

Maintenance: Vehicles and State of Good Repair





Learning Objectives

At the end of this lesson you will be able to:

- Implement proper vehicle database practices
- Identify minimum service-life standards and vehicle retirement points
- Understand the importance of healthy spare-ratios
- Rationalize extending life of vehicles due to budget constraints





Reference Materials

- Participant notebook
- Lesson 3 PowerPoint presentation
- Handout of maintenance checklist
- Handout of example service fleet





Lesson 3. Maintenance: Vehicles and State of Good Repair

WHY BE CONCERNED ABOUT MAINTENANCE COSTS WHEN THEY ARE UNAVOIDABLE?





Vehicle Maintenance is Unavoidable

- **Texas Transit Maintenance Stats (2011)**
 - Rural agencies spent 6 percent on maintenance (\$0.21 per revenue mile, \$3.82 per revenue hour)
 - State-funded urban agencies spent 18 percent on maintenance (\$0.73 per revenue mile, \$10.59 per revenue hour)





What are some activities that affect maintenance?

- Factors controlled by the agency?
- Factors beyond the agency's control?





Factors Affecting Maintenance

■ Internal

- Fleet condition
- Fleet age
- Level of transit service provided
- Preventive maintenance practices
- Contracts for maintenance

■ External

- Inclement or extreme weather
- Vehicular accidents
- Roadway conditions



Why Be Concerned about Maintenance Costs?

Table 4-1. Texas Transit District Operating Expenses by Function
(Fiscal Years 2009 to 2011).

Function	FY 2009	FY 2010	FY 2011
Operating	\$97,598,443	\$106,497,995	\$115,276,755
Maintenance	\$20,990,585	\$23,040,572	\$22,945,568
Administrative	\$18,473,477	\$20,361,563	\$21,094,627
Planning	\$2,177,011	\$2,727,457	\$2,476,197
Purchased Transportation	\$18,744,364	\$19,575,641	\$25,081,941
Transit Districts TOTAL	\$157,983,880	\$172,203,228	\$186,875,088





Activity: Identify Current Maintenance Cost-Related Practices

MAINTENANCE CHECKLIST



Maintenance Practices

- Do you benchmark maintenance performance against other peer operators?
- Do you track the number of road calls made for your vehicles by vehicle and type of issue?
- Do you periodically adjust your maintenance program due to performance or other issues?
- Do you have an annual vehicle replacement plan?
- Do you have a spare vehicles ratio of at least 10 percent?
- Do you maintain vehicle equipment according to recommended preventive maintenance schedules?
- Do you maintain a clear record (e.g., spreadsheet) of all vehicle-related data and maintenance activity?
- Do you routinely conduct spot inspections of vehicle cleanliness and operation?
- Do you monitor the performance of systems (e.g., exhaust system) for compliance with noise specifications?
- If contracted, is your maintenance provider contractually bound to adhere to preventive maintenance standards?





Lesson 3. Maintenance: Vehicles and State of Good Repair

GATHER AND USE INFORMATION TO MANAGE MAINTENANCE COSTS





Gather and Use Information to Manage Maintenance Costs

- Can be done either through paper records, spreadsheet files, or more advanced tracking software
- Determine your fleet condition by keeping an asset inventory with all notable data
- Both revenue and non-revenue vehicles should be included





Capturing Data

- *Vehicle Unit Number*: Makes the vehicle easily identifiable without having to use the VIN
- *Year Model*: Allows you to keep track of the vehicle's age
- *Vehicle Make/Model*: Helps in quickly identifying vehicles
- *License Plate*: Another quick identifier
- *VIN*: Stays with the vehicle throughout its life
- *Number of Seats*: Assess fleet mix and capacity





Capturing Data

- *Vehicle Length*: Useful in assessing fleet mix
- *Vehicle In-Service Date*: Helps determine when the vehicle's useful life will end
- *Vehicle Condition*: Based on criteria defined by your agency
- *Revenue/Non-Revenue*: Separate support vehicles from service vehicles
- *In-Service/Out-of-Service*: Helps you judge your existing fleet



Why Networking Databases Is a Good Idea

Table 4-3. Excerpt from Public Transit Services Asset Inventory Database.

Unit	Year	Vehicle	# Seats	Length	Mileage	Vehicle Condition	Status
H25	2010	Ford Senator Bus	10	21'	13,540	Excellent	In-Service
H22	2011	Ford Type III	14	22'4"	4,325	Excellent	In-Service
H23-New	2011	Ford Type III	14	22'4"	6,222	Excellent	In-Service
H24	2011	Ford Type III	14	22'4"	2,639	Excellent	In-Service
H25	2011	Ford Type III	14	22'4"	3,124	Excellent	In-Service
H26	2011	Ford Type III	14	22'4"	7,826	Excellent	In-Service
H27	2011	Ford Type III	14	22'4"	5,452	Excellent	In-Service
B17	2008	Chevy Uplander	3	12'1"	92,124	Fair	In-Service
B19	2008	Chevy Uplander	3	12'1"	92,001	Fair	In-Service
B18	2008	Chevy Uplander	3	12'1"	90,790	Fair	In-Service
B20	2008	Chevy Uplander	3	12'1"	72,447	Fair	In-Service
B21	2007	GMC Savana	14	21'	127,414	Poor	To be sold
A60	1999	Ford Van	12	17'	127,020	Poor	Sold





Vehicle Inspection Practices and Data

- Vehicles should be inspected before and after each trip
- Should a problem become apparent, operators or maintenance managers must make them known
- Vehicle condition can also be recorded in the asset-inventory database or one of its own
- Mileage-based inspections are also critical





Tracking Road Calls & Vehicle Failures

- Road calls can also be an indication of declining vehicle performance
- Monitor numbers over specified mile intervals
- Calculating the number of miles between vehicle failures can indicate larger problems





Repairs by Cost Type

- Revenue Vehicle Mechanical Failures vs. Other Mechanical Failures
- Provides a better snapshot than overall maintenance cost
- More serious repairs such as engine failures are greater factors



PTN-128 and Vehicle Maintenance

Microsoft Excel - Book3

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Texas Department of Transportation

PTN-128 Worksheet - 5311 Service Provider

West Texas Opportunities, Inc.

	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	2019	2020			
													YTD Total	Prior Year Total	Variance	1st Quarter	2nd Quarter
Hours																	
Actual Vehicle Revenue Hours													0				0
Actual Vehicle Hours													0				0
Deadhead Ratio																	
Miles																	
Actual Vehicle Revenue Miles													0				0
Actual Vehicle Miles													0				0
Deadhead Ratio																	
System Speed:																	
Revenue																	
Deadhead																	
Unlinked Passenger Trips																	
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
General Public:																	
													0				0
Other:																	
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Medical Transportation Program													0				0
5010 Elderly & Disabled													0				0
JARC													0				0
CMAQ													0				0
New Freedom													0				0
Other Contracts (Set below)													0				0
1													0				0
2													0				0
3													0				0
4													0				0
5													0				0
Average Weekly Passenger																	
Passengers per Revenue Mile																	
Passengers per Revenue Hour																	

Sheet2

PTN-128 Worksheet

Sheet3

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Utilizing PTN-128

- All urban and rural transit agencies in Texas submit operating expense information to PTN
- PTN-128 data are used to submit annual reports to FTA
- Allows transit agencies to have readily available periodic data





Maintenance Efficiency Performance Measure(s)

- Maintenance cost per revenue mile or hour
- Disadvantages of relying on cost per mile
 - Can you give example?
- Using performance measures for maintenance





Lesson 3. Maintenance: Vehicles and State of Good Repair

POLICIES, PROCEDURES, AND STRATEGIES TO MANAGE MAINTENANCE COSTS



FTA Standards for Managing Vehicles

Table 4-4. Transit Vehicle Minimum Service-Life.

	Typical Characteristics			Minimum Life		
					(Whichever comes first)	
<i>Category</i>	<i>Length</i>	<i>Approx. GVW</i>	<i>Seats</i>	<i>Average Cost</i>	<i>Years</i>	<i>Miles</i>
Heavy-Duty Large Bus	35 to 48ft and 60ft artic.	33,000 to 40,000	27 to 40	\$325,000 to over \$600,000	12	500,000
Heavy-Duty Small Bus	30ft	26,000 to 33,000	26 to 35	\$75,000 to \$175,000	7	200,000
Medium-Duty and Purpose-Built Bus	30ft	16,000 to 26,000	22 to 30	\$75,000 to \$175,000	7	200,000
Light-Duty Mid-Sized Bus	25 to 30ft	10,000 to 16,000	16 to 25	\$50,000 to \$65,000	5	150,000
Light-Duty Small Bus, Cutaways, and Modified Van	16 to 28ft	6,000 to 14,000	10 to 22	\$30,000 to \$40,000	4	100,000



Retirement Compared to FTA Standards

Table 4-5. Actual Average Vehicle Retirement.

Vehicle Category/ Minimum Retirement Age	Average Retirement Age (Years)	Share of Active Vehicles That Are:	
		One or more years past the retirement minimum	Three or more years past the retirement minimum
12 - Year Bus	15.1	19%	9%
10 - Year Bus	8.4*	7%	4%
7 - Year Bus	8.2	12%	3%
5 - Year Bus / Van	5.9*	23%	5%
4 -Year Van	5.6	29%	10%



Why Do I Need a Vehicle Replacement Plan?

- Shows accountability
- Project replacement in a given year
- Keeping vehicles useful
- Preparing for capital expenses

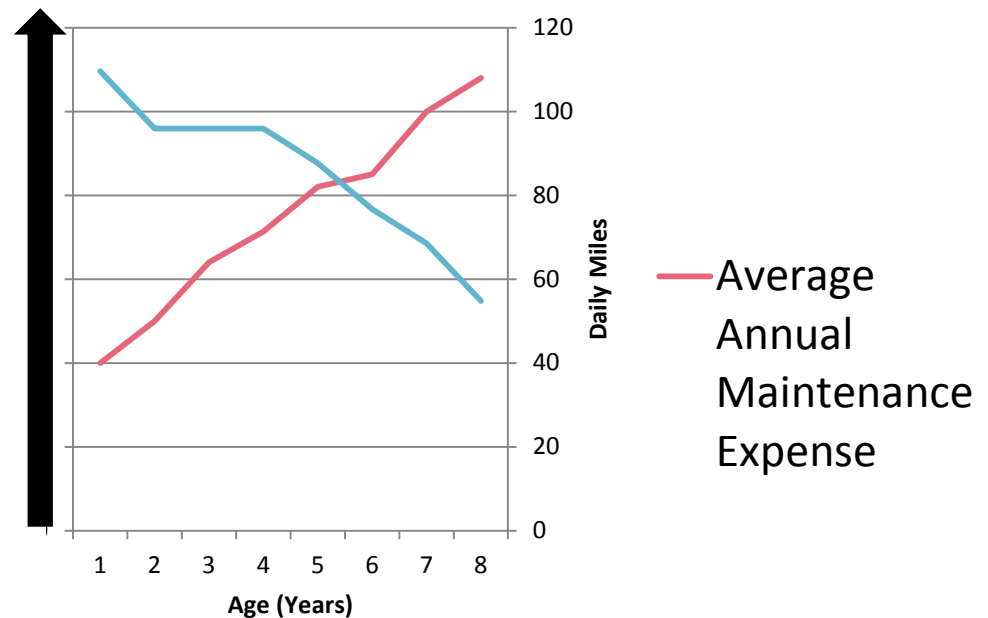


Figure 4-1. Maintenance Expense and Vehicle Usage by Age.





Activity: Replacing your fleet

FLEET DATA



Maximizing Vehicle Effectiveness

VIN	Year	Vehicle	Service Start	Service Months	Actual Mileage	Maintenance per Mile
1	2006	Aerotech	Oct-05	99	226,000	\$ 0.30
2	2010	Goshen	Nov-09	51	164,000	\$ 0.20
3	2010	Goshen	Nov-09	51	190,000	\$ 0.18
4	2010	El Dorado	Jul-10	42	116,000	\$ 0.27
5	2010	El Dorado	Jul-10	42	100,000	\$ 0.17
6	2010	El Dorado	Jul-10	42	131,000	\$ 0.15
7	2011	Senator	Oct-10	39	130,000	\$ 0.15
8	2011	Senator	Oct-10	39	97,000	\$ 0.25
9	2011	Candidate	Jun-11	31	83,000	\$ 0.20
10	2012	Candidate	Aug-11	29	80,000	\$ 0.14
11	2012	Candidate	Sep-11	28	87,000	\$ 0.14
12	2012	Ford	Sep-11	28	72,000	\$0.28

We will calculate:

- Mileage per Month
- FTA Retirement Year
- Adjusted Retirement Year

Maximizing Vehicle Effectiveness

VIN	Year	Vehicle	Service Start	Service Months	Actual Mileage	Maintenance per Mile	Mileage per Month
1	2006	Aerotech	Oct-05	99	226,000	\$ 0.30	2,283
2	2010	Goshen	Nov-09	51	164,000	\$ 0.20	3,216
3	2010	Goshen	Nov-09	51	190,000	\$ 0.18	3,726
4	2010	El Dorado	Jul-10	42	116,000	\$ 0.27	2,762
5	2010	El Dorado	Jul-10	42	100,000	\$ 0.17	2,381
6	2010	El Dorado	Jul-10	42	131,000	\$ 0.15	3,119
7	2011	Senator	Oct-10	39	130,000	\$ 0.15	3,333
8	2011	Senator	Oct-10	39	97,000	\$ 0.25	2,487
9	2011	Candidate	Jun-11	31	83,000	\$ 0.20	2,677
10	2012	Candidate	Aug-11	29	80,000	\$ 0.14	2,758
11	2012	Candidate	Sep-11	28	87,000	\$ 0.14	3,107
12	2012	Ford	Sep-11	28	72,000	\$0.28	2,571



Maximizing Vehicle Effectiveness

VIN	Year	Vehicle	Service Start	Service Months	Actual Mileage	Maintenance per Mile	Mileage per Month	FTA Retirement
1	2006	Aerotech	Oct-05	99	226,000	\$ 0.30	2,283	2014
2	2010	Goshen	Nov-09	51	164,000	\$ 0.20	3,216	2014
3	2010	Goshen	Nov-09	51	190,000	\$ 0.18	3,726	2014
4	2010	El Dorado	Jul-10	42	116,000	\$ 0.27	2,762	2015
5	2010	El Dorado	Jul-10	42	100,000	\$ 0.17	2,381	2015
6	2010	El Dorado	Jul-10	42	131,000	\$ 0.15	3,119	2014
7	2011	Senator	Oct-10	39	130,000	\$ 0.15	3,333	2014
8	2011	Senator	Oct-10	39	97,000	\$ 0.25	2,487	2016
9	2011	Candidate	Jun-11	31	83,000	\$ 0.20	2,677	2016
10	2012	Candidate	Aug-11	29	80,000	\$ 0.14	2,758	2016
11	2012	Candidate	Sep-11	28	87,000	\$ 0.14	3,107	2016
12	2012	Ford	Sep-11	28	72,000	\$0.28	2,571	2016



Maximizing Vehicle Effectiveness

VIN	Year	Vehicle	Service Start	Service Months	Actual Mileage	Maintenance per Mile	Mileage per Month	FTA Retirement	Retirement
1	2006	Aerotech	Oct-05	99	226,000	\$ 0.30	2,283	2014	2014
2	2010	Goshen	Nov-09	51	164,000	\$ 0.20	3,216	2014	2014
3	2010	Goshen	Nov-09	51	190,000	\$ 0.18	3,726	2014	2014
4	2010	El Dorado	Jul-10	42	116,000	\$ 0.27	2,762	2015	2015
5	2010	El Dorado	Jul-10	42	100,000	\$ 0.17	2,381	2015	2016
6	2010	El Dorado	Jul-10	42	131,000	\$ 0.15	3,119	2014	2015
7	2011	Senator	Oct-10	39	130,000	\$ 0.15	3,333	2014	2015
8	2011	Senator	Oct-10	39	97,000	\$ 0.25	2,487	2016	2016
9	2011	Candidate	Jun-11	31	83,000	\$ 0.20	2,677	2016	2017
10	2012	Candidate	Aug-11	29	80,000	\$ 0.14	2,758	2016	2017
11	2012	Candidate	Sep-11	28	87,000	\$ 0.14	3,107	2016	2017
12	2012	Ford	Sep-11	28	72,000	\$0.28	2,571	2016	2016





Preventive Maintenance Practices

- Establish all service intervals as multiples of a common denominator
- Consider seasonal and environmental conditions that can impact maintenance
- Include a regular schedule for washing and cleaning vehicles





Policies, Procedures, and Strategies to Manage Maintenance Costs

- Maintenance contractor oversight
 - Ensure contractor has the most up-to-date vehicle information
 - Store work orders with invoices for comparison to each other
 - Ensure maintenance supervisor has enough time to oversee operations
- Do you use a contractor for maintenance?



Policies, Procedures, and Strategies to Manage Maintenance Costs

- Fleet spare vehicle ratio

$$\text{Spares Ratio} = \frac{\text{Total Active Fleet} - \text{Peak Vehicle Requirement}}{\text{Peak Vehicle Requirement}}$$

- Should be between 10 to 20 percent
- Varies depending on specific agency needs

- Do you know your spares ratio?



Factors influencing the spares ratio

- Operating environment
- Annual bus mileage
- Bus operating speeds
- Ridership fluctuations
- Planned service/route adjustments
- Age of fleet
- Peak-to-base ratio
- Fleet mix of bus makes and models
- Road calls
- Vehicles per mechanic
- Alternative-fuel buses
- Management and finance
- Bus purchase/retirement schedule
- Inventory management
- Maintenance training





TCRP Synthesis 109

- Update of work from TCRP 11
- Survey of transit agencies of all sizes
- Looks at the effects of 20 percent spare ratio standard of agencies themselves





Challenges of Spares Ratio

- Reduced capital dollars to purchase buses
- Reduced staffing for maintenance
- Older maintenance facilities; complex vehicles
- Intermittent nature of special service
- Service reductions leading to unused fleet
- Sub-fleets: different kinds of vehicles in the fleet





Suggestions for maintaining a healthy Spares Ratio

- Work on a sustainable funding source
- Rehabilitation of aging vehicles
- Avoid large purchases of buses when possible
- Long-term contracts with a single manufacturer
- A more homogenous, uniform fleet





Review

- Why is maintaining a vehicle database important?
- Why is networking a database useful?
- What are some good maintenance practices?
- How does maintenance factor in to replacement?
- Give examples of when vehicle life should be extended.

