Maintenance Management System Fact Sheet: Transit Overview

September 2007

Technology Overview

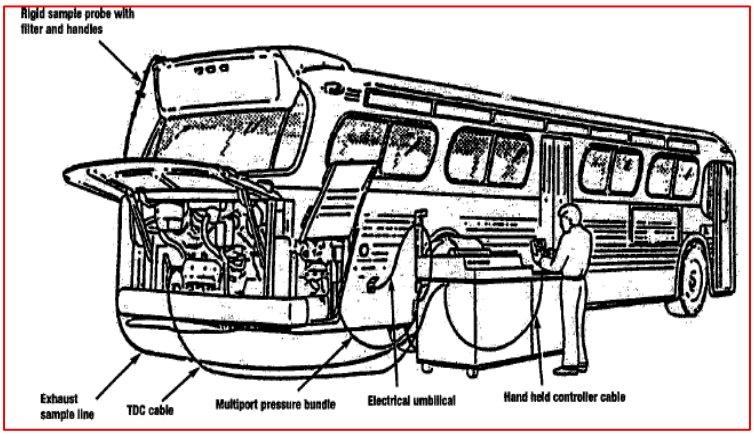
On average, transit operators spend about one-fifth of their operating budgets on vehicle maintenance. With use of new monitoring technologies paired with **Intelligent Transportation Systems (ITS)** systems such as **Automatic Vehicle Location (AVL)** or **Computer-Aided Dispatch (CAD)**, transit operators can build **Maintenance Management Systems (MMS)** to monitor everything from fuel and other fluid levels to engine temperature and to alert operators and dispatchers of failure of a transit vehicle mechanical component, such as an out-of-tolerance reading from the engine or the exhaust system. Advanced MMS can capture vehicle-operating conditions, such as temperature, pressures, and voltages, to support trend analysis for condition-based maintenance and to predict failure of parts. MMS can help managers to improve the effectiveness and efficiency of maintenance operations and ensure the use of more reliable transit vehicles.

Use Maintenance Management Systems to:

- Manage fluids on vehicles
- Alert operations managers of underperforming vehicles and parts
- Manage maintenance parts inventory
- Maintain and produce maintenance records
- Monitor and manage warranties
- Diagnose vehicle problems remotely

Maintenance Management Systems are also known as Vehicle Component Monitoriing, Automatic Vehicle Monitoring, and Maintenance Tracking.

Common Technology Combinations

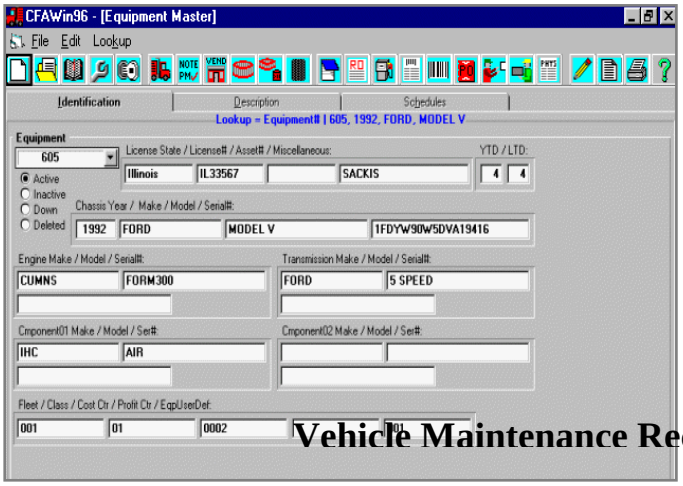


Maintenance and Repair

Automatic Vehicle Location (AVL) or **Computer-Aided Dispatch (CAD)** can be used in conjunction with Maintenance Management Systems to pinpoint vehicles that are in need of repair or are underperforming. Such preventative maintenance allows systems to run more smoothly. To enable transfering of the maintenance data, the transit agency will need to integrate the MMS on each vehicle with a radio data connection for real-time information diagnostic transmittals or a link to a garage central computer to download the diagnostic information during vehicle servicing.

Systems and Service Planning

MMS can be used to collect data about vehicle components such as brakes, electrical, and heating, ventilation, and air conditioning (HVAC) and to report and store all information centrally to a **Mobile Data Terminal (MDT)** for further use and analysis.



Vehicle Maintenance Record

Real-Time Operations

If an operational transit vehicle relays via the **radio or other communication system** that it has received an out-of-tolerance warning, then the central control may decide to continue the route using the current vehicle, replace the vehicle in the field, or reroute the vehicle along a more "tolerant" path (e.g., a flatter route for braking issues, along a shadier or less hot route for HVAC problems). The dispatch center can determine these routing or replacement options by utilizing their **CAD** and **AVL** systems and transmitting the decision on the vehicle and route to the operator via a **Mobile Data Terminal (MDT)**.

Is This Technology Right for My Agency?

Maintenance Management Systems (MMS) should be considered by officials operating ***Medium*** and ***Large Fixed Route Bus***, ***Demand Response*** and ***Human Service Transit Agencies***. MMS is very useful for all transit agencies with moderate-sized fleets and perform in-house maintenance. The remote diagnostic features of a MMS is probably not necessary for most agencies. Most MMS functions are to be utilized withing the garage environment, including monitoring the life-cycle vehicle costs and tracking inventories. The MMS for ***Fixed Route Bus Transit Agencies*** should be developed as part of their asset management system. All ***Rail Transit*** agencies should examine the remote diagnostics capabilities of the vehicle component monitoring system, but also ensure that they include a manual override of any automatic shut-down commands.

Maintenance Tracking
Core Technology By Mode

Agency Size	Transit Mode					
	Fixed Route Bus	Demand Response	Human Service Transit	Rural Transit	Rail Transit	Ferry Boat
Large	✓	✓	✓		✓	
Medium	✓	✓	✓		✓	
Small	Best use with garage record keeping	Basic maintenance database is needed for in-house maintenance			✓	

Before installing MMS in a fleet of vehicles, planning, implementation, and integration should be considered so the technology can be used to optimize the fleet's performance.

Planning

- Develop a well-structured procurement plan and performance-oriented requirements.
- Ensure adequate data storage and analysis capacity.
- Avoid proprietary interfaces between vehicle and dispatch-center components.
- Choose technologies with open standards, and develop detailed documentation.
- Ensure scalability for changes in fleet size.
- Identify vehicle capacity for additional wiring and discuss impact to available passenger space.

Implementation

- Train drivers and dispatchers.
- Hire new staff as needed to analyze data collected from vehicles.
- Test and troubleshoot to ensure that data are being gathered correctly.
- Update other technologies, such as **Global Positioning Systems (GPS)** or **communications**, as needed.

LACMTA vehicle under repair in maintenance facility

Integration

- Integrate MMS with **AVL, CAD**, or **MDTs** to track trends or changes in vehicle's status fluid levels, and engine temperature.
- Consider integration of MMS with other ITS capabilities and functions, including planning and scheduling systems.

Benefits and Costs

Benefits

Preventative Maintenance

Reduced in-service breakdowns and improved fleet capability will ensure that transit systems run more smoothly.

SEPTA has developed an integrated MMS

Centralized Data

The Southeast Pennsylvania Regional Transportation Authority (SEPTA) integrated reference manuals, purchasing, inventory control, and work-order functions into its MMS, centralizing information on vehicles at one accessible location.

Trend Analysis

Integrated systems can capture conditions such as temperature, pressures, and fluid levels and can analyze trends to predict the need for parts and service.

Costs

Price

Many transit agencies have deployed fuel dispensing management systems, a basic MMS, for as little as $15,000 per garage. A sophisticated MMS would include on-board mechanical monitoring sensors that are linked to the communications system to enable real-time transmittal of data collected to an operations control center. Such a system has cost a multi-modal agency more than $2 million to deploy.

Based on existing systems, the median deployment cost of MMS is in the area of $100,000. On-board sensor equipment and integration varied greatly between $500 and $10,000 per vehicle. Capital cost to connect the MMS to the central control / dispatch center ran between $10,000 and $50,000 per center.

Operations and Maintenance (O&M)

- O&M costs for onboard equipment average 2% of the original capital cost.
- Recurring costs can include telecom service fees.

Training

In order for an MMS to be cost-effective, fleet managers must be trained to use the information the system collects. Training of limited select staff is usually included within the full deployment cost.

Transit Agency Deployments of Maintenance Systems

Agency	Contact Information	Number of Vehicles	Context / Success of Deployment
Los Angeles County Metropolitan Transportation Authority (LAC MTA)	One Gateway Plaza Los Angeles, CA 1-800-COMMUTE (1-800-266-6883)	2,450 buses	• 100 percent of fleet equipped with onboard MMS. • Integrated with maintenance and material management systems • Powertrain alarms transmitted in real time.
New Jersey Transit (NJT)	NJ Transit Headquarters Building One Penn Plaza East Newark, NJ 1-800-772-2222	200 commuter rail cars 60 electric locomotives (also has 2,035 buses in fleet)	• Initial deployment with Rail Operations • Remote diagnostics and automatic real-time failure notification on 60 electronic locomotives. • Single-point-of-maintenance data access on all commuter railcars
Chicago Transit Authority (CTA)	567 W. Lake St. Chicago, IL 312-664-7200	2000 buses	• 100 percent of fleet equipped with onboard MMS. • Powertrain alarms transmitted in real time. • Voice annunciation system used to report health status of ITS component
Southeastern Pennsylvania Regional Transit Authority (SEPTA)	1234 Market St. Philadelphia, PA 215-580-7800	1,388 buses 1,190 rail cars	MMIS - Maintenance Management Information System - incorporates vehicle maintenance with purchasing and inventory control.
Pierce Transit (Tacoma area)	3701 96th St SW (P.O. Box 99070) Lakewood, WA 98496 253-581-8000	100 buses (total fleet – 250 buses)	Comprehensive maintenance data collection, analysis, and reporting system

Additional Resources on Maintenance Systems (and ITS)

- Advanced Public Transportation Systems: State-Of-The-Art Update 2006 (March 2006), http://www.fta.dot.gov/documents/APTS_State_of_the_Art.pdf
- A Guidebook for Developing and Sharing Transit Bus Maintenance Practices – TCRP Report 109 / Project e-5 (2005); http://onlinepubs.trb.org/onlinepubs/tcrp/tcrp_rpt_109.pdf
- Handbook of Automated Data Collection Methods for the National Transit Database (October 2003), http://www.nctr.usf.edu/pdf/473-11.pdf
- e-Transit: Electronic Business Strategies for Public Transportation (Volume 1) - Supply Chain: Parts and Inventory Management – TCRP Report 84 / Project J-09 (2002); http://onlinepubs.trb.org/onlinepubs/tcrp/tcrp_rpt_84-v1.pdf
- Understanding and Applying Advanced On-Board Bus Electronics – TCRP Report 43 / Project C-10A (1999); http://onlinepubs.trb.org/onlinepubs/tcrp/tcrp_rpt_43.pdf
- Transportation Research Board AP035 Transit Fleet Maintenance Web Board; http://webboard.trb.org/default.asp?BoardID=17&action=0 (Scope: This committee is concerned with all maintenance aspects of public transportation fleets, including heavy rail, light rail, bus, paratransit, and new technology fleets.)