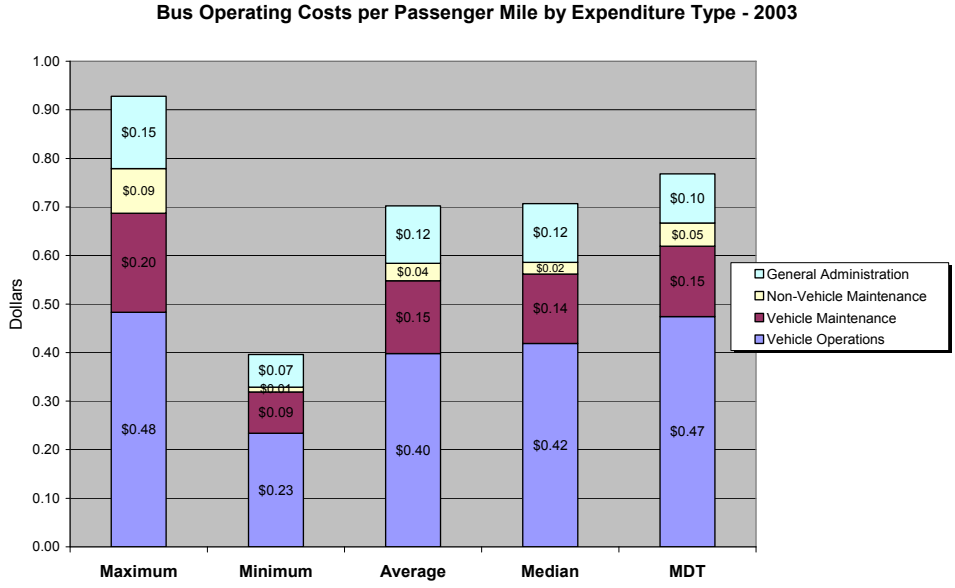
The growth in the percentage and absolute cost of vehicle operations from 2002 to 2003 was apparent in the graph above. It was surmised that this increase was related to increased fuel and PTP costs that were incurred in the agency during that period.

On a cost per passenger mile basis, Metrobus operating costs were 77 cents per mile in 2003. This compared with Metrorail for the same year at 60.3 cents per mile. The Metrobus operating cost per passenger mile increased from 51 cents per mile in 1999 to 60 cents per mile in 2002.



The graph below compared Metrobus operating costs on a passenger mile basis to the 13 peer transit agencies' costs. As with the vehicle mile comparison, MDT was below the median and average costs for the period of 1999 to 2002. The PTP ramp-up put the agency slightly above the average in 2003 at 77 cents per passenger mile compared to the average of 70 cents per mile. The highest peer property was calculated at 86 cents per passenger mile and the lowest at 40 cents. It should be noted that the range in costs among peer agencies for the bus analysis would be expected to be narrower than for the rail analysis. The reason was that for the rail comparison, all heavy rail systems were used in order to analyze a substantial number of other agencies. For the bus analysis, systems of similar size and service were selected for comparison.





On a passenger mile basis, MDT's costs compared favorably to the average and median costs reported by the peer agencies for the year 2003 for general administration, non-vehicle maintenance, and vehicle maintenance. Vehicle operations at $0.47 per passenger mile were 5 cents above the median and 1 cent below the maximum reported.

A series of graphs further detailing cost comparisons that were a product of the study were attached to the memorandum.

Findings

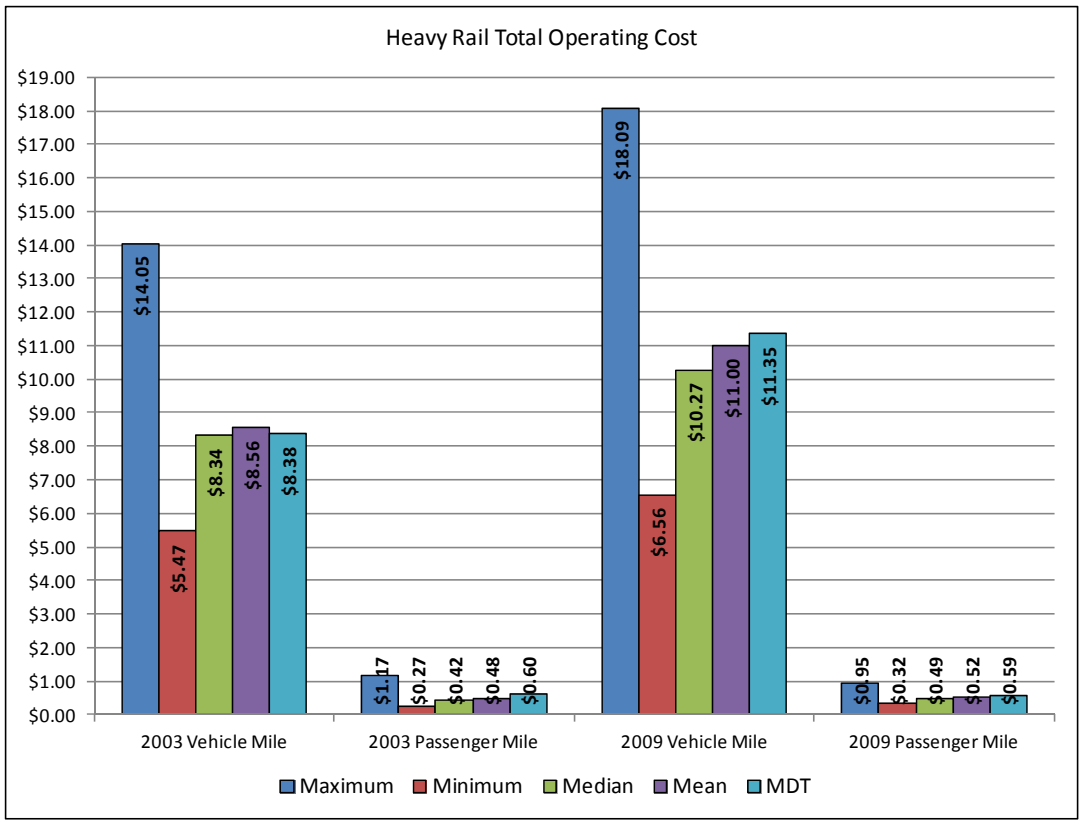
Based on a fairly quick review of operating costs for MDT Metrorail and Metrobus, CUTR determined for the five-year period that:

- MDT did not report the highest cost in any of the expenditure categories examined
- On a vehicle mile basis, MDT's operating costs compared favorably to peer agencies' median and average costs for both bus and rail
- Metrorail operating costs on a vehicle mile basis increased modestly from $8.11 per mile in 1999 to $8.38 per mile in 2003
- The rail cost per vehicle mile in 2003 was $8.38 compared to median cost for peer agencies of $8.34
- General Administration costs for rail were declining on a vehicle mile basis and flat on a passenger mile basis
- In 2003, MDT bus operating cost per vehicle mile was $6.69 per mile—$2.38 per mile lower than the highest peer agency, and less than 17 cents higher than the average.
- Bus operating costs rose more from 2002 to 2003 than in the other years studied. This could have resulted from the "ramp-up" for the PTP. When the 2004 data are available, the analysis should be repeated.
- MDT's operating cost profile looked better on a vehicle mile basis than on a passenger mile basis. The ability to accurately account for every boarding should be improved with the acquisition of the automatic passenger counters.
- The majority of operating expenses in both rail and bus were attributable to vehicle operations and vehicle maintenance.

Status of Operating Costs in 2009

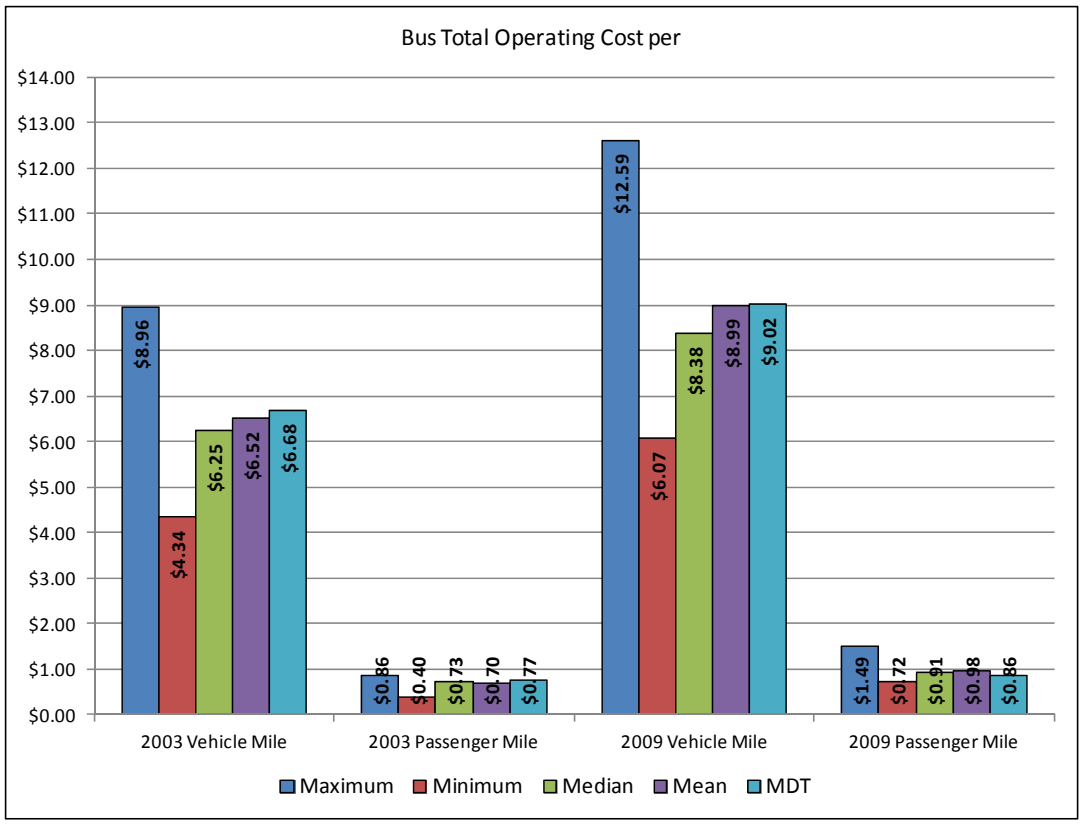
Heavy Rail Total Operating Costs: 2009 versus 2003

	Operating Cost per			
	2003		2009	
Transit Agency - Heavy Rail	Vehicle Mile	Passenger Mile	Vehicle Mile	Passenger Mile
MTA New York City Transit (NYCT)	$6.90	$0.30	$9.11	$0.33
Chicago Transit Authority (CTA)	$5.57	$0.34	$6.69	$0.38
Washington Area Metropolitan Transit Authority (WMATA)	$8.31	$0.34	$11.04	$0.48
San Francisco Bay Area Rapid Transit District (BART)	$5.47	$0.29	$6.97	$0.34
Massachusetts Bay Transportation Authority (MBTA)	$9.92	$0.40	$12.96	$0.52
Southeastern Pennsylvania Transportation Authority (SEPTA)	$7.36	$0.32	$9.22	$0.37
Port Authority Trans-Hudson Corporation (PATH)	$14.05	$0.67	$18.09	$0.68
Metropolitan Atlanta Rapid Transit Authority (MARTA)	$5.51	$0.27	$6.56	$0.32
Miami-Dade Transit (MDT)	$8.38	$0.60	$11.35	$0.59
Port Authority Transit Corporation (PATCO)	$7.65	$0.44	$9.42	$0.49
Los Angeles County Metropolitan Transp Authority (LACMTA)	$10.82	$0.44	$14.15	$0.39
Maryland Transit Administration (MTA)	$8.64	$0.73	$9.49	$0.59
Staten Island Rapid Transit Operating Authority (SIRTOA)	$10.71	$1.17	$15.64	$0.95
The Greater Cleveland Regional Transit Authority (GCRTA)	$10.59	$0.47	$13.33	$0.78
Maximum	$14.05	$1.17	$18.09	$0.95
Minimum	$5.47	$0.27	$6.56	$0.32
Median	$8.34	$0.42	$10.27	$0.49
Mean	$8.56	$0.48	$11.00	$0.52



Bus Total Operating Costs: 2009 versus 2003

	Operating Cost per			
	2003		2009	
Transit Agency - Bus	Vehicle Mile	Passenger Mile	Vehicle Mile	Passenger Mile
Washington Area Metropolitan Transit Authority (WMATA)	$7.40	$0.79	$9.97	$1.23
Southeastern Pennsylvania Transportation Authority (SEPTA)	$8.38	$0.81	$11.63	$1.01
Port Authority of Allegheny County	$5.73	$0.77	$8.38	$1.00
Metro Transit	$6.26	$0.68	$8.28	$0.88
Massachusetts BayTransportation Authority (MBTA)	$8.96	$0.75	$12.59	$1.49
Maryland Transit Administration (MTA)	$8.46	$0.72	$11.21	$0.92
Denver Regional Transportation District (RTD)	$5.48	$0.73	$8.10	$0.85
Tri-County Metropolitan Transp District of Oregon (Tri-Met)	$6.24	$0.72	$8.71	$0.91
Metropolitan Atlanta Rapid Transit Authority (MARTA)	$5.65	$0.73	$6.65	$0.72
The Greater Cleveland Regional Transit Authority (GCRTA)	$6.37	$0.86	$8.33	$1.26
Miami-Dade Transit (MDT)	$6.68	$0.77	$9.02	$0.86
Pace - Suburban Bus Division (PACE)	$4.34	$0.53	$6.07	$0.72
Orange County Transportation Authority (OCTA)	$5.69	$0.58	$7.93	$0.84
City and County of Honolulu Department of Transp Services (DT	$5.57	$0.40	n/a	n/a
Maximum	$8.96	$0.86	$12.59	$1.49
Minimum	$4.34	$0.40	$6.07	$0.72
Median	$6.25	$0.73	$8.38	$0.91
Mean	$6.52	$0.70	$8.99	$0.98



Findings: 2009 versus 2003

- MDT did not report the highest cost in any of the expenditure categories examined
  Status: No change in 2009
- On a vehicle mile basis, MDT's operating costs compared favorably to peer agencies' median and average costs for both bus and rail
  Status: No change in 2009
- Metrorail operating costs on a vehicle mile basis increased modestly from $8.11 per mile in 1999 to $8.38 per mile in 2003
  Status: Growth in Metrorail operating costs on a vehicle mile basis in 2009 compared to 2003 exceeded growth noted in 2003 compared to 1999; Metrorail operating cost per vehicle mile increased from $8.38 per mile in 2003 to $11.35 per mile in 2009.
- The Metrorail cost per vehicle mile in 2003 was $8.38 compared to median cost for peer agencies of $8.34.
  Status: Metrorail operating cost per vehicle mile in 2009 was $11.35 compared to a median cost for peer agencies of $10.27.
- General Administration costs for rail were declining on a vehicle mile basis and flat on a passenger mile basis.
  Status: 2009 General Administration costs were not reviewed.
- In 2003, the MDT bus operating cost per vehicle mile was $6.69 per mile—$2.38 per mile lower than the highest peer agency, and less than 17 cents higher than the average.

Status: In 2009, Metrobus operating cost per vehicle mile was $9.02 per mile-$3.57 lower than the highest peer agency, and 3 cents higher than the average.

- Bus operating costs rose more from 2002 to 2003 than in the other years studied. This could have resulted from the "ramp-up" for the PTP. When the 2004 data are available, the analysis should be repeated.
  Status: Data tend to confirm that the escalation in operating costs was due to the PTP ramp-up.

Growth in Operating Costs

Year	Metrorail	Growth	Metrobus	Growth
1999	$50,104,404		$144,007,333	
2000	$50,881,886	1.6%	$150,855,187	4.8%
2001	$57,849,645	13.7%	$161,919,911	7.3%
2002	$61,511,584	6.3%	$164,278,071	1.5%
2003	$65,889,174	7.1%	$214,417,916	30.5%
2004	$61,437,722	-6.8%	$229,427,318	7.0%
2005	$71,834,407	16.9%	$260,756,940	13.7%
2006	$75,025,360	4.4%	$309,379,653	18.6%
2007	$80,628,996	7.5%	$319,327,599	3.2%
2008	$82,381,902	2.2%	$337,894,421	5.8%
2009	$78,399,299	-4.8%	$334,727,320	-0.9%
2010	$76,836,442	-2.0%	$307,852,630	-8.0%

- MDT's operating cost profile looked better on a vehicle mile basis than on a passenger mile basis. The ability to accurately account for every boarding should be improved with the acquisition of the automatic passenger counters.
  Update: Metrorail and Metrobus total operating cost profiles in 2009 looked better on a passenger mile basis than on a vehicle mile basis.

2009 Operating Cost Profiles

	Metrorail		Metrobus	
	Vehicle Mile	Passenger Mile	Vehicle Mile	Passenger Mile
Agency-Maximum	$18.09	$0.95	$12.59	$1.49
Agency-Minimum	$6.56	$0.32	$6.07	$0.72
Agency-Median	$10.27	$0.46	$8.38	$0.91
Agency-Mean	$11.00	$0.52	$8.99	$0.98
Miami-Dade Transit	$11.35	$0.59	$9.02	$0.86
MDT vs Maximum	-$6.74	-$0.36	-$3.57	-$0.63
MDT vs Minimum	$4.79	$0.27	$2.95	$0.14
MDT vs Median	$1.08	$0.13	$0.64	-$0.05
MDT vs Mean	$0.35	$0.07	$0.03	-$0.12

- The majority of operating expenses in both rail and bus were attributable to vehicle operations and vehicle maintenance
  Status: No change in 2009.

Operating Expenses as a Percent by Type – Metrobus and Metrorail

Metrobus							
Expense Type	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**
Vehicle Operations Expenses	64.0%	67.4%	66.2%	64.6%	63.8%	63.5%	62.3%
Vehicle Maintenance Expenses	17.7%	18.9%	20.3%	21.2%	21.3%	21.9%	21.4%
Non-vehicle Maintenance Expenses	5.9%	5.5%	5.4%	6.0%	5.6%	6.2%	4.8%
General Administration Expenses	12.4%	8.2%	8.1%	8.2%	9.2%	8.4%	11.5%

Metrorail							
Expense Type	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**
Vehicle Operations Expenses	40.8%	41.3%	42.4%	42.3%	42.3%	43.8%	41.7%
Vehicle Maintenance Expenses	23.7%	22.7%	21.4%	19.9%	20.1%	18.2%	20.0%
Non-vehicle Maintenance Expenses	23.9%	22.4%	22.7%	22.6%	24.0%	24.4%	22.8%
General Administration Expenses	11.6%	13.6%	13.5%	15.2%	13.6%	13.5%	15.5%

XVI. Service Standards RTC Presentation, November 2005

In response to a request from RTC, MDT established new proposed service standards to replace the MDT service guidelines that had been in place since 1998. In 2005, MDT asked CUTR to prepare an overview of new standards that included a definition of the standards and compared MDT's proposed standards not only to MDT's existing guidelines but also to standards used by Denver, Chicago, and San Antonio.

Service Standards Defined

- Design standards
  - Route design – spacing, coverage, and stop requirements
  - Schedule design – service span, and frequency/headway
- Performance standards
  - Productivity – passengers per revenue mile, passengers per trip, and farebox recovery ratio
  - Service delivery – on-time rate
  - Safety – accidents/incidents per 100k miles
- Route-level standards differ by service class
  - Express
  - MAX
  - Regular
  - Circulator
- Enforcing & adopting standards
  - Adopted by board as policy
  - Enforced – management level and department level
  - Monthly and annual reviews
  - Service adjustment (with line-ups)
  - Annual budget adjustments

Recommended Service Standards versus Guidelines

Service Coverage

- Denver, Chicago, San Antonio had established standards
- Created new standard and criteria for determining areas with concentrations of transit dependent populations
- Established standards and criteria for providing service in Expansion Areas

Bus Route Spacing

- Denver, Chicago and San Antonio had established standards
- No change to the standards
- Defined the urban core

Bus Route Directness

- Denver had established standards

- Limited total amount of deviation on a route to 125 percent of length of route
- New Deviation Standard for areas of need not otherwise served by transit

Bus Stop Spacing

- Denver had established standards
- Local service routes had a standard
- Limited service routes had more flexible standard with possibly greater spacing
- Express service routes had more flexibility to concentrate stops at ends
- Circulators addressed, but no quantitative standard

Bus Stop Amenities

- Neither 1998 nor 2005 standards had specific minimum requirements
- Changes included linking advertising potential to amenities
- Municipalities were recognized to provide enhanced levels of amenities

Maximum Bus Headway

- Denver, Chicago and San Antonio had established standards
- Standards for local service simplified
- Standards for limited service added
- Headways were generally shorter than 1998 guidelines but longer than PTP headways

Metrorail Headway

- Denver and Chicago had established standards
- Headways decreased
  - Peak – 40% less
  - Base – 50% less
  - Early Evening – 50% less
  - Late Evening – same
  - Saturday/Sunday – 25% less
- Provided increased service
  - Less waiting time for passengers

Bus Passenger Loading

- Denver and San Antonio had established standards
- Maximum load decreased
- 30-minute loads generally increased
- Elderly ridership standard quantified
- Short duration standard quantified
- Remedy for overcrowding defined

Rail Passenger Loading

- Denver had established standards
- Maximum load decreased

  - Peak period over 10-minute headways, and
  - Night service over 10-minute headways
- Remedy for overcrowding defined

Bus Service Span

- Denver and Chicago had established standards
- Sunday and Holiday service span increased
- Premium routes criteria added
- Weekend service criteria added
- Overnight service criteria added

Rail & Mover Service Span

- Denver had established standards
- Metrorail service span decreased ½ hour
- Metromover service span decreased ½ hour
- Criteria for expansion to 24-hour operation added

Bus System-wide Productivity

- Denver and Chicago had established standards
- Minimum system-wide average boardings per hour standards defined
- Corrective action to be more comprehensive

Bus Route Productivity

- Productivity standards added
- Cost/passenger standards added
- Criteria for corrective action defined
- New route performance criteria provided for earlier action or removal (12 versus 24 months)

Bus Passengers per Trip

- Standards for minimum boardings per one-way trip provided
- Substandard trip corrective action defined

STS Productivity

- STS Productivity Goal provided

On-time Performance

- System-wide on-time performance standards
  - Metrobus – 80%
  - Metrorail – 98%
  - STS – 85%
- On-time criteria
  - Metrobus – departs time point 0-5 min. late
  - Metrorail – departs station 0-2 min. late
  - STS – pickup no more than 30 min. late – increase trips per service hour to 1.8 by 2005 (goal)

Projected Impact of Recommended Service Standards

Service Standard	Change	Impact to Passenger Service	Impact to System Efficiency
1.1 Service Coverage	Service to elderly and expansion areas	↑	↓
1.2 Bus Route Spacing	No change	-	-
1.3 Bus Route Directness	Limits deviations of new routes	↓	↑
1.4 Bus Stop Spacing	More flexible standard for Limited and Express	↑	↑
1.5 Bus Stop Amenities	No qualitative standard	-	-
2.1 Bus Headways	Shorter than 1998 standard, longer than PTP	↓	↑
2.1 Rail Headways	Shorter	↑	↓
2.2 Bus Passenger Load	Maximum reduced, generally increased	↓	↑
2.3 Rail Passenger Load	Maximum reduced	↑	↓
2.4 Bus Service Span	Sundays and Holidays increased	↑	↓
2.5 Rail Service Span	Reduced by ½ hour	↓	↑
3.1 Bus System Productivity	Provide criteria for service reduction	↓	↑
3.2 Bus Route Productivity	Provide criteria for service reduction	↓	↑
3.3 Bus Passengers/Trip	Provide criteria for service reduction	↓	↑
3.4 STS Productivity	New goal for utilization	-	↑
4.0 On-time Performance	Provides criteria for added service	↑	↓

On September 29, 2009, MDT Service Planning & Scheduling proposed new service standards that were subsequently adopted on November 4, 2009. MDT's service standards mirror the recommended standards detailed by CUTR researchers; however, specific service metrics, as proposed by CUTR, were modified to meet MDT's service needs at the time of implementation. MDT's service standards were designed to provide a consistent and fair evaluation of existing and proposed services and followed procedures published by the Transportation Research Board's (TRB) Transit Cooperative Research Program (TCRP) of the National Academies (NA).

MDT Service Planning & Scheduling will periodically revise the new service standards, and on an annual basis will evaluate the numerical values of the standards, using the most recent 12-month period for which data are available.

MDT Adopted Service Standards

MDT's adopted service standards encompass the following:

Route Design

- Bus route spacing
- Route deviation

- Network connectivity
- Route directness
- Bus stop spacing
- Service coverage

Schedule Design

- Different types and levels of service
- Passenger loading
- Headways
- Span of service

Route performance and productivity

- System-wide standards - if minimum system-wide productivity standards are not met, MDT will conduct a thorough evaluation of all routes to identify areas of opportunity to achieve improved productivity and efficiency.

Metrobus and Metrorail System-wide Productivity, 2004-2010

Boardings/Hour	2004	2005	2006	2007	2008	2009	2010	Service Standard
Metrobus								
Average Weekday	31	29	28	29	31	30	29	30
Average Saturday	28	30	31	31	36	30	31	25
Average Sunday	23	22	23	22	28	25	25	25
Metrorail								
Average Weekday	41	46	44	51	62	61	60	60
Average Saturday	42	41	41	45	51	81	65	60
Average Sunday	31	32	32	30	33	64	43	50

Source: FTIS.Org/INTDAS/B10, Form S10-Transit Agency Service, 2004-2009; 2010 data are unaudited data provided by MDT.

- MDT achieved most productivity standards beginning in 2008. Metrobus average weekday and Metrorail average Sunday boardings per hour both fell below the standard in 2010.
- Individual bus route standards
- Passengers per hour/mile/trip
- Revenue per passenger per route
- Subsidy per passenger
- Minimum cost recovery ratio

Service Delivery

- On-time performance is the time deviation of actual operating time from the published schedule. MDT buses are considered on-time if the scheduled time is no more than 59 seconds before actual departure and no more than 4 minutes and 59 seconds (the on-time window) past the scheduled time of departure. On-time performance is measured monthly by comparing the actual departure

time at all time points using the AVL System with the corresponding departure times, excluding the first and last time points for each trip. Metrobus on-time performance as reported in the 2008-2011 MDT Scorecard is presented below. Metrobus consistently exceeded the on-time performance service standard of 75 percent.

Metrobus On-time Performance

Metrobus On-time Performance				Service	FYTD	FYTD
Report	As of	Actual	Target	Standard	Actual	Target
Q1 2008	Dec 2007	73.28%	78.00%		72.25%	78.00%
Q2 2008	Apr 2008	77.49%	78.00%		72.93%	78.00%
Q3 2008	Jul 2008	81.66%	78.00%		75.21%	78.00%
Q4 2008	Oct 2008	76.35%	75.00%		76.35%	75.00%
Q1 2009	Dec 2008	78.29%	75.00%		77.18%	75.00%
Q2 2009	Apr 2009	81.55%	75.00%		78.43%	75.00%
Q3 2009	Jun 2009	82.12%	75.00%		79.19%	75.00%
Q4 2009	Sep 2009	77.65%	75.00%		79.19%	75.00%
Q1 2010	Dec 2009	79.13%	75.00%	75.00%	79.47%	75.00%
Q2 2010	Mar 2010	79.92%	75.00%	75.00%	79.44%	75.00%
Q3 2010	Jun 2010	83.48%	75.00%	75.00%	80.20%	75.00%
Q4 2010	Oct 2010	78.50%	n/a	75.00%	78.50%	n/a
Q1 2011	Dec 2010	84.73%	75.00%	75.00%	81.57%	75.00%
Q2 2011	Apr 2011	80.91%	75.00%	75.00%	80.66%	75.00%
Q3 2011	Jul 2011	85.69%	75.00%	75.00%	81.58%	75.00%

Metrorail on-time performance window is no more than 59 seconds before and no more than 4 minutes and 59 seconds past the scheduled time. Metrorail 5 minute on-time performance is calculated using the following formula:

$$\text{5-minute reliability} = \frac{(\text{Total Trips} - \text{Total Vehicle Caused Late Trip})}{(\text{Total Trips})} * 100$$

Metrorail on-time performance as reported in the 2008-2011 MDT Scorecard is presented below. Metrorail consistently exceeded the on-time performance service standard of 95 percent.

Metrorail On-time Performance

Metrorail On-time Performance				Service	FYTD	FYTD
Report	As of	Actual	Target	Standard	Actual	Target
Q1 2008	Dec 2007	94.02%	98.00%		97.22%	98.00%
Q2 2008	Mar 2008	94.26%	98.00%		96.44%	98.00%
Q3 2008	Jul 2008	96.25%	98.00%		95.69%	98.00%
Q4 2008	Nov 2008	92.89%	95.00%		93.15%	95.00%
Q1 2009	Dec 2008	96.05%	95.00%		94.10%	95.00%
Q2 2009	Apr 2009	96.15%	95.00%		94.10%	95.00%
Q3 2009	Jun 2009	95.72%	95.00%		94.51%	95.00%
Q4 2009	Sep 2009	98.00%	95.00%		95.55%	95.00%
Q1 2010	Dec 2009	99.01%	95.00%	95.00%	97.67%	95.00%
Q2 2010	Mar 2010	98.00%	95.00%	95.00%	97.67%	95.00%
Q3 2010	Jul 2010	98.01%	95.00%	95.00%	97.61%	95.00%
Q4 2010	Oct 2010	97.00%	n/a	95.00%	97.00%	n/a
Q1 2011	Dec 2010	95.00%	95.00%	95.00%	96.00%	95.00%
Q2 2011	Apr 2011	96.00%	95.00%	95.00%	95.72%	95.00%
Q3 2011	Jul 2011	97.00%	n/a	95.00%	96.10%	n/a

- "Missed trips" is defined as trips, other than routine schedule changes, that are either added to or removed from the daily schedule. Mechanical failures and driver absences are common causes of missed trips. Trips resulting from bus bridges or extraordinary events that are added are referred to as extras. The maximum "missed trips" allowed is five percent of trips.

Passenger Comfort and Safety

- The following standards were established to evaluate passenger comfort and safety:
  - Passenger complaints
    - Rail – maximum of 1.5 complaints per 100,000 boardings
    - Bus – maximum of 11 complaints per 100,000 passengers
    - Mover – maximum of 0.5 complaints per 100,000 passengers
  - Passenger complaints as reported in the 2009-2011 MDT Scorecard are presented below.

Metrobus Passenger Complaints per 100,000 Boardings

Metrobus Complaints				Service	FYTD	FYTD
Report	As of	Actual	Target	Standard	Actual	Target
Q2 2009	Sep 2008	8.77	n/a		8.45	n/a
Q3 2009	Jan 2009	9.32	15.00		9.63	15.00
Q4 2009	Aug 2009	9.26	15.00		9.36	15.00
Q1 2010	Sep 2009	10.47	15.00		9.45	15.00
Q3 2010	Jun 2010	12.63	11.00	11.00	10.69	11.00
Q4 2010	Sep 2010	11.63	11.00	11.00	10.83	11.00
Q1 2011	Dec 2010	14.50	11.00	11.00	12.41	11.00

Metrorail Passenger Complaints per 100,000 Boardings

Metrorail Complaints Report	As of	Actual	Target	Service Standard	FYTD Actual	FYTD Target
Q2 2009	Oct 2008	1.08	1.10		1.08	1.10
Q3 2009	Mar 2009	0.59	1.10		0.60	1.10
Q4 2009	Aug 2009	0.80	1.10		0.71	1.10
Q1 2010	Sep 2009	0.95	1.10		0.73	1.10
Q3 2010	Jun 2010	0.77	1.50	1.50	0.87	1.50
Q4 2010	Sep 2010	0.41	1.50	1.50	0.80	1.50
Q1 2011	Dec 2010	0.92	1.50	1.50	0.81	1.50

Metromover Passenger Complaints per 100,000 Boardings

Metromover Complaints Report	As of	Actual	Target	Service Standard	FYTD Actual	FYTD Target
Q2 2009	Oct 2008	0.26	0.30		0.26	0.30
Q3 2009	Mar 2009	0.15	0.30		0.20	0.30
Q4 2009	Aug 2009	0.15	0.30		0.17	0.30
Q1 2010	Sep 2009	0.00	0.30		0.16	0.30
Q3 2010	Jun 2010	0.15	0.50	0.50	0.20	0.50
Q4 2010	Sep 2010	0.56	0.50	0.50	0.38	0.50
Q1 2011	Dec 2010	0.00	0.50	0.50	0.17	0.50

- Accidents and incidents Standards include:
  - Bus – maximum of 6 accidents per 100,000 vehicle miles

Metrobus Accidents per 100k Vehicle Miles

Year	100k Vehicle Miles	Accidents	Standard	Accidents per 100k Veh Miles
2004	360.4	200		0.55
2005	399.0	169		0.42
2006	428.9	92		0.21
2007	420.2	125		0.30
2008	391.1	84		0.21
2009	370.9	58	6.0	0.16
2010	343.5	25	6.0	0.07

Source: NTD Safety and Security Time Series May 2011 and MDT data, 2004-2010.

- Transit amenities
  - Minimum requirement for new Metrobus stops
    - Future real time information – more than 100 boardings per day and major transfer points
    - Bench – all stops without a shelter with sufficient right-of-way

- Shelter – all stops with greater than 100 boardings per day with sufficient right-of-way (municipalities install shelters within their own jurisdictions)
- Litter bins – all MDT bus stops with benches or bus shelters

- Minimum requirement for Metrorail stations
  - Information – passenger information case with a system map and individual route schedules that service the particular station
  - Litter bins – at all Metrorail stations
  - Emergency phone – at all Metrorail stations

MDT will evaluate requests for new service against existing MDT service standards. Requests that are stipulated within the standards will be ranked and considered for implementation based on funding availability. In addition, new service will be implemented as demonstration service for 24 months and initiated during service line-ups, which occur two times a year.

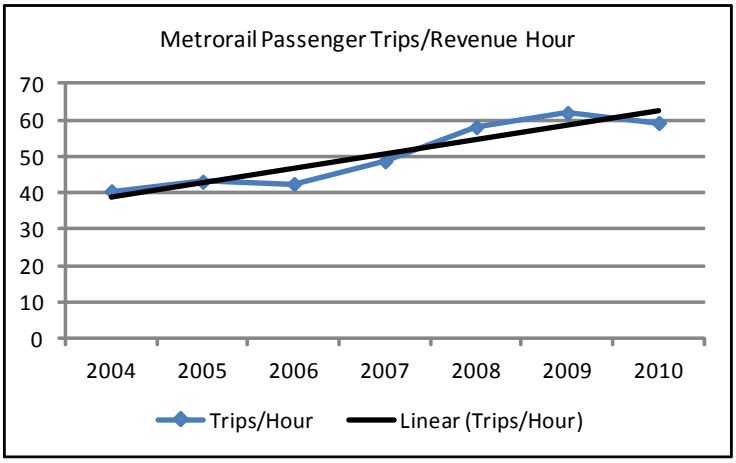
From 1998 until late in 2009, MDT's service was driven by guidelines rather than service standards. Service standards were formally adopted in November 2009 (the second month of FY 2010) and provided MDT with the ability to enhance system efficiency.

MDT Service Planning & Scheduling indicated that a primary factor used to evaluate the effectiveness of service consumption is the number of passenger trips per revenue hour. Metrorail and Metrobus passenger trips per revenue hour from 2004 through 2010 are illustrated below and do provide a baseline against which future performance can be evaluated.

Since 2004, MDT has grown the number of passenger trips per revenue hour for both rail service and, to a lesser extent, bus service. Metrorail revenue hours in 2010 represented a 27.2 percent decrease compared to 2006, while passenger trips during that period grew by 1.5 percent. Metrobus reported a 17.5 percent decrease in revenue hours in 2010 compared to 2006; however, unlike Metrorail, Metrobus passenger trips fell by 13.9 percent during that period.

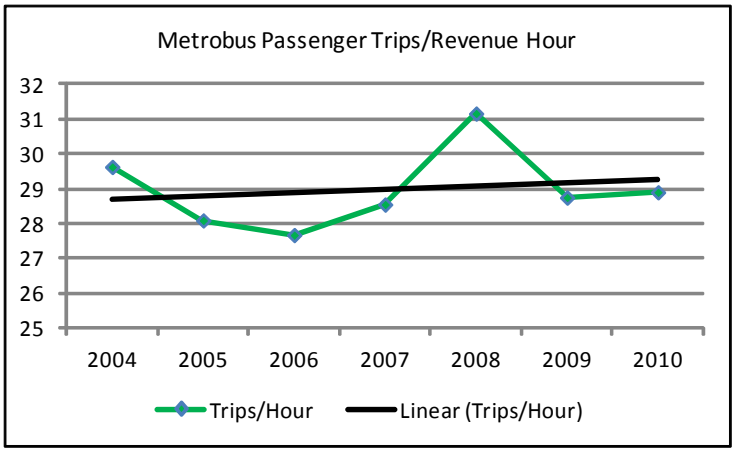
MDT Metrorail

Year	Passenger Trips	Revenue Hours	Trips/ Hour
2004	15,637,516	386,495	40
2005	17,034,513	395,072	43
2006	17,234,962	405,539	42
2007	17,504,736	359,326	49
2008	18,538,741	318,765	58
2009	18,244,476	294,140	62
2010	17,494,020	295,247	59



MDT Metrobus

Year	Passenger Trips	Revenue Hours	Trips/ Hour
2004	75,137,426	2,535,807	30
2005	76,752,965	2,731,978	28
2006	81,637,435	2,949,999	28
2007	83,458,376	2,923,018	29
2008	85,789,745	2,752,703	31
2009	75,608,000	2,629,625	29
2010	70,317,535	2,432,795	29



XVII. Facilities Maintenance Division FY 2004 Work Order Analysis, March 2006

In conjunction with assistance provided to MDT in the development of a Facilities Maintenance Division Equipment & Maintenance Plan, MDT asked CUTR to examine staffing needs for the Facilities Division based on documented preventive maintenance and repair activities.

CUTR researchers examined repair and PM work orders completed monthly from October 2003 through September 2004 (painting work orders, labor hours, and labor costs were excluded from the analysis as they were outside of the Facility Maintenance Technician role).

Parameters

- Locations where work was completed included:
  - Bus facilities
    - Central Bus Facility (CBF)
    - Coral Way Facility (CWF)
    - Northeast Facility (NEF)
    - South Dade Busway (SDB)
    - Park & Ride (PRK)
  - Rail Facilities
    - Metromover (MM)
    - Metromover Maintenance (MM-MT)
    - Metrorail (MR)
    - William Lehman Facility (WLF)
- 30 different job types were identified, including PMIs
- Detailed review of each location was conducted
  - Included area of PMI or repair work order, labor hours, and labor costs
  - Incorporated a summary of PMI hours identified in the most recent inventory
  - Provided percentage of total for work hours, labor hours, and labor costs by PMI, repair, projected PMIs, and projected repairs
- Projected Facilities labor needs in terms of actual and projected PMIs and repairs based on 1,438 productive labor hours per Transit Facilities Mechanic

Findings

- Identified 9,329 work orders (monthly average = 777 work orders)
- Labor hours totaled 19,450 hours (monthly average = 1,620.9 labor hours)
- Labor costs totaled $525,514 (monthly average = $55,180 labor costs)
- Average labor hours per work order equaled 2.1 labor hours
- Average labor cost per work order equaled $104.98
- Based on location, Metrorail had the highest percentage of total:
  - Work orders – 45.7 percent
  - Labor hours – 31.9 percent
  - Labor costs – 43.7 percent (lighting 2nd with 23.7%)
  - PM work orders
  - Work orders – 54.1%

- Labor hours – 34.1%
- Labor costs – 28.9%
- Repair work orders
- Work orders – 45.9%
- Labor hours – 65.9%
- Labor costs – 71.1%

Projected Facilities Labor Hour Needs

Labor Hour Requirements	Bus	Metromover	Metrorail	Total
Projected PM labor hours	30,563	5,674	14,594	50,831
Actual PM labor hours	1,984	968	3,682	6,634
Additional PM labor hours required	28,579	4,706	10,912	44,197
Projected repair labor hours	10,188	1,891	4,865	16,944
Actual repair labor hours	6,464	1,299	5,053	12,816
Additional repair labor hours required	3,724	592	-188	4,128
Total PM and repair labor hours required	32,303	5,298	10,724	48,325

Status of Work Orders in 2009

Pursuant to the updated Facilities Equipment & Maintenance Plan, March 2009, Facilities Maintenance Division performs scheduled (preventive) maintenance, which includes scheduled replacement of specific components and/or systems to improve the reliability of equipment, as well as unscheduled (corrective) maintenance, which includes repairs required as a result of in-service failures.

As detailed in the FEMP 2009, the Facilities Maintenance Division uses the following process to determine PM/repair manpower needs and allocation:

- Facilities staff conducts a thorough analysis of the inventory to determine PM needs and manpower requirements
- PM needs are reviewed by area to determine effective allocation of manpower
- Priority PM requirements are identified
- Staff requirements are established for priority PMIs
- Past repair work orders are reviewed to determine unscheduled corrective maintenance needs
- Staff requirements for repair work orders, including backlog, are established
- Based on the level of PMIs and repair needs, staff established a 30/70 PM/repair split in the short term until such time when older equipment has been refurbished or replaced

XVIII. Track & Guideway Division Equipment & Maintenance Plan, April 2006

CUTR researchers assisted in the development of the inaugural MDT Track & Guideway Division Equipment & Maintenance Plan (TGEMP). The TGEMP was a statement of the processes and practices by which MDT established proper maintenance of the Metrorail track and the Metrorail and Metromover guideway systems, station structures and equipment required for track and structural maintenance through the Track & Guideway Division. The TGEMP described the organization of the Track & Guideway Division; detailed the assignment of responsibility for track and structural maintenance; outlined inspections and routine maintenance actions designed to ensure proper care and maximum useful service life; and, detailed the record-keeping system used to maintain permanent records and inspection activity.

Track & Guideway Division processes and practices, as outlined in the TGEMP, complied with FTA Circular 5010.1C, Chapter II, 3e(5) and Circular 9030, Chapter V 5e.

The plan was based on current realities and assumptions and was, therefore, subject to future revision. The plan was scheduled to be updated on a regular basis to assist in the planning and operation of MDT Track & Guideway Division.

The TGEMP was structured to present an overview of the MDT Track & Guideway Division followed by a discussion of current operating practices in terms of preventive maintenance, rehabilitation and renovation, and replacement. Identified demands translated into maintenance manpower requirements were included along with warranty recovery maintenance plan requirements, including identification, recovery and enforcement.

Due to project time constraints, the project was not completed in its entirety. Gaps in the TGEMP included the following:

- Procedure to schedule and track PMIs
- Process flow diagram for corrective maintenance for major and minor repairs
- Track & Guideway Division Maintenance Plan incomplete

The official TGEMP distributed by MDT on July 14, 2009 included the following revisions of and additions to the April 2006 Draft TGEMP.

Updated Inventories

- Metrorail mainline
- Metrorail track components
- Aerial structure inventory
- Heavy equipment serviced by Track & Guideway
- Service contracts

Organization

- Track & Guideway reported a total of 16 vacancies

Preventive Maintenance

- The Rail Shop coordinates the PMI schedule and tracking with Rail Maintenance Control based on manufacturers' recommendations and time intervals; a total of 56 individual PMIs have been developed
- A Pre-Trip Equipment Inspection is in place
- Staff completed inventories and identified PM and maintenance requirements:
  - Heavy equipment
  - Rail Track Wayside
  - Structural
- Equipment repair contract is not working
  - Lack of contractors to fix equipment
  - Work trains are obsolete and are not due for replacement

Corrective Maintenance

- Projected manhour requirements for Rail Structure repairs are contained in the TGEMP

Replacement and Rehabilitation Projects: Capital Budget, 2006-2015

- Palmetto Yard Crossings & Mainline Replacement
- Mainline Miter Joint Replacements
- Rail Fastener Replacement
- Seal Gland Rehabilitation
- Coverboard Replacement
- Acoustical Barrier Replacement
- Guideway Pier Coating

Future Projects

- Replace mainline frogs
- Equipment replacement plan 5, 10 and 15-year
- Replace fasteners in station areas
- Paint Metrorail and Metromover box girders

Commitment to Continuous Improvement

The TGEMP identifies a variety of activities to be accomplished in the next two years to achieve Track & Guideway objectives delineated in the Track & Guideway Division Maintenance Plan.

Inter-Agency Assignments

Track & Guideway staff is completing a significant amount of work for the Port of Miami and the Miami International Airport. All work is done on weekends on an overtime basis.

XIX. Subsidy Policy Peer Review & Analysis, July 2006

MDT requested additional information to help the agency and the county determine if a system-wide subsidy or cost recovery standard should be used as a mechanism to determine when and how much to increase fares. A peer review was conducted through a telephone survey combined with web-based data collection.

Parameters

Peer agencies (21) were generally selected by their rank in size in terms of FY 2004 annual ridership as well as by capacity size (number of vehicles) and the number of transit modes operated. Peer agencies included:

Survey Participants		
MTA, NYCT – New York, NY	Muni – San Francisco, CA	OCTA – Los Angeles, CA
CTA, - Chicago, IL	MARTA – Atlanta, GA	PAT – Pittsburgh, PA
WMATA – Washington, DC	MTA – Baltimore, MD	AC Transit – San Francisco, CA
LACMTA – Los Angeles, CA	Metro – Seattle, WA	DTS – Honolulu, HA
MBTA – Boston, MA	BART – San Francisco, CA	GCRTA – Cleveland, OH
SEPTA – Philadelphia, PA	Tri-Met – Portland, OR	Metro Transit – Minneapolis, MN
NJT – New Jersey	RTD – Denver, CO	Valley Metro – Phoenix, AZ

The survey did not clearly indicate a majority policy regarding subsidy level and fare increase. A comparison of the properties illustrated that every property operated in a unique environment defined by:

- Urban area density
- Organizational size
- Fleet size
- Ratio of rail use to bus use
- Expansion commitments
- Financing
- Legal requirements
- Size of financing jurisdiction relative to service area
- Amount of public subsidy
- Relative proportions of public subsidy sources

Most staff interviewed during the survey recognized the merits of tying subsidy and fare levels by policy; however, few thought it was feasible within the organization due to the numerous conditions that impact fare policy. Findings by property are summarized below.

Farebox Operating Ratio and Subsidy Required

Agency	Farebox Operating Ratio	Subsidy Required	Agency	Farebox Operating Ratio	Subsidy Required
MTA-NYCT	57%	NA	**MDT**	**19%**	**NA**
CTA	43%	NA	BART	48%	62%
WMATA	24%	NA	Tri-Met	20%	25%
LACMTA	40%	NA	RTD	19%	30%
MBTA	28%	NA	OCTA	21%	20%
SEPTA	37%	45%	PAT	24%	46%
NJT	37%	NA	AC Transit	19%	30%
Muni	25%	NA	DTS	26-27%	33%
MARTA	25%	NA	GCRTA	18%	25%
MTA	31%	40%	Metro Transit	26%	35%
Metro	19%	25%	Valley Metro	18%	NA

In all of the agencies that did not have a strict policy formula, decisions about raising fares were made by the governing board and, usually, simultaneously with the budget process. Extensive public involvement occurred in decisions regarding fare changes. Tri-Met in Portland, Oregon represented one exception in fare policy. Tri-Met had to some extent systemized their fare change policy by simply tying it to price indices with regular intervals for increases.

Subsidy Policy Update

MDT, like Tri-Met, has systemized their fare charge policy by tying it to CPI with three-year regular intervals available for increases. A required subsidy has not been mandated.

XX. Metrobus Maintenance Program, Review & Recommendations, Phase Two, September 2006

The work was intended to assist MDT in documenting its bus maintenance needs and in developing a plan to address those needs. The assessment included a review of the current condition of the Metrobus maintenance system, a comparison with other transit properties' bus systems as well as with best practices identified in past research, and a recommended plan of action to carry MDT forward.

The first phase of the work involved a detailed analysis of MDT bus maintenance personnel and bus operators' attitudes and concerns about current and potential benefits, incentives, and working conditions. The results included a series of recommended actions that could enhance the employee benefits and incentive program and improve overall levels of employee satisfaction.

Phase one of the project began in November 2002 and focused on surveying attitudes and concerns of maintenance staff and bus operators regarding employee benefits, incentives and satisfaction. The Phase One Final Report was completed in March 2004. During the project, CUTR provided assistance to MDT in the preparation of MDT Metrobus Fleet Management, Revision II: January 2005. Phase two of the project commenced shortly after phase one began and continued throughout 2005.

The approach to the project included the formation of a Metrobus Maintenance Task Force composed of key personnel within MDT in addition to the project team. Status reports and presentation of data collected to date occurred on a regular basis early in the project. Extensive analysis of FTA Section 15 data, as reported in the NTD, was ongoing throughout the project. Performance reports prepared and distributed by MDT were also reviewed in detail. Many members of MDT staff were interviewed and tours were conducted at all divisions. Site visits were conducted at three peer properties, including: Maryland Transit Administration in Baltimore, Maryland (Baltimore); Greater Cleveland Regional Transportation Authority in Cleveland, Ohio (Cleveland); and, the Regional Transportation District in Denver, Colorado (Denver).

Findings

Best Practices Incorporated by MDT

- Management sought and received employee feedback concerning preferred incentives and benefits to increase employees' effectiveness.
- MDT promoted a cooperative working environment between bus maintenance personnel and bus operators through feedback in problem diagnosis.
- MDT had a written maintenance program and a Bus Maintenance Procedures Manual. Both items were updated regularly by bus maintenance control with assistance from support services, bus maintenance, and Field Engineering & Systems Maintenance (FESM).
- MDT used a 3-tiered approach to bus maintenance.
- Performance measures and indicators were in place to assist MDT in achieving identified objectives.
- The Pilot Apprenticeship Program initiated in 2003 provided the first graduates to MDT in the fall of 2005.

- MDT contracted with Florida International University (FIU) to complete a *Times Standards Study* within bus maintenance.
- While MDT had no written policy on specialization, some maintenance technician positions were specialized in the sense that they were "pick positions" that required specialized skills to be accomplished successfully.
- MDT was in the process of making significant improvements to the established PMI program.
- MDT operated a relatively new, somewhat homogeneous fleet.
- In terms of the use of advanced technology, MDT had integrated the use of laptop computers for diagnostics. Other functions, such as repair orders and fleet status, were completed and tracked manually.

Best Practices Not Incorporated by MDT

- MDT lacked adequate training resources for all levels of staff.
- While MDT had developed agency-specific objectives and actively strove to meet the objectives, the objectives focused almost exclusively on fleet maintainability.
- MDT's current existing workplace design throughout the maintenance shops limited bus maintenance productivity.
- Lack of routine facility and specialized equipment maintenance negatively impacted bus maintenance activities.
- The maintenance division had no specific policy that directed the supervisor's degree of oversight and/or control of assigned staff.
- MDT was struggling with adapting to the change required by significant growth of the fleet in response to expanded service mandates.
- Supervisors focused almost exclusively on meeting peak requirements, which precluded them from looking beyond the current duty shift.
- The impact of a harsh summer climate on the fleet was a major obstacle to MDT in maximizing the efficiency of bus maintenance operations.
- Information sharing with peer agencies was limited.

Peer Review

The selection of peer agencies was based on three comparative analyses and yielded Baltimore, Cleveland, and Denver as the most similar peers.

- Miami vehicles logged more miles per vehicle operated in maximum service (VOMS) than Baltimore, Cleveland, and Denver during the 2000-2004 period of study.
- Miami reported the largest number of full-time vehicle maintenance employees in 2004 compared to the peer agencies.
- Miami achieved fewer passenger miles per vehicle employee work hour than Baltimore and Denver, fell below the 2004 average of the three agencies and showed a 20 percent decline in performance in 2004 compared to Miami's performance in 2000.
- Miami's total system failures per VOMS exhibited a clear downward trend.

- Miami increased the number of miles between failures from 1,283 miles to 2,375 miles, an 85 percent improvement.
- In 2004, Baltimore logged three times more revenue miles between failures than Miami; Cleveland logged four times as many; and, Denver reported nine times as many.
- In 2004, while Miami's vehicles available for maximum service declined, VOMS increased by 31 percent, suggesting that Miami improved fleet utilization.
- Despite Miami's 2004 growth in inspection and maintenance labor hours per VOMS (29.2% growth versus 2003), Miami provided fewer inspection and maintenance labor hours per VOMS than the peer agencies and was 18.1 percent below the average of the four agencies.
- Baltimore, Cleveland, Denver, and Miami include vendor training packages with new bus procurement contracts.
- Common performance measures among the agencies included: on-time performance, vehicle availability in peak service, PMI on-time adherence, and miles between mechanical road calls.
- In terms of specialization, Baltimore had three degrees of union-level repairmen, i.e., "A," "B," and "C." Only "A" level repairmen are allowed to diagnose problems. Cleveland and Denver also used a combination workforce.
- Denver had a slightly higher supervisor-to-technician ratio than Miami, Baltimore, and Cleveland.
- Baltimore, Cleveland, and Denver were at varying stages in integrating computer technology into their bus maintenance programs for reporting, tracking, cost-benefit analysis and report generation.
- A significant difference in the structure of the peer agencies was in the nature of the technicians' advancement. Baltimore and Denver developed tenure and certification requirements for advancement to higher level positions with additional compensation. Cleveland required proficiency for assignment to specialized shops. Miami relied exclusively on seniority for advancement.

Updated Peer Review[2]

- In 2010, Miami logged fewer miles per VOMS than Baltimore and Cleveland
- Miami reported fewer full-time vehicle maintenance employees than Baltimore in 2010
- Miami logged more passenger miles per vehicle employee work hour than Baltimore, Cleveland and Denver in 2010
- Miami's system failures per VOMS continued to show a downward trend
- Miami increased the number of miles between failures from 1,283 miles in 2000 to 2,697 miles in 2010
- In 2010, Baltimore logged two times more revenue miles between failures than Miami; Cleveland logged four times as many; and, Denver reported seven times as many

[2] Data obtained from FTIS, Reports, Directly Operated Motorbus, 2000-2010.

Updated Peer Review Performance Metrics

2010	Miami	Baltimore	Cleveland	Denver
Vehicle Miles	34,508,219	22,622,883	15,615,215	25,634,758
VOMS	817	557	379	458
Vehicle Miles/VOMS	42,238	40,616	41,201	55,971
Full-time Maintenance Employees	463	417	251	388
Vehicle Maintenance Employee Work Hours (FT+PT)	904,363	937,774	508,669	792,241
Full-time Employee Equivalent = 2,080 hours	2,080	2,080	2,080	2,080
Vehicle Maintenance FTEs	435	451	245	381
Passenger Miles	379,704,686	286,250,993	136,352,946	258,792,817
Vehicle Maintenance Employee Work Hours	904,363	937,774	508,669	792,241
Pass Miles/Vehicle Employee Work Hour	419.9	305.2	268.1	326.7
System Failures	10,820	3,726	1,345	1,049
VOMS	817	557	379	458
System Failures/VOMS	13.2	6.7	3.5	2.3
Vehicle Miles	34,508,219	22,622,883	15,615,215	25,634,758
System Failures	10,820	3,726	1,345	1,049
Vehicle Miles between Failures	3,189.3	6,071.6	11,609.8	24,437.3
Revenue Miles	29,177,775	20,073,940	13,310,980	20,787,470
System Failures	10,820	3,726	1,345	1,049
Revenue Miles between Failures	2,696.7	5,387.5	9,896.6	19,816.5

MDT Revenue Vehicle System Failures/VOMS

	System Failures	VOMS	Failures/ VOMS
2000	18,869	530	35.6
2001	16,317	547	29.8
2002	17,137	564	30.4
2003	12,157	506	24.0
2004	13,097	663	19.8
2005	15,808	751	21.0
2006	18,951	823	23.0
2007	15,248	839	18.2
2008	15,926	825	19.3
2009	13,933	716	19.5
2010	10,820	817	13.2

MDT Revenue Miles between Failures

	Revenue Miles	System Failures	Rev Miles/ Failures
2000	24,214,832	18,869	1,283
2001	25,175,835	16,317	1,543
2002	26,294,132	17,137	1,534
2003	27,506,309	12,157	2,263
2004	31,100,472	13,097	2,375
2005	34,222,523	15,808	2,165
2006	36,825,387	18,951	1,943
2007	35,654,448	15,248	2,338
2008	33,407,289	15,926	2,098
2009	31,547,096	13,933	2,264
2010	29,177,775	10,820	2,697

MDT Bus Maintenance

- Communication methods and frequency varied by shop and were influenced by a variety of factors. Regular communication between bus maintenance and bus operators appeared to be based on proximity with increased communication occurring at locations with the closest proximity of the two groups of employees. Communication between shops, within shops, and with Support Services and FESM was irregular at best.
- An important goal that was identified by the Bus Maintenance Implementation Team was making problem-solving more proactive by increasing the amount of time shop supervisors spent on the shop floor with bus technicians.
- Bus maintenance control provided critical support to bus maintenance.
- Bus triage – the process of prioritizing buses requiring maintenance and optimizing the order of repairs – was highly variable and especially dependent on the skill level of individual supervisors.
- The manner in which bus defect cards were submitted and processed was found to be variable and less efficient than it should be.
- Direct supervision of and communication with hostlers was reported to be minimal.
- Bus maintenance staff and vehicles were equally distributed among the four divisions with the exception of the Medley Division, which was smaller and responsible for fewer vehicles than the other divisions. The Medley Division was managed by a project manager pursuant to the Miami-Dade County/Penske Trucking contract.
- Miami bus maintenance supervisors generally agreed that bus operator training for wheel chair lifts was inadequate.
- There was an ongoing debate about whether or not to assign each service truck to a specific geographic area.
- Bus maintenance supervisors generally agreed that the benefits of using laptop computers for bus maintenance procedures outweighed the problems. Problems that were identified included: incompatibility with connections on newer buses, insufficient storage space for recharging, lack of proficiency on the part of technicians, durability in the harsh maintenance environment, and maintaining the latest software updates.

- A minimum tool requirement for bus technicians negatively impacted productivity; general tool practices varied within the agency; and, a lack of specialty tools at the shops impeded efficiency.
- Supervisors at only one facility identified attempts to use manpower data for employee productivity purposes. Maintenance management staff applied such information to improve morale among new employees by assigning work of specific interest.
- Within bus maintenance, over the past three years, absenteeism for technicians, hostlers, helpers, and supervisors ranged from 14.6 percent to 19.6 percent.
- Some supervisors reported that retrofits commonly lacked extensive procedural documentation. As such, in the event that a knowledgeable employee left the agency, specific retrofit details stood a good chance of being lost.
- Shop-specific data collection efforts conducted by the O&I shops were infrequent and sporadic. Some bus performance data were collected on an informal basis and minimally documented. Data were rarely used to evaluate the impact of remedial actions.
- Warranty work was a frequent cause for buses to be taken out of service. The removal of vehicles to an off-site location for the warranty work further compounded the loss of the vehicle.
- "Buses down for parts" was one of the most serious issues facing bus maintenance, regardless of shop.
- MDT was in the process of evaluating the structure and focus of the "Unit Room."
- Some areas encountered difficulty with seasoned supervisors who were resistive to change, particularly in the use of computers and advanced technology.
- Supervisors had become accustomed to inspecting vendors' work closely. Many vendors had experienced high turnover rates, resulting in inadequately trained technicians producing less than acceptable work.
- Two past reporting efforts that were slated to be re-introduced include the Unit Room Production Report and the Engine Reliability Report.
- MDT allowed buses to return to service with defects identified during a PMI as long as the defects were not safety defects.
- Some decline in bus availability was noted at all shops in FY 2005.
- No significant differences in areas, such as parts use and fleet performance, were noted among the shops.

MDT as a Top-20 Transit Agency, 2000-2004

Ranking: Performance Data

- Expanded service in terms of vehicle revenue miles and hours along with increased unlinked passenger trips moved MDT into top-10 rankings in the service area.
- While manpower efforts continued to fall below top-10 rankings, the increases in inspection and maintenance labor hours and full-time employee work hours were positive.
- MDT ranked 12th in terms of vehicles operated in maximum service in 2004 compared to 18th in 2000.

Ranking: Performance Indicators

- Unfortunately, positive growth in the fleet, recent increases in manpower, and expanded service were accompanied by a shift in ranking from 8th to 5th for total system failures.
- Not only did MDT consistently report more failures per vehicle operated than other top-20 agencies, but also MDT logged the fewest revenue miles between failures. In terms of fleet reliability, MDT performed at a less than satisfactory level.
- MDT ranked 10th to 13th in full-time employee work hours per VOMS during 2000 through 2002 and then moved to 4th in 2003 and 2nd in 2004, which represented a significant increase in manpower allocation. Nonetheless, MDT's ranking for inspection and maintenance hours per VOMS increased only slightly in 2004 (from 16th and 17th in 2001 and 2003 to 13th), and the increase in ranking was only modestly better than the ranking of 14th in 2000. Furthermore, the relationship between MDT's inspection and maintenance labor hours to total labor hours ranked 16th, essentially remaining unchanged throughout the reporting period. The increases in manpower produced little, if any, increase in vehicle inspection and maintenance, which called in to question workforce productivity.
- MDT ranked between 1st and 4th in the relationship between VOMS and VAMS throughout 2000 to 2004, indicating significant use of the available fleet.
- MDT ranked between 1st and 3rd in Vehicle Miles and Hours per VOMS throughout the reporting period, which indicated that MDT generally operated vehicles for more hours and more miles than most other top-20 agencies.
- When revenue hours and miles were viewed as a percentage of total hours and miles, MDT's ranking falls to 6th and 8th indicating that MDT's vehicle hours and vehicle miles were less efficient than some of the other agencies.
- While MDT ranked 9th in unlinked passenger trips per VOMS, which was similar to previous rankings, MDT's ranking for passenger miles per VOMS moved from 2nd in 2003 to 6th in 2004, despite increases in revenue miles and hours per VOMS. It appeared that increased revenue miles and revenue hours were not accompanied by increased passenger miles.
- MDT's vehicle maintenance cost per revenue mile ranked 17th (from 14th in 2001 through 2003) for the first time since 2000. MDT's maintenance cost per revenue mile was less than the cost incurred by 16 of the other top-20 properties in 2004.

Metrobus Equipment Performance by Fleet Type, FY 2004-2005

- The NABI 99 (9.5% of the fleet) and the NABI 00 (9.8% of the fleet) recorded the largest percentages of road calls throughout FY 2004 and FY 2005, until September 2005. In September 2005, the NABI 02 logged the largest percentage of road calls. The newer NABIs, i.e., NABI 02 through NABI 05, appeared to be the most efficient fleet types.
- The NABI 99 and NABI 00 displayed inefficient performance throughout the entire reporting period and shared that category with the older Artics and Flxibles.
- The overall performance of the minibuses appeared to be good; although, the efficiency of the Optare 03 declined in mid FY 2005.
- In FY 2005, the NABI 02 and NABI 03 logged a smaller percentage of miles but a larger percentage of road calls.

Metrobus Equipment Performance by Fleet Type by Division, FY 2004-2005

- The Artic 95, which operated only out of Central bus, showed improvement in July 2005, as the percentage of road calls fell to its lowest level.
- Specific mileage and road call data for the Northeast Facility in FY 2004 were unavailable.
- Only Northeast operated the Flx 9350, Flx 9411, and Flx 9450. The percentage of road calls consistently exceeded the percentage of miles for the three fleet types.
- In 2005, some improvement in terms of the relationship between the percentage of miles and road calls for the NABI 97 was noted at all three facilities.
- The NABI 98 fleet, which had performed slightly better at Coral Way than Central bus, was moved to Medley in April 2004. NABI 98 performance at Medley was, at best, inconsistent, with the percentage of road calls exceeding the percentage of miles during the last 13 months.
- Despite two rather high road call percentages reported by the NABI 00 at Medley in the summer of 2004, the NABI 00 fleet at Medley achieved a slightly better percentage of miles to road calls than at Central bus and Coral Way in FY 2005.
- The Minibus BB 99 fleet was transferred from Coral Way to Medley in April 2004. The percentage of road calls exceeded the percentage of miles at Medley during 16 of 18 months with little improvement at the end of FY 2005.
- Central bus, Coral Way, and Northeast operated Optare 03 fleets. While the FY 2004 percentage of miles consistently exceeded the percentage of road calls for the Optare 03 fleets, FY 2005 proved to be a difficult period for all three facilities. During FY 2005, the Optare 03 percentage of road calls exceeded the percentage of miles for seven months at Central bus, nine months at Northeast, and five months at Coral Way.

Determining Manpower Needs

- From 2000 through 2004, MDT reported fewer VOMS, fewer vehicle maintenance employees, and fewer annual vehicle miles than the average of the top-20 transit agencies studied.
- MDT recorded more vehicle miles per employee (12.6% to 22.4% above the average) and more vehicle miles per employee per VOMS (25.0% to 46.4% above the average) than the average of the top-20 agencies. This indicated that MDT's ratio of employees and VOMS to vehicle miles logged was lower than the average.
- MDT reported fewer labor hours for inspection and maintenance (16.1% to 67.9% below the average), fewer labor hours per VOMS, and fewer labor hours per employee (25.9% to 71.9% below the average). Not only was MDT's ratio of employees to vehicle miles and VOMS lower than average, MDT's employees produced fewer hours than those produced on average by the top-20 transit agencies.
- The analysis of the 2000-2004 NTD data clearly shows that MDT was a top-20 agency that had expanded service at record levels in the past five years. Nonetheless, the analysis also showed an agency that was falling behind in maintenance performance, which was compounded by the impact of the high mileage accumulated annually by the vehicles.
- The June 2003 Manpower Study concluded that each maintenance mechanic could provide 1,554 productive manhours annually. However, an analysis of the inspection and maintenance labor

hours from 2000-2004 indicated productivity of only 824 to 1,103 hours per employee a year, while the top-20 agency average was 1,336 to 1,407 hours per employee a year.

- Increasing employee productivity to 1,500 hours per year would reduce the number of vehicle miles per inspection and maintenance hour from a range of 71.3 - 107.4 miles to a range of 50.5 - 56.6 miles, a significant improvement. Improved productivity would also place MDT in a more competitive position with the top-20 agencies.

Phase Two Recommendations

Recommendation	Status
Make the Phase One Final Report available to employees and implement recommendations	The analysis was made available to employees (Status of recommendations - Report IX)

Recommendation	Status
Formalize bus operator feedback in problem diagnosis	All bus operators are met by a Yard Supervisor, who surveys them on problems encountered and forwards problems to bus maintenance

Recommendation	Status
Update the written Maintenance Program and the Bus Maintenance Procedures Manual	The Maintenance Program and Bus Maintenance Procedures Manual were updated and are available on Transitnet

Recommendation	Status
Review and update existing agency objectives for bus maintenance to ensure they are measurable, time limited and appropriate to conditions/needs	Objectives are updated and reported through the MDT Scorecard and Transit Services Monthly Report

Recommendation	Status
Conduct an inventory of training needs for all levels of staff and coordinate the training program with HR	Consolidated all training under one department and HR conducted a training needs survey

Recommendation	Status
Immediately modify the Apprenticeship Program to require completion of a CDL license, safety instruction, and EPA certification prior to graduation	Discontinued the Apprenticeship Program after hiring 40 of the 44 program participants

Recommendation	Status
Review Times Standards Study completed by FIU and incorporate time standards for bus maintenance activities where appropriate	Use as a guide to schedule activities and will incorporate it in EAMS

Recommendation	Status
Initiate a "maintenance facilities modernization initiative"	Are modernizing through the Infrastructure Renewal Program (IRP)

Recommendation	Status
Immediately establish a facilities maintenance program for bus maintenance that includes routine maintenance and repair of all buildings and assigned equipment	Completed: Facilities now reports to Infrastructure Engineering & Maintenance; some shops have already been painted

Recommendation	Status
Investigate the use of "specialty shops" to handle specific repairs or routine activities, such as PMIs, brakes, and retrofits	Set aside specific positions within bus maintenance to complete assigned tasks

Recommendation	Status
Continue ongoing work to improve the PMI process to ensure timely and complete inspections of the entire fleet; establish an acceptable method to ensure that all defects noted during the PMI are repaired prior to returning a bus to service	Set a target of 100 percent on-time. Categorize defects as: safety, road call, and schedule

Recommendation	Status
MDT's recent bus procurements have enabled MDT to establish a relatively new and homogeneous fleet, which affords MDT the opportunity to maximize maintenance performance, realize savings from reduced inventory needs, and require less specialized technician training; maintain a detailed history of performance characteristics and complete trend analyses of current functioning	Trend analysis is completed by Knowledge Management. Fleet performance is detailed in Transit Services Monthly Report

Recommendation	Status
Implement and utilize advanced technology in as many areas as possible; utilize portable, wireless, handheld devices wherever possible to eliminate paper; implement a streamlined method for repair orders using advanced technologies	Significantly expanded use of technology. Decided to use PC-based system due to reliability concerns; PMI/repair forms and manuals are all on line; successfully integrated EAM at Metromover, and bus is next in line

Recommendation	Status
Provide a sufficient number of laptop computers for bus maintenance diagnostics	Laptops are available

Recommendation	Status
Utilize/install wireless networks in all repair facilities	Decided against use of wireless due to proximity of fare collection equipment

Recommendation	Status
Thoroughly and properly train technicians in the use of advanced technologies and how to enter repair order information electronically	Technicians use CAD/AVL in bus for AVM

Recommendation	Status
Utilize advanced technology to track Support Service's rebuilt component inventory	No longer completed by Support Services

Recommendation	Status
Provide each body shop with a modern digital camera and necessary peripheral equipment	Provide one per shop

Recommendation	Status
Use advanced technologies for communications between chiefs, superintendents, supervisors, and the general superintendent	Every chief has a cell phone

Recommendation	Status
Share information with peer agencies and seek out information from peer agencies when undertaking new initiatives; take advantage of web-based programs that are transit specific	Use FTIS; have a good relationship with BCT, JTA, and APTA members; CITT is funding MDT to be part of benchmarking consortium

Recommendation	Status
Create a simple and effective customer feedback mechanism and incorporate findings to improve bus maintenance operations	Completed

Recommendation	Status
Provide training to bus maintenance supervisors	All supervisors receive training

Recommendation	Status
All aspects of the bus fueling system should be streamlined	Fueling procedures were revised

Recommendation	Status
Assign clerks to the bus maintenance shops to handle administrative tasks; enlist the assistance of bus maintenance supervisors to identify their assigned duties (Comprehensive 90-day Review Long-range Goal)	Did not see a need for clerks even though maintenance supervisors are out of the office

Recommendation	Status
Implement the "odd day scheduled" bus maintenance clerk to work a 40-hour week, scheduled Tuesday through Saturday; the addition of this clerk will improve productivity and eliminate early week overloads for regular Monday through Friday clerks	Tried and failed due to lack of supervision

Recommendation	Status
Prioritize ADA compliance	Have established time limit

Recommendation	Status
Identify all repeat failures by garage and vehicle type; implement an auto-response mechanism that flags repeat failures and calls them to the attention of supervisors, chiefs, and superintendents	On-line

Recommendation	Status
Establish a cooperative relationship with Field Engineering & System Maintenance and Bus maintenance control to troubleshoot parts failures	Established relationship – Knowledge Management

Recommendation	Status
Revise the tool policy in bus maintenance to mirror existing policies at rail and mover	Maintained tool allowance

Recommendation	Status
Incorporate performance factors into contracts for parts, rebuilt components, and warranty work	Completed

Recommendation	Status
Take active steps to improve employee attendance	MDT Scorecard and TWU incentive

Recommendation	Status
Implement goals identified by the Comprehensive 90-day Review; provide employees with continual status reports of progress to date and incorporate changes in the maintenance plan	Weekly staff meeting; publish monthly report; and performance for week report by garage

Recommendation	Status
Continue the efforts of the Bus Maintenance Implementation Team; as with the Comprehensive 90-day Review, provide employees with continual status reports of progress to date and incorporate changes in the maintenance plan	Continued

Recommendation	Status
Establish and monitor performance metrics for maintenance beyond percent of the fleet that makes daily "pull-out;" establishing performance metrics and working to improve results in areas recommended will develop within the agency an efficient and effective bus maintenance operation; if undue priority is placed only on making pullout, many old practices will continue that will subvert the improvement of the operation	Have established a number of performance metrics

Recommendation	Status
Incorporate productivity standards into the calculation of manpower requirements for vehicle inspection and maintenance	Completed

Metrobus Reporting

Bus Services tracks and reports the following performance indicators on a monthly basis.

Transit Services Monthly Report: Bus Services Executive Summary

- Metrobus On-time Performance (Goal = 75%)
- Bus Availability-Weekday AM (Goal = 100%)
- Bus Availability-Weekday PM (Goal = 100%)
- Late Pullouts (Goal = 0%)
- Missed Pullouts (Goal = 0%)
- Preventive Maintenance Adherence (Goal = 90%)
- Scheduled versus Unscheduled Maintenance (Goal = 70% schedule/30% unscheduled)
- Cumulative Open Work Orders (Goal = <800)
- Buses Down for Parts (Goal = <3%)
- Interior Cleaning Adherence (Goal = 90%)
- Metrobus Fleet Average Mean Distance Between Failures (Goal = >4,000 miles)
- Metrobus Fleet Average Miles Between Roadcalls (Goal = >3,000)
- Bus Operator Absenteeism (Goal = <16.5%)
- Bus Technician Absenteeism (Goal = <16.5%)
- Destination Sign Operational Status (Goal = 95.0%)
- PA System Operational Status (Goal = 95.0%)
- Wheel Chair Equipment Availability (Goal = 95.0%)
- Maintenance-related Complaints (Goal = <30)
- Total Accidents (Goal =<3.6 per 100k miles)

Transit Services Monthly Report: Bus Services

- System Reliability Report – fleet type mean distance between failures for large and mini fleets
- MBRC by division and roadcalls by top failure mode, with and without lost time of five minutes
- MDBF by division and fleet type
- Mean distance between subsystem failures
- Mechanical roadcalls by fleet type
- Top 5 system repairs from roadcalls, 12-month rolling data
- Cost per mile by fleet type
- Fluid analysis
- Reliability Matrix
- Warranty recovery

XXI. Field Engineering & Systems Maintenance, April 2007

CUTR was asked to conduct an independent analysis to determine the reasonableness of a three-part divisional modification plan that was prepared by Field Engineering & System Maintenance (FESM). Included was a review of the current state of FESM, a comparison of the division to similar groups at peer transit agencies, and development of a series of recommendations related to each area of the divisional improvement plan.

Phase One

The MDT field test engineering modification plan presented a strong, proactive approach to the challenges associated with ongoing and imminent agency growth, modernization efforts for current systems, and implementation of advanced technologies. Specifically, the plan sought to reshape the existing section into a full-fledged division by addressing personnel deficiencies, modifying the organizational structure, and revising the overriding management philosophies. Through the modification plan, field test engineering leaders clearly expressed their vision for a strong, comprehensive division, which would serve as an in-house resource of engineering expertise. The plan identified very specific criteria, including personnel needs, equipment needs, and administrative needs.

- Grant lead field test engineers official manager oversight authority
- Reorganize the MDT field test engineering section
- Consider devising an outreach effort related to systems engineering, which was an emerging field of engineering
- Prepare a contingency plan for use in the event that structural and/or staffing modifications were rejected by the agency
- Consider the following operating practices:
  - Adopt the WMATA work plan method outlined in the report
  - Use out-tasking, which involves only smaller, specialized tasks for which MDT does not have available resources to complete
  - Adopt a policy that involves participation of operations and maintenance staff early in the procurement process
  - Use the Horizontal Action Team (HAT) approach for management of special maintenance projects. The team is initialized during the design phase of a project and remains in place through final acceptance of the deliverables.

Phase Two

The MDT FESM/Systems Maintenance (SM) modification plan presented a detailed, proactive approach to the challenges associated with ongoing and imminent agency growth, modernization efforts, and implementations of advanced technologies. Specifically, the plan addressed personnel deficiencies, supervisory needs, and equipment costs. FESM/SM managers engaged CUTR to review the modification plan and to determine the reasonableness of the provisions within it. The recommendations that resulted from this research effort were categorized into 2 areas - recommendations specifically related

to the reasonableness of plan #2 and suggested actions and recommended next steps for FESM/SM based on the body of knowledge gained over the course of the project.

- At a minimum, the organization of FESM/SM should be restructured according to the terms outlined in plan #2
- Establish a policy to deal effectively with responsibilities related to digital video
- Review peer practices and devise a plan to implement policies that encourage qualified personnel to compete for systems maintenance positions
- Although new fare collection technologies were under development, FESM/SM might want to explore the possibility of contracting service and maintenance of this difficult-to-maintain equipment
- Explore specialization versus proficiency in all maintenance areas

Phase Three

The MDT structural inspection & analysis (SIA) division modification plan presented a concise, proactive approach to the challenges associated with ongoing and imminent agency growth, modernization efforts, and implementations of advanced technologies. Specifically, the plan addressed personnel deficiencies, inspector overtime requirements, and equipment needs. FESM/SIA management engaged CUTR to review the modification plan and to determine the reasonableness of its provisions. Based on the body of knowledge gained during the course of this project and the analysis completed, researchers presented the following recommendations.

- Consider hiring additional personnel to resolve problems due to insufficient SIA personnel levels
- Consider developing a written mission statement and identifying goals and objectives to serve as a point of reference and guidance for the group
- Consider significant modernization efforts for SIA office and storage facilities. Current facilities provided insufficient space for staff and storage of sensitive field inspection books.
- Investigate potential technology upgrades for SIA and implement them wherever possible

Status of Recommendations

In FY 2008/2009, following completion of the FESM Report, FESM, which formerly reported directly to the Deputy Director Operations, was integrated into Infrastructure Engineering & Maintenance, a newly created work unit. The staffing allocation consisted of a chief and administrative secretary. IEM was established to oversee the following:

- Structural Inspections (formerly a direct report to the Deputy Director Operations)
- Facilities Maintenance (formerly reported to the Assistant Director Rail Services)
- Field Engineering & Systems Maintenance (formerly a direct report to the Deputy Director Operations)

Structural Inspections Staffing by Function

Structural Inspections	FY07 /08	FY08 /09	vs FY07/08 +/-	vs FY07/08 % +/-	FY09 /10	vs FY08/09 +/-	vs FY08/09 % +/-
Non-vehicle Maintenance	7	6	-1	0.0%	6	0	0.0%
General Administration	1	2	1	100.0%	2	0	0.0%
Total	8	8	0	0.0%	8	0	0.0%
FY 09/10 versus FY 07/08						0	0.0%

Most of the 16 Facilities Maintenance positions that were eliminated over time were non-vehicle maintenance positions, such as laborers, painters, equipment technicians and control clerks.

Facilities Maintenance Staffing by Function

Facilities Maintenance	FY07 /08	FY08 /09	vs FY07/08 +/-	vs FY07/08 % +/-	FY09 /10	vs FY08/09 +/-	vs FY08/09 % +/-
Non-vehicle Maintenance	71	59	-12	-16.9%	58	-1	-1.7%
General Administration	31	31	0	0.0%	28	-3	-9.7%
Total	102	90	-12	-11.8%	86	-4	-4.4%
FY 09/10 versus FY 07/08						-16	-15.7%

Most of the 16 FESM positions that were eliminated over time were non-vehicle maintenance positions, such as control clerks and electronic technicians.

Field Engineering & Systems Maintenance

Field Engineering & Systems Maintenance	FY07 /08	FY08 /09	vs FY07/08 +/-	vs FY07/08 % +/-	FY09 /10	vs FY08/09 +/-	vs FY08/09 % +/-
Non-vehicle Maintenance	99	80	-19	-19.2%	84	4	5.0%
General Administration	21	19	-2	-9.5%	20	1	5.3%
Total	120	99	-21	-17.5%	104	5	5.1%
FY 09/10 versus FY 07/08						-16	-13.3%

The newly created Infrastructure Engineering & Maintenance staffing by work unit is presented below. Through reorganization and consolidation, MDT effectively reduced 30 staff within this area.

Infrastructure Engineering & Maintenance

Infrastructure Engineering & Maintenance	FY07 /08	FY08 /09	vs FY07/08 +/-	vs FY07/08 % +/-	FY09 /10	vs FY08/09 +/-	vs FY08/09 % +/-	vs FY07/08 +/-	vs FY07/08 % +/-
Infrastructure Engineering & Maintenance	0	2	2	100.0%	2	0	0.0%	2	100.0%
Structural Inspections	8	8	0	0.0%	8	0	0.0%	0	0.0%
Facilities Maintenance	102	90	-12	-11.8%	86	-4	-4.4%	-16	-15.7%
Field Engineering & Systems Maintenance	120	99	-21	-17.5%	104	5	5.1%	-16	-13.3%
Total	230	199	-31	-13.5%	200	1	0.5%	-30	-13.0%

Performance Reporting

FESM tracks and reports the following performance indicators on a monthly basis in the Transit Service Monthly Report.

- Fare Collection Roadcalls by Symptom
  - Roadcalls by Division
  - Top Five Roadcalls by Division
- Preventive Maintenance
  - Systems
  - Closed Circuit TV (CCTV)
  - Radio
  - Farebox – Bus
  - Fare Collection – Rail
- Warranty Recovery

XXII. Organizational Review & Peer Comparison, January 2010

MDT asked CUTR for assistance in an effort to examine MDT's past performance based on metrics not only within MDT but also at select peer agencies. In addition, MDT requested a review of the impact of organizational realignments that had been undertaken by MDT over the past several years on overall performance of the agency.

Parameters

- Compare MDT to peer organizations
  - Heavy Rail
    - Greater Cleveland Regional Transit Authority (GCRTA)
    - Los Angeles County Metropolitan Transportation Authority (LACMTA)
    - Maryland Transit Administration (MTA)
    - Massachusetts Bay Transportation Authority (MBTA)
    - Southeastern Pennsylvania Transportation Authority (SEPTA)
  - Bus
    - Broward County Transit (BCT)
    - Greater Cleveland Regional Transit Authority (GCRTA)
    - King County Metro (KCM)
    - Los Angeles County Metropolitan Transportation Authority (LACMTA)
    - Maryland Transit Administration (MTA)
    - Massachusetts Bay Transportation Authority (MBTA)
    - Southeastern Pennsylvania Transportation Authority (SEPTA)
  - Automated Guideway
    - Detroit Transportation Corporation (DTC)
    - Jacksonville Transportation Authority (JTA)
- Review organizational changes made over the past several years
- Analyze recent agency performance and performance measures
- Assess proposed new organizational changes in budgetary context

Peer Review

Operating Expenses per VOMS, 2003 – 2008

- Heavy rail expenses consistently fell below all peers in all functions
- Bus expenses exceeded the peer maximum in vehicle operations prior to 2007
- Heavy rail and bus reported increased costs in most areas in 2008

Updated Operating Expense per VOMS

MDT Operating Expense ($000) per VOMS by Function and Mode

	Vehicle Operations			Vehicle Maintenance			Non-vehicle Maintenance			General Administration		
Year	Rail	Bus	AG	Rail	Bus	AG	Rail	Bus	AG	Rail	Bus	AG
2003	$260	$262	$294	$178	$80	$432	$172	$26	$216	$77	$56	$132
2004	$243	$221	$313	$141	$61	$438	$143	$20	$229	$69	$43	$119
2005	$285	$234	$331	$157	$66	$421	$155	$19	$261	$94	$28	$148
2006	$306	$249	$318	$155	$76	$384	$164	$20	$208	$97	$31	$156
2007	$348	$246	$304	$164	$81	$362	$186	$23	$210	$125	$31	$174
2008	$356	$261	$356	$169	$87	$365	$202	$23	$221	$114	$38	$200
2009	$409	$297	$336	$170	$102	$354	$228	$29	$217	$126	$39	$201
2010	$381	$282	$334	$183	$97	$282	$209	$22	$182	$142	$52	$197

- Vehicle operations and non-vehicle maintenance expenses per VOMS declined in all three modes in 2010 versus 2009; Mover expenses were below 2008 costs
- Vehicle maintenance expenses per VOMS fell for bus and mover, while rail expenses increased 7.8 percent compared to 2009 and 8.7 percent compared to 2008; mover vehicle maintenance expenses per VOMS fell by more than 20 percent in 2010
- General administration costs per VOMS grew in rail and bus; rail costs increased 12 percent compared to 2009 and 24 percent compared to 2008

Employee Work Hours per VOMS, 2003 – 2007

- Heavy rail work hours consistently exceeded the peer maximum in general administration
- Bus work hours frequently exceeded the peer maximum in vehicle operations and vehicle maintenance
- Bus vehicle operations work hours per VOMS declined significantly over time
- Automated guideway required significant employee resources for vehicle maintenance and general administration

Updated Employee Work Hours per VOMS

MDT Employee Work Hours per VOMS by Function and Mode

	Vehicle Operations			Vehicle Maintenance			Non-vehicle Maintenance			General Administration		
Year	Rail	Bus	AG	Rail	Bus	AG	Rail	Bus	AG	Rail	Bus	AG
2003	2,667	7,910	2,026	4,164	1,555	7,865	3,987	276	4,630	1,634	888	2,079
2004	2,823	6,884	2,179	2,683	1,549	9,115	4,876	238	6,432	2,078	921	3,074
2005	2,635	6,381	2,005	2,848	1,555	8,651	4,321	223	6,128	2,221	862	3,141
2006	2,893	6,172	1,493	2,665	1,495	8,616	5,154	300	4,331	2,517	663	3,810
2007	3,121	5,801	1,375	3,088	1,355	8,009	4,772	302	3,949	2,426	544	4,046
2008	2,800	6,123	2,173	2,641	1,348	7,461	4,680	272	4,002	1,573	490	2,780
2009	2,769	5,848	2,127	3,114	1,433	7,774	5,206	314	4,159	1,822	479	2,661
2010	3,205	5,703	1,327	4,106	1,330	5,404	2,939	161	3,326	2,969	800	4,815

- Bus and Mover reduced vehicle operations and vehicle maintenance work hours per VOMS in 2010 compared to 2009, while rail reported a 15.7 percent increase; similar trends were noted in 2009 compared to 2008
- All modes reduced non-vehicle maintenance work hours per VOMS ranging from 20.0 percent to 48.6 percent in 2010 compared to 2009 and ranging from 16.9 percent to 40.8 percent in 2009 versus 2008
- All modes increased general administration work hours ranging from 67.2 percent to 81.0 percent in 2010 versus 2009 and ranging from 63.2 percent to 88.8 percent in 2009 versus 2008

Employee Work Hours per Passenger Trip, 2003 – 2008

- Heavy rail and bus work hours exceeded peer maximums in most functions from 2003 through 2007
- Heavy rail, bus, and automated guideway reduced work hours per passenger trip in most areas in 2008

Updated Employee Work Hours per Passenger Trip

MDT Employee Work Hours per Passenger Trip (000s) by Function and Mode

	Vehicle Operations			Vehicle Maintenance			Non-vehicle Maintenance			General Administration		
Year	Rail	Bus	AG	Rail	Bus	AG	Rail	Bus	AG	Rail	Bus	AG
2003	17.9	62.0	5.9	27.9	12.2	22.7	26.8	2.2	13.4	11.0	7.0	6.0
2004	18.6	60.7	4.8	17.7	13.7	19.9	32.1	2.1	14.1	13.7	8.1	6.7
2005	16.1	62.4	3.8	17.4	15.2	16.5	26.4	2.2	11.7	13.6	8.4	6.0
2006	17.5	62.2	3.3	16.1	15.1	18.9	31.1	3.0	9.5	15.2	6.7	8.3
2007	17.5	58.3	3.2	17.3	13.6	18.6	26.7	3.0	9.2	13.6	5.5	9.4
2008	14.8	58.9	4.9	14.0	13.0	16.9	24.7	2.6	9.1	8.3	4.7	6.3
2009	12.8	55.4	5.5	14.3	13.6	20.2	24.0	3.0	10.8	8.4	4.5	6.9
2010	15.4	55.2	3.4	19.7	12.9	13.9	14.1	1.6	8.6	14.3	7.7	12.4

- Bus and Mover reduced vehicle operations and vehicle maintenance work hours per passenger trip in 2010 compared to 2009, while rail reported a 20.3percent increase; similar trends were noted in 2009 compared to 2008
- All modes reduced non-vehicle maintenance work hours per passenger trip ranging from 20.4 percent to 46.7 percent in 2010 compared to 2009 and from 5.5 percent to 42.9 percent in 2009 versus 2008
- All modes increased general administration work hours per passenger trip ranging from 70.2 percent to 79.7 percent in 2010 versus 2009 and ranging from 63.8 percent to 96.8 percent in 2009 versus 2008

Employee Work Hours per Revenue Mile, 2003 – 2008

- Heavy rail 2008 general administration work hours per revenue mile fell below the 2007 record high
- Bus work hours per revenue mile increased in 2008
- Automated guideway work hours per revenue mile exceeded most bus and heavy rail levels, but did decline in 2008

Updated Employee Work Hours per Revenue Mile

MDT Employee Work Hours per Revenue Mile (000s) by Function and Mode

	Vehicle Operations			Vehicle Maintenance			Non-vehicle Maintenance			General Administration		
Year	Rail	Bus	AG	Rail	Bus	AG	Rail	Bus	AG	Rail	Bus	AG
2003	33.2	145.5	35.4	51.9	28.6	137.3	49.7	5.1	80.8	20.4	16.3	36.3
2004	31.9	146.8	38.8	30.3	33.0	162.5	55.1	5.1	114.6	23.5	19.6	54.8
2005	29.3	140.0	38.6	31.7	34.1	166.5	48.1	4.9	117.9	24.7	18.9	60.4
2006	31.1	137.9	28.5	28.6	33.4	164.7	55.3	6.7	82.8	27.0	14.8	72.8
2007	36.6	136.5	29.4	36.2	31.9	171.3	56.0	7.1	84.5	28.5	12.8	86.6
2008	38.3	151.2	38.8	36.2	33.3	133.2	64.1	6.7	71.4	21.5	12.1	49.6
2009	34.8	132.7	41.6	39.1	32.5	152.1	65.3	7.1	81.4	22.9	10.9	52.1
2010	40.1	133.5	26.4	51.4	31.1	107.5	36.8	3.8	66.2	37.2	18.7	95.8

- Mover reduced vehicle operations, vehicle maintenance and non-vehicle maintenance work hours per revenue mile in 2010 compared to 2009
- Bus and rail increased vehicle operations work hours per revenue mile in 2010 compared to 2009
- Rail increased vehicle maintenance expenses per revenue mile in 2010 compared to 2009 and in 2009 compared to 2008
- All modes reduced non-vehicle maintenance work hours per revenue mile ranging from 18.7 percent to 46.5 percent in 2010 compared to 2009 and from 7.3 percent to 43.3 percent in 2009 versus 2008
- All modes increased general administration work hours per revenue mile ranging from 62.4 percent to 83.9 percent in 2010 versus 2009 and ranging from 54.5 percent to 93.1 percent in 2009 versus 2008

Salary Cost per Passenger Trip, 2003 – 2007

- Heavy rail costs exceeded the peer maximum in general administration and were consistently double those of LACMTA
- Bus costs fell below all peer agencies in all functions, but remained relatively stable
- Heavy rail's non-vehicle maintenance cost was 8 to 11 times greater than bus and Automated guideway and 2 times greater than Automated guideway administration cost

Salary Cost per Passenger Trip

Salary Cost per Passenger Trip (000s) by Function - MDT

	Vehicle Operations			Vehicle Maintenance			Non-vehicle Maintenance			General Administration		
Year	Rail	Bus	AG	Rail	Bus	AG	Rail	Bus	AG	Rail	Bus	AG
2003	$719	$1,673	$385	$646	$400	$904	$893	$80	$461	$343	$209	$194
2004	$620	$1,623	$293	$406	$339	$669	$752	$67	$364	$291	$168	$155
2005	$610	$1,797	$254	$443	$437	$574	$721	$76	$326	$354	$189	$155
2006	$717	$1,830	$192	$444	$453	$671	$796	$89	$287	$375	$188	$236
2007	$776	$1,779	$229	$464	$476	$751	$761	$96	$336	$418	$192	$304
2008	$812	$1,859	$435	$412	$498	$887	$760	$93	$440	$280	$203	$294
2009	$773	$2,194	$344	$389	$589	$717	$664	$126	$370	$265	$246	$240
2010	$886	$2,203	$212	$480	$579	$447	$419	$56	$275	$341	$387	$382

- Rail and bus increased vehicle operation salary cost per passenger trip in 2010 compared to 2009; similar trends were noted in 2009 compared to 2008
- Rail increased vehicle maintenance salary cost per passenger trip in 2010 compared to 2009 and in 2009 compared to 2008; bus and Mover reported lower vehicle maintenance salary cost per passenger trip in 2010 compared to 2009
- All modes reduced non-vehicle maintenance salary cost per passenger trip ranging from 25.7 percent to 55.6 percent in 2010 compared to 2009 and from 37.5 percent to 44.9 percent in 2009 versus 2008
- All modes increased general administration salary cost per passenger trip ranging from 28.7 percent to 59.2 percent in 2010 versus 2009 and ranging from 21.8 percent to 90.6 percent in 2009 versus 2008

Revenue Miles between Failures, 2003 – 2008

- Heavy rail outperformed only LACMTA
- Bus improved revenue miles in 2007, but remained well below all peers
- Heavy rail and bus revenue miles between failures declined in 2008
- Automated guideway, which performed well below peers, showed significant improvement in 2007 and 2008

Updated Revenue Miles Between Failures

MDT Revenue Miles Between Failures by Mode

	2002	2003	2004	2005	2006	2007	2008	2009	2010
Metrorail	3,324	5,114	4,806	4,773	5,266	4,776	4,198	2,303	3,051
Metrobus	1,534	2,263	2,375	2,165	1,943	2,338	2,098	2,264	2,684
Metromover	2,675	1,305	3,324	2,719	1,045	1,281	1,650	1,916	2,237

- Rail, Bus and Mover improved revenue miles between failures in 2010 compared to 2009.
- Mover reported the highest number of revenue miles between failures since 2005
- Bus reported the largest number of revenue miles between failures since, at least, 2001

- Rail improved revenue miles between failures over 2009, but still reported well below a high of 5,266 revenue miles between failures reported in 2006

Staffing Allocation

- MDT's consolidation of a variety of performance-related functions within a new Performance Management Division had the potential to eliminate unnecessary duplication, improve responsiveness, and enhance the quality of the final product
- MDT's decision to retain Resource Allocation within the Financial Services Division seemed to be prudent from a financial management perspective
- Consistent with OSBM's recommendation, efforts should be initiated to explore further any possible duplication of services in the division of Civil Rights & Labor Relations within Miami-Dade County
- The Safety & Security Division was the only division that expanded
- Assignment of technical assistance positions to the Deputy Director Operations could be very useful
- Most of the Facilities Maintenance and Engineering & System Maintenance positions eliminated were non-vehicle maintenance positions
- Through reorganization and consolidation, MDT effectively reduced 30 staff within Infrastructure Engineering & Maintenance
- With responsibility for Materials Management assigned to the Deputy Director Operations, it might be prudent to establish additional financial oversight of materials management functions
- Given OSBM's recommendations regarding the Rail/Mover Vehicle work unit, possible recommendations for enhancing the effectiveness of the Rail/Mover Vehicle work unit include the addition of personnel skilled in accounting and a review of supervisory requirements
- Paratransit Administration, an operating unit, is now a direct report to Bus Services
- Through reorganization and consolidation, MDT reduced a total of 434 staff within Operations
- Consolidation and staff reductions undertaken in Engineering Planning & Development were consistent with OSBM's recommendation that MDT explore additional staff reductions in this area
- Relocation of Information Technology to Support Services was in line with OSBM's recommendation
- MDT 's consolidation of the training function within a single work unit assigned to an area that serves the entire organization would seem to be a positive move not only from an efficiency perspective but also to enhance training effectiveness
- The assignment of Human Resources to Support Services, a direct report and an area that serves the entire organization, complies with OSBM's recommendations
- Support Services established an integrated unit of services for the entire organization

Staffing Allocation Update

Reduction of staff positions by MDT, while modest, continued into FY 2011. The FY 2011 budget reflects a 14 percent decrease in allocated positions compared to FY 2008, with the greatest number of positions eliminated from Metrobus operations followed by Operational Support and Metrorail. The FY 2011 increase in Metrobus staffing reflects the restoration of 18 positions previously eliminated in FY 2010 in accordance with TWU contractual negotiations.

Staffing Allocation by Program

					FY2010 vs FY 2008		FY2011 vs FY2010	
Program	**FY2008**	**FY2009**	**FY2010**	**FY2011**	**+/-**	**% +/-**	**+/-**	**% +/-**
Office of the Director	8	9	9	10	1	12.5%	1	11.1%
Operational Support[1]	550	544	511	495	-39	-7.1%	-16	-3.1%
Metrobus	2,354	2,055	1,995	2,019	-359	-15.3%	24	1.2%
Metromover	101	70	70	69	-31	-30.7%	-1	-1.4%
Metrorail	477	432	427	426	-50	-10.5%	-1	-0.2%
Paratransit	48	32	31	30	-17	-35.4%	-1	-3.2%
Engineering	182	159	158	150	-24	-13.2%	-8	-5.1%
Total	3,720	3,301	3,201	3,199	-519	-14.0%	-2	-0.1%

[1] *Includes Customer Service staff: 57 in FY 07-08 and 63 in FY 08-09*

Performance Metrics

- OSBM continued to use balanced scorecards on a quarterly basis to measure MDT's success in achieving priority outcomes within four areas, including customer, financial, internal, and learning & growth
- MDT performed exceptionally well in the area of customer service
- Few measures were reported over the long-term, as performance measures frequently changed from quarter to quarter, and measures often focused on outputs rather than outcomes; however, there appeared to be a recent change in focus
- Operating costs were not tracked
- MDT incorporated three standardized measures, which all focused on quantity and quality of service, that were found to be in use by other transit agencies
- Measures of efficiency and effectiveness were not identified as measures of performance
- Based on the standardized performance measures, all three MDT modes improved performance
- Metromover and Metrorail exceeded MDT targets
- Bus achieved MDT targets
- MDT could benefit from developing additional measures of performance that focus on outcomes and target efficient and effective operations
- The standardized list of performance measures identified within CUTR's report provided a good selection for MDT's consideration

Performance Metrics Update

The following performance metrics by mode were at some point reported and tracked within the MDT Scorecard. Specific service metrics drawn from the MDT Scorecard have been integrated into the budget package and include actual past performance along with a target for the current budget year. Items highlighted in blue indicate a metric for which MDT achieved the target. Metrics, budget highlights and enhancements for the FY 2011 budget are presented for Metrobus, Metromover, Metrorail, Operational Support and Paratransit.

Metrobus

TP5-1: Dramatic improvement in the level of bus service (priority outcome)
Objectives: Maintain a safe, cost efficient, and reliable bus system

Metrobus Measures	FY2007 Actual	FY2008 Actual	FY2009 Actual	FY2010 Actual	FY2011 Target
Average daily bus boardings (000s)	264	275	266	225	217
Bus revenue miles (millions)	35.7	32.6	32.0	29.2	29.2
Bus on-time performance (%)	71%	75%	79%	79%	75%
Preventive Maintenance completed on schedule (%)	92.2%	98.8%	99.0%	99.0%	90.0%
Mean distance between mechanical breakdowns (miles)	2,975	3,714	3,951	5,032	4,000
Peak hour bus availability (%)	n/a	100%	99%	99%	100%
Unanticipated bus operator absenteeism (%)	12%	16%	n/a	n/a	n/a

Metrobus Highlights and Budget Enhancements or Reductions

- Continue preventive maintenance program (Consistent with Metrobus Fleet Management Plan, March 2009 Revision 04)
  - Process mapping to realize new efficiencies
  - 3,000-mile inspection
  - 6,000-mile inspection focused on mechanical/safety diagnostic and corrective actions
  - 3, 6, and 9-year critical component replacement plan with a 6-year bus body rehabilitation program that includes repainting
- Route structure and total revenue miles based on ridership and service standards (Consistent with Service Standards, adopted September 29, 2009)
  - Passenger boardings per hour >15
  - Fiscal subsidy per passenger <$4.40
  - Lower cost alternatives to unproductive routes include alternative service from route realignments and occasionally a "lifeline" service
- Staffing
  - Restored 18 positions previously eliminated in FY 2010 in accordance with TWU contractual negotiations

Updated Metrobus Consolidated Performance Measures

Metrobus Performance Measures	2003	2004	2005	2006	2007	2008	2009	2010
MDT Balanced Scorecard								
On-time performance (weekday)					72.3%	76.4%	79.2%	78.5%
Mean distance between failures						3,413	3,951	5,012
Bus operator discourtesy complaints							28	5
Complaints per 100k revenue miles							22.7	
Complaints/100k boardings		9.20	11.13	11.42	11.80		9.36	10.83
General Performance Measures								
Average headway (minutes)	17.61	13.05	12.26	11.44	11.33		12.90	12.90
Revenue miles/failures	2,263	2,375	2,165	1,943	2,338	2,098	2,264	2,684
Passenger trips/vehicle mile	2.0	2.1	1.9	1.9	2.0	2.2	2.0	2.0
Passenger trips/vehicle hour	24.7	26.9	25.7	25.4	26.1	28.5	26.3	26.3
Passenger trips/revenue hour	27.6	29.6	28.1	27.7	28.6	31.2	28.8	28.9
Passenger trips/capita	13.1	15.3	15.6	16.6	17.0	17.4	31.5	28.1
Operating cost/passenger trip	$3.32	$3.05	$3.40	$3.79	$3.83	$3.94	$4.43	$4.38
Operating cost/passenger mile	$0.77	$0.77	$0.80	$0.89	$0.75	$0.79	$0.86	$0.81
Recovery ratio	25.1%	25.3%	28.1%	22.4%	22.3%	21.2%	23.5%	25.5%
Operating cost/vehicle mile	$6.68	$6.37	$6.54	$7.21	$7.60	$8.64	$9.02	$8.96
Operating cost/revenue mile	$7.80	$7.38	$7.62	$8.40	$8.96	$10.11	$10.61	$10.60
Operating cost/vehicle hour	$81.98	$82.21	$87.46	$96.24	$99.75	$112.25	$116.44	$115.31
Operating cost/revenue hour	$91.78	$90.48	$95.45	$104.87	$109.25	$122.75	$127.29	$126.54
Operating rev/operating exp	45.2%	60.7%	53.1%	46.8%	50.2%	48.0%		
Vehicle miles/vehicle	63,391	54,356	53,131	52,115	50,079	47,410	51,805	50,509
Vehicle revenue hours/capita	0.4749	0.5155	0.5554	0.5997	0.5942	0.5596	1.0947	0.9729
Revenue miles/vehicle miles	0.86	0.86	0.86	0.86	0.85	0.85	0.85	0.85

Metromover

TP1-4: Safe and reliable transit facilities and transit vehicles (priority outcome)

Objectives: Maintain a safe, cost efficient, and reliable Metromover system

Metromover Measures	FY2007 Actual	FY2008 Actual	FY2009 Actual	FY2010 Actual	FY2011 Target
Average daily Metromover boardings	27,000	28,000	25,700	26,500	26,000
Preventive Maintenance completed on schedule (%)	99%	100%	92%	86%	100%
Metromover mean miles between failures	4,897	4,154	6,359	7,704	6,000
Metromover service availability (%)	n/a	n/a	99.5%	99.3%	100%

Metromover Highlights and Budget Enhancements or Reductions

- FY 2009 – complete Phase One replacement of 12 Metromover cars that have been in service since 1986 ($33.427 million) with the last car to be delivered August 2008 and operational by September 2008 (Consistent with Metromover Fleet Management Plan, Revision 04)

- FY 2010 – continue Phase II replacement of 17 Metromover cars that have been in service since 1986 ($42.446 million) with the last car to be delivered August 2011 (Consistent with Metromover Fleet Management Plan, Revision 04)

Updated Metromover Consolidated Performance Measures

Metromover Performance Measures	2003	2004	2005	2006	2007	2008	2009	2010
MDT Balanced Scorecard								
Mean distance between failures						4,895	6,359	7,398
Complaints/100k revenue miles							1.1	
Complaints/100k boardings		0.41	0.49	0.66	0.71	0.29	0.17	0.38
Metromover Facelift-A/C units replaced							4	
General Performance Measures								
Revenue miles/failures	1,305	3,324	2,719	1,045	1,281	1,650	1,916	2,237
Average headway (minutes)	3.18	3.33	3.33	3.33	3.33	3.33	3.33	
Passenger trips/vehicle mile	5.9	8.0	9.9	8.7	9.1	7.9	7.5	7.6
Passenger trips/vehicle hour	64.8	81.4	101.5	87.5	92.7	80.1	76.7	76.0
Passenger trips/revenue hour	65.8	83.1	103.0	89.1	94.1	80.2	76.8	79.0
Passenger trips/capita	1.3	1.6	1.9	1.7	1.8	1.8	3.4	3.3
Operating cost/passenger trip	$3.10	$2.40	$2.21	$2.33	$2.44	$2.58	$2.87	$2.56
Operating cost/passenger mile	$3.02	$2.36	$2.21	$2.34	$2.38	$2.58	$2.77	$2.40
Recovery ratio	0.25%	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Operating cost/vehicle mile	$18.43	$19.18	$22.01	$20.21	$22.13	$20.35	$21.65	$19.45
Operating cost/revenue mile	$18.74	$19.58	$22.34	$20.37	$22.46	$20.38	$21.68	$19.79
Operating cost/vehicle hour	$200.89	$195.69	$224.53	$204.13	$225.73	$206.87	$220.19	$194.40
Operating cost/revenue hour	$204.24	$199.68	$227.90	$207.80	$229.12	$207.23	$220.49	$202.24
Operating rev/operating exp	32.3%	40.5%	42.2%	43.5%	43.3%	39.4%		
Vehicle miles/vehicle	58,251	57,254	52,746	52,742	47,447	56,130	51,168	51,165
Vehicle revenue hours/capita	0.0192	0.0190	0.0186	0.0188	0.0186	0.0224	0.04393	0.04132
Revenue miles/vehicle miles	0.98	0.98	0.99	0.99	0.99	1.00	1.00	0.98

Metrorail

TP1-4: Safe and reliable transit facilities and transit vehicles (priority outcome)
Objectives: Maintain a safe, cost efficient, and reliable Metrorail system

Metrorail Measures	FY2007 Actual	FY2008 Actual	FY2009 Actual	FY2010 Actual	FY2011 Target
Rail on-time performance (%)	94%	93%	96%	97%	95%
Metrorail mean miles between failures	3,177	3,143	3,200	3,482	3,400
Average daily Metrorail boardings (000s)	n/a	n/a	61,000	59,700	58,000

Metrorail Highlights and Budget Enhancements or Reductions

- FY 2010 – begin replacement of Metrorail vehicles ($37.260 million programmed in FY 10 from a total project cost of $401.455 million) for 136 vehicles; 72 new vehicles will arrive in FY 2011 with the remaining to be replaced by December 2015 (Consistent with Metrorail Fleet Management Plan, Revision 06)

- FY 2010 – begin construction ($6.573 million) of a test track for Metrorail with a projected completion date of FY 2011; continue to rehabilitate existing track and guideway equipment and fixtures ($7.033 million programmed for FY 2010), begin construction on Palmetto Station traction power substation ($13.020 million programmed for FY 2010 and on the new central control room system for Metrorail ($13.931 million programmed in FY 2010) (Referenced in Metrorail Fleet Management Plan, Revision 06)

Updated Metrorail Consolidated Performance Measures

Metrorail Performance Measures	2003	2004	2005	2006	2007	2008	2009	2010
MDT Balanced Scorecard								
On-time performance				94.0%	96.4%	93.2%	95.6%	97.0%
Mean distance between disruptions					41,175	48,169	46,567	65,780
Complaints per 100k revenue miles							1.9	
Complaints/100k boardings		1.88	1.97	2.28	1.70		0.71	0.80
General Performance Measures								
Revenue miles/failures	5,114	4,806	4,773	5,266	4,777	4,199	2,303	3,051
Average headway (minutes)	6.56	5.30	5.62	5.53	5.60	6.63	6.52	
Passenger trips/vehicle mile	1.8	1.7	1.8	1.7	2.0	2.5	2.6	2.5
Passenger trips/vehicle hour	42.6	38.2	40.4	39.6	45.0	53.4	57.1	57.8
Passenger trips/revenue hour	46.1	40.5	43.1	42.5	48.7	58.2	62.0	59.3
Passenger trips/capita	2.9	3.2	3.5	3.5	3.6	3.8	7.6	7.0
Operating cost/passenger trip	$4.61	$3.93	$4.22	$4.35	$4.61	$4.44	$4.30	$4.39
Operating cost/passenger mile	$0.60	$0.50	$0.53	$0.57	$0.60	$0.58	$0.59	$0.60
Recovery ratio	14.7%	16.3%	15.9%	26.2%	16.7%	16.1%	20.1%	23.0%
Operating cost/vehicle mile	$8.38	$6.63	$7.76	$7.54	$9.37	$11.12	$11.35	$11.10
Operating cost/revenue mile	$8.56	$6.74	$7.69	$7.74	$9.65	$11.51	$11.72	$11.45
Operating cost/vehicle hour	$196.00	$150.08	$170.48	$172.40	$207.26	$237.46	$245.45	$253.71
Operating cost/revenue hour	$212.43	$158.96	$181.83	$185.00	$224.39	$258.44	$266.54	$260.24
Operating rev/operating exp	51.1%	68.7%	56.9%	55.2%	53.4%	49.0%		
Vehicle miles/vehicle	81,934	89,918	89,012	95,689	87,789	75,564	82,257	82,425
Vehicle revenue hours/capita	0.0631	0.0786	0.0803	0.0824	0.0730	0.0648	0.1224	0.1181
Revenue miles/vehicle miles	0.98	0.98	1.01	0.97	0.97	0.97	0.97	0.97

Operational Support

TP1-4: Safe and reliable transit facilities and transit vehicles (priority outcome)

Objectives: Provide operational support for core services provided by the Transit Department

Operational Support Measures	FY2007 Actual	FY2008 Actual	FY2009 Actual	FY2010 Actual	FY2011 Target
Average monthly security post inspections	300	400	988	750	750
Metrorail/Metromover elevator and escalator availability	98.0%	98.0%	98.0%	97.0%	95.0%

Operational Support Highlights and Budget Enhancements or Reductions

- FY 2011 – ensure the reliability of the transit system by adhering to the Metrorail and Metrobus route and time schedules
- FY 2010 – reduce 50 administrative and operational support positions (representing $2.5 million annualized savings) and $9 million in base budget line item expenditures
- FY 2011 – reduce 20 administrative and operational support positions (representing $1.5 million annualized savings) and $5.112 million in base budget line item expenditures

Paratransit

TP1-1: Minimum wait time for transit passengers (priority outcome)
Objectives: Ensure timely Paratransit services

Paratransit Support Measures	FY2007 Actual	FY2008 Actual	FY2009 Actual	FY2010 Actual	FY2011 Target
Paratransit on-time performance	89%	83%	83%	83%	80%

Paratransit Highlights and Budget Enhancements or Reductions

- FY 2011 – provide Paratransit functions to include Special Transportation Services (STS) programming (1.51 million trips)

Potential Financial Impact of Reorganization

- In the absence of growth in operating costs, MDT's proposed organizational realignment for FY 2009/2010 represented a reduction of $40 million in wages and fringe benefits versus FY 2007/2008
- With a projected growth rate of 5.3 percent applied in FY 2008/2009 and in FY 2009/2010, the reduction in wages and fringe benefits is almost $28 million
- Fluctuation in the number of revenue miles provided, increases in projected work hours per full-time equivalent employee, and changes in wages and fringe benefits that increase them as a percentage of total operating expenses could all have negative impacts on the estimated savings

Financial Impact of Reorganization Update

Full-time and Part-time Employee Work Hours

Actual & Projected Full-time and Part-time Employee Work Hours

Fiscal Year	VOMS	Vehicle Operations		Vehicle Maintenance		Non-vehicle Maintenance		General Administration		Total Operating	
		Proj	Actual	Proj	Actual	Proj	Actual	Proj	Actual	Proj	Actual
2003	620	4,295,150		1,328,098		605,737		643,479		6,872,464	
2004	783	4,891,969		1,458,248		769,694		877,107		7,997,018	
2005	873	5,102,397		1,620,123		726,955		934,658		8,384,133	
2006	945	5,407,111		1,662,497		860,522		876,294		8,806,424	
2007	957	5,200,444		1,599,981		800,145		775,297		8,375,867	
2008	943	5,369,433	5,369,433	1,519,765	1,519,765	763,304	763,304	614,217	614,217	8,266,719	8,266,719
2009	821	3,913,650	4,464,588	1,327,234	1,450,518	648,706	749,420	1,317,259	551,542	7,206,850	7,216,068
2010	785	3,896,952	4,175,279	1,255,547	1,362,791	630,289	426,457	1,218,985	894,493	7,001,772	6,859,020
FY10vs08		-1,472,481	-1,194,154	-264,218	-156,974	-133,015	-336,847	604,768	280,276	-1,264,947	-1,407,699
%vs 08		-27.4%	-22.2%	-17.4%	-10.3%	-17.4%	-44.1%	98.5%	45.6%	-15.3%	-17.0%

- MDT exceeded the projected reduction of 1.3 million work hours in 2010 compared to 2008; reductions were noted in vehicle operations, vehicle maintenance and non-vehicle maintenance
- A sizeable increase in general administration work hours appeared to offset the reductions in the other functional areas; additional analysis is required to determine the nature of the increase in general administration employee work hours

Full-time Equivalent Employees

Actual & Projected Full-time Equivalent Employees

Fiscal Year	VOMS	Vehicle Operations		Vehicle Maintenance		Non-vehicle Maintenance		General Administration		Total Operating	
		Proj	Actual	Proj	Actual	Proj	Actual	Proj	Actual	Proj	Actual
2003	620	2,066		638		311		318		3,335	
2004	783	2,055		665		380		466		3,574	
2005	873	2,500		777		342		460		4,077	
2006	945	2,292		797		363		472		3,931	
2007	957	2,187		764		362		401		3,724	
2008	943	2,050	2,541	727	742	371	373	793	325	3,941	3,981
2009	821	1,852	2,567	648	742	317	373	697	325	3,514	4,007
2010	785	1,844	1,971	613	695	308	224	645	462	3,410	3,352
FY10vs08		-206	-570	-114	-47	-63	-149	-148	137	-531	-629
%vs 08		-10.0%	-22.4%	-15.7%	-6.3%	-17.0%	-39.9%	-18.7%	42.2%	-13.5%	-15.8%

- MDT exceeded the projected reduction of 531 full-time employee equivalents in 2010 compared to 2008; reductions were noted in vehicle operations, vehicle maintenance and non-vehicle maintenance
- As with employee work hours, a sizeable increase in general administration full-time employee equivalents appeared to offset the reductions in the other functional areas

Operating Expenses

Actual & Projected Operating Expenses ($000s)

Fiscal Year	Vehicle Operations		Vehicle Maintenance		Non-vehicle Maintenance		General Administration		Total Operating	
	Proj	Actual	Proj	Actual	Proj	Actual	Proj	Actual	Proj	Actual
2003	$162,578		$65,448		$33,716		$37,889		$299,631	
2004	$177,202		$62,598		$32,105		$37,633		$309,538	
2005	$211,435		$73,165		$35,141		$33,750		$353,491	
2006	$242,216		$85,929		$37,363		$38,082		$403,591	
2007	$246,341		$91,033		$41,563		$42,020		$420,957	
2008	$257,540	$257,540	$95,836	$95,836	$43,307	$43,307	$46,436	$46,436	$443,119	$443,119
2009P	$243,042	$254,137	$89,266	$94,875	$38,669	$44,584	$42,651	$42,796	$408,796	$436,392
2010P	$242,005	$230,825	$84,445	$87,225	$37,571	$36,203	$39,469	$51,332	$396,713	$405,586
FY10vs08	-$15,534	-$26,714	-$11,392	-$8,611	-$5,736	-$7,105	-$6,967	$4,897	-$46,407	-$37,533
%vs 08	-6.0%	-10.4%	-11.9%	-9.0%	-13.2%	-16.4%	-15.0%	10.5%	-10.5%	-8.5%

- MDT reduced 2008 operating costs by $37 million in 2010 with a $26 million cut in vehicle operations, a $9 million reduction in vehicle maintenance and a $7 million reduction in non-vehicle maintenance
- General administration operating costs grew by $5 million

Projected Savings from Wages and Fringe Benefits

Projected Savings - Wages+Fringe

Fiscal Year	*Projected Operating Cost*	*Projected Wages + Fringe*	*Actual Operating Cost*	*Actual Wages + Fringe*	*Actual vs Projected Operating Costs*	*Actual vs Projected Wages + Fringe*
2003	$299,631,275	$201,769,189	$299,631,275			
2004	$309,537,911	$208,962,479	$309,537,911			
2005	$353,490,950	$240,450,478	$353,490,950			
2006	$403,590,703	$260,581,320	$403,590,703			
2007	$420,957,300	$267,194,200	$420,957,300			
2008	$443,119,400	$281,380,819	$443,119,189	$282,433,133	0.0%	0.4%
2009P	$391,192,576	$248,407,285	$436,391,836	$290,175,887	11.6%	16.8%
2010P	$379,629,531	$241,064,752	$405,585,745	$276,782,976	6.8%	14.8%
FY10Pvs08	-$63,489,869	-$40,316,067	-$37,533,444	-$5,650,157		
%vs 08	-14.3%	-14.3%	-8.5%	-2.0%		

- Researchers projected that most savings would be gained from reduced wages and fringes based on the schedule of staff reductions MDT instituted
- Reduced wages and fringe benefits accounted for less than $6 million of the $37.5 million reduction in operating costs