*A3C02: Committee on Transit Fleet Maintenance*
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# Transit Fleet Maintenance

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The transit fleet maintenance community is positioned to make some significant advances in the new millennium. Changes in technology offer much potential for supporting both traditional management activities and some equipment capabilities that have recently become available. However, benefits will be realized only after successfully navigating some significant challenges. Ironically, the tendency is to view the technology itself as a key challenge but, how fleet maintenance managers align their organizations in adapting to technology probably will determine the extent of any advances. One key conclusion of a recent study was that the success of a maintenance organization would depend on its ability to adapt to change (*1*). The fleet maintenance community views this process as a partial catalyst to discussions about the development of a fleet maintenance research agenda.

In documenting challenges to the fleet maintenance community in the new millennium, we very quickly realized that they do not fall into neatly defined categories by subject or age, but frequently depend on—or directly affect—each other. Challenges include narrowing long-standing information gaps, managing maintenance costs, adapting the organization to changes in technology, and modifying preventive maintenance programs.

## MAINTENANCE INFORMATION

The need for the detailed and accurate recording of maintenance activities and resources has long been recognized. Because of the trend toward more powerful processing technology at continually decreasing costs, there never has been a more exciting opportunity to make significant advances. Fleet managers now are able to fully support the development and implementation of basic record-keeping systems. However, every strategy for improvement is accompanied by a challenge. The challenge of this situation is to consider the business processes that must be in place to generate the data needed to produce information. This basic requirement of successful fleet management can be met by using an integrated fleet management system. With the right information readily available, fleet managers will have significant opportunities to improve the way they work in the new millennium.

## Integrated Maintenance Management Information

Traditionally, the information required to manage a fleet of vehicles was derived from observations made at the maintenance facility: mileage, consumables, operator defect cards, and other data. Today, advanced technology allows vehicles to generate and store observations about itself. The state of the art, with respect to information integration, incorporates both traditional maintenance information and state-of-the-art on-board-generated data. Although the technology itself is readily available, the challenge will be to integrate the data, then restructure people's daily work activities to take advantage of the gathered information.

### *Traditional Maintenance Information*

The state of the practice is improving, as evidenced by an effort under way at the Southeast Pennsylvania Regional Transportation Authority (SEPTA) (*2*). One recent effort incorporated maintenance reference manuals, purchasing, inventory control, and work-order functions into an integrated maintenance management information system (MMIS). Work is in progress to incorporate the fuel management system so they can measure real-time consumable usage. More importantly, cumulative vehicle mileage will be recorded as part of the fueling function, which will provide the basis for both an incremental preventive maintenance program and mileage-based productivity analyses.

### *On-Board Information*

Much of the effort in incorporating on-board data collection revolves around developing a standard data communications protocol. Although such a discussion is beyond the scope of this article, it is a challenge to the overall effectiveness—and integration—of any MMIS considered for implementation in the new millennium.

## Information Availability

To be useful, real-time information must be available to mechanics and supervisors on the shop floor as well as to analysts and managers. This feature is key to the SEPTA MMIS. However, pushing information down into the organization implies a commensurate level of empowerment to make decisions. One related challenge is the degree to which the organization is willing to decentralize decision making, thus giving more say to both the mechanical and the first-line supervisory staffs.

## Better Decision Making

Fleet maintenance managers will be in a position to make better decisions in the new millennium. Access to information, the ability to develop a strong business case, and the skills needed to implement change will help managers by improving their abilities in the following areas:

- Finding adequate staff time to plan, design, and implement major investments. (Simply running the operation consumes most available resources.)
- Evaluating the necessary trade-offs during the design, and subsequent purchase, of replacement vehicles. (The key here is to strike a balance between the complexity of the vehicle and the ability of the workforce to maintain it.)

- Breaking away from traditional management practices toward more inclusive approaches.
- Establishing a basis for developing job standards.
- Benchmarking with other organizations.
- Evaluating cost-effectiveness as a function of vehicle age.
- Making a more rational case for fleet replacement.

## MANAGING COSTS

The availability of funding makes the implementation of cost-control strategies more important than ever in maximizing the use made of each available dollar. With the dependence on *subsidies* (the italics are deliberate until such time as the true cost of public transport is addressed by all concerned), there will be an increasing demand to justify the cost to the public purse of transit provisions as more demands are made on local resources. The value to the operator of being able to undertake this type of analysis, underpinned by defensible cost data, is in the ability to undertake "what-if" analyses that clearly demonstrate the negative impact of not receiving adequate funding.

Changes in the availability of maintenance information in the new millennium will readily support several techniques for managing maintenance costs.

### Life-Cycle Costing

Life-cycle costing looks at the initial capital expense, maintenance and operating expenses over the fleet's useful life, and the eventual expense to replace the fleet. Because this technique is highly dependent on a history of accurate data, it is a valuable tool (and is most commonly used) in making cost-effective decisions about whether to repair, overhaul, or replace a series of vehicles. Life-cycle costing is an effective alternative to low-bid procurement. Although it is the most appropriate method of making this kind of decision, challenges to using it include

- The availability of accurate data,
- The willingness of manufacturers to share data about the useful life of components,
- The need to develop a common data structure to make industry-wide comparisons, and
- The extent to which local management philosophy plays a role.

### Activity-Based Costing

One challenge to the industry is to continually adapt to change. Accomplishing this task requires a method for evaluating the activities that make up the fleet maintenance processes. Activity-based costing is used to generate a basis against which proposed changes in individual maintenance activities are evaluated. This analysis is structured in the form of a business case that simply compares the benefits of the proposed changes against the costs of not making them. If the proposed changes generate a savings, then process modifications are recommended. If the proposed changes do not bring about cost benefits, then no change is justified at present. This is the essence of business process reengineering. Activity-based costing would be a key analysis tool in developing work methods and standards that would, in turn, be supported by the increased availability of maintenance information achievable in the new millennium.

### Incremental Cost and Benefit Analysis

One important aspect of cost analysis is evaluating the incremental effects of changes in resource inputs needed to generate improvements in output. For example, most organizations use vehicle availability as an indicator of fleet performance. The annual goal process usually focuses on a desired improvement—say, from 90 percent to 95 percent. However, it should be clear which resource inputs are necessary to achieve the desired output, because the life-cycle cost implications may not be cost-effective.

## UPGRADING TECHNOLOGY AND SKILLS

The increasing use of electronics and more sophisticated systems (e.g., electronic engine controls, multiplexing, and vehicle location systems) demands new, enhanced tools and skills for vehicle maintenance. Such requirements must be assessed and addressed before new vehicle purchases are finalized. They are, in fact, add-ons to the purchase price and can potentially reduce vehicle availability and, hence, revenue.

A study released in 1998 identified two key challenges facing transit mechanics and supervisors: changes in technology and a more decentralized, flexible work organization (*1*).

### Changes in Technology

A continual training process is necessary if an organization intends to keep pace with changes in technology. One challenge to the fleet maintenance community is to get the existing workforce to make the continued shift. Simultaneously, managers are challenged to keep the interest of new employees who may already be comfortable with the technology yet have to function in an organization where it is only beginning to evolve. The challenge to the industry, then, is to bring the existing workforce up to par with the required skills, modify the selection criteria used in recruiting new employees, and then implement a strategy to manage that part of the workforce unable to make the transition. Incentives will almost certainly play a role here.

### Changes in Organizations

The same 1998 study (*1*) outlined why changes in fleet maintenance organizational structure were required. Among the reasons was the need to establish a direct relationship among desired performance, workforce skills, and the reward system. Relating these factors will be a major challenge, because in many cases, this task will have to be accomplished in a union environment, where reward traditionally is based on seniority and is intentionally unrelated to skill and performance.

### Alternative Fuel Implications

From a fleet maintenance perspective, the challenge of alternative fuel vehicles is to fully understand the maintenance implications and how these vehicles differ from the existing fleet. It also is important to understand the life-cycle capital and operating costs before making an informed decision. As more and more organizations implement alternative fuel programs, the continued development of the knowledge base will support fleet maintenance managers in making effective decisions.

*Workforce Skills*
Although the skills necessary for maintaining conventional diesel engines are relatively transferable, this is not necessarily the case with alternative fuel vehicles. The fleet maintenance community will improve its ability to implement alternative fuel programs by focusing on some of the strategies used for adapting to technology that were outlined earlier.

*Maintenance Activities and Cost Implications*
Federal, state, and local regulations play a large role in the evolution of maintenance activities required to support fleets of alternative fuel vehicles. This challenge will be met by fleet managers who have a good understanding of the life-cycle cost implications of the alternatives.

## PREVENTIVE MAINTENANCE

The industry faces several challenges to realizing the benefits of a preventive maintenance regime—for example, reduced in-service breakdowns, improved fleet availability—including

- Standardizing work methods and procedures,
- Persuading operators and manufacturers to share information about vehicle performance,
- Adhering to written policies, and
- Providing access to proper facilities and equipment.

Finally, the state of the practice is evolving, as witnessed in several interesting trends.

### Standardization

The trucking industry is currently developing standard maintenance procedures, mainly in the form of time standards for certain activities. Standards would not only serve a purpose in the management of traditional bus and subway fleets, they also would be particularly valuable in establishing new starts.

Standards are also useful in

- Evaluating actual performance,
- Determining the need for training,
- Assessing the need for tools,
- Establishing preventive maintenance activities for new fleet procurements,
- Performing time-series analyses, and
- Benchmarking.

Challenges to the transit industry include adopting standards that are meaningful enough to use and flexible enough to adapt across fleets of different sizes, under different operating conditions, with different management philosophies.

### Industrywide Information Exchange

Several methods of information interchange are valuable for disseminating information among fleet maintenance managers.

*Transit Cooperative Research Program*
Any discussion of the state of the practice must reference the Transit Cooperative Research Program (TCRP). The TCRP synthesis series is designed to quickly spread information about best practices on various topics of interest to transit fleet managers and others. Its reauthorization as part of the Transportation Equity Act for the 21st Century ensures that TCRP will continue to play a key role in transit fleet management in the new millennium.

*Internet*
Never has there been a more exciting mode of communication than the Internet. Websites and bulletin boards exist in many areas of interest to fleet managers. Slowly but surely, more organizations are gaining access to the Internet. It is only a matter of time before almost anyone can benefit from it. Fleet maintenance managers are beginning to recognize the enormous potential of the Internet.

**Walking the Walk**
Fleet maintenance managers will have an unprecedented opportunity to realize the benefits of preventive maintenance policies that have been in effect but, because of challenges outlined earlier, difficult to implement. Again, the availability of better maintenance information will play a major role in this area.

**Replacement Part Availability**
The availability of spare parts and their timely delivery are basic needs for the efficient operation of a transit fleet. Both the absolute availability of spare parts—especially where current manufacturers are ceasing production or new suppliers are based overseas—and the development of automated parts-procurement systems are particularly important. The use of bar coding of spare parts should be actively pursued.

**Trends**
Several programs illustrate recent trends in preventive maintenance. The first two trends tie preventive maintenance directly to the quality of service delivery to motorists. The third trend shows how a pilot overhaul program is being used to channel revenue back into the organization.

*Integrating Preventive Maintenance Services with Vehicle Procurement*
The state of the practice of at least one manufacturer of commuter rail equipment is to offer preventive maintenance services as part of the original procurement contract (*3*). The goal of the program is to eliminate equipment problems before they affect service to the commuters. This particular firm uses a state-of-the-art MMIS to track the quality of the program.

*Minimizing the Effects of Vandalism*
Graffiti and vandalism are inevitable on public transportation vehicles, especially in large cities. Spray paint, markers, and implements that etch glass and metal are among the more common materials used. Two ways to combat graffiti and vandalism are the immediate removal of the “tag,” as it is known, and on-board video surveillance, which is used both as a deterrent and in prosecuting offenders. One such program, implemented in 1998 by the

Chicago Transit Authority (CTA), is known as Operation Clear View (*4*). CTA deters vandalism and replaces damaged windows to keep buses in good repair, which, in turn, is important to its customer base.

*Leveraging the Resources of an Overhaul Program*

The Washington Area Metropolitan Transit Authority (WMATA) is piloting an innovative mid-life overhaul program designed to extend the useful life of each bus and bring the fleet into compliance with emissions standards (*5*). More importantly, WMATA has made the service available to other transit properties. This program allows WMATA to share its expertise with others while generating revenue for the organization.

## CONCLUSION

Although some significant challenges will face the fleet maintenance community in the new millennium, never has there been the potential to make such significant gains. One of the more critical skills of a maintenance manager will be the ability to view issues in a new light. Technology is too often seen as the culprit, when the key issue really may be the organization's ability to adapt. To this end, shifting the focus of the organization from mechanical to electronic and diagnostic will be important in the new millennium.

## REFERENCES

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