Research and Training of Private Transportation Providers for the Efficient and Effective Provision of Public Transportation Services

Final Report—June 2004

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MTC
MIDWEST TRANSPORTATION CONSORTIUM

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The Midwest Transportation Consortium (MTC) is housed at the Center for Transportation Research and Education (CTRE) at Iowa State University. CTRE's mission is to develop and implement innovative methods, materials, and technologies for improving transportation efficiency, safety, and reliability while improving the learning environment of students, faculty, and staff in transportation-related fields.

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16. Abstract

A considerable portion of urban public transportation is provided by private transportation operators. Overall, 1.8% of urban transportation research/training dollars are spent on research and training needs of the privately provided public transportation sector. The imbalance is striking considering the amount and type of urban public transportation service offered by the private sector. Private providers offer most of the service for special sporting events and the majority of the tourism transportation, and they also generate significant employment when all aspects are taken into consideration.

The objectives of this project were to undertake research and training programs that support more efficient and effective public transportation services from both the public and private sectors with the purpose of sharing findings and providing recommendations to the large number of private transportation officials engaged in providing public transportation.

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RESEARCH AND TRAINING OF PRIVATE TRANSPORTATION PROVIDERS FOR THE EFFICIENT AND EFFECTIVE PROVISION OF PUBLIC TRANSPORTATION SERVICES

MTC Project 2001-03

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EXECUTIVE SUMMARY

Through a cooperative agreement with the Taxi, Limousine, and Paratransit Association and support through the MTC Research & Training Grant DTRS99-6-0007, the Center for Transportation Studies was able to devote considerable time and effort to the research and training of private transportation providers for the efficient and effective provision of public transportation services. This work consisted of the research and development of a series of industry seminars with the purpose of sharing findings and offering recommendations to the large number of private transportation officials engaged in providing public transportation.

The topics for the seminars were selected on the basis of surveys and an understanding of the most important issues and concerns in the industry. Over the course of two years, these seminars were given on the topics of marketing, maintenance, dealing with the media, human resource development, and technology innovations. Seminar attendees were able to learn best practices and share experience on issues involving the human resources management, dispatching technologies, relation with media, sales and marketing, or fleet maintenance.

1. INTRODUCTION

1.1 Problem Statement

There is considerable funding for transportation research in the United States. In 2001, we were spending approximately $110 million per year for mass transit research. The funding for publicly provided transportation research is considerable. We are funding research on every aspect of public transportation (mass transit, rail, and bus). We support research and training on vehicles, drivers, asset utilization, planning, facilities, future modes, marketing, and general management. Most, if not all, of this University-centered research is aimed at publicly provided transportation. However, a considerable portion of urban public transportation is provided by private transportation operators. Suggesting that this significant portion of urban public transportation is going under-researched is a vast understatement. Overall, 1.8% of urban transportation research/training dollars are spent on research and training needs of the privately provided public transportation sector. The imbalance is striking considering the amount and type of urban public transportation service offered by the private sector. Private providers offer most of the service for special sporting events and the majority of the tourism transportation, and they also generate significant employment when all aspects are taken into consideration.

1.2 Research Objectives

The objectives of this project were to undertake research and training programs that support more efficient and effective public transportation services from both the public and private sectors with the purpose of sharing findings and offering recommendations to the large number of private transportation officials engaged in providing public transportation.

1.3 Report Organization

This report will present summaries of each of the research initiatives undertaken by the Center for Transportation Studies, including literature reviews, surveys, and seminars. Materials cited in this document are available in the Appendices.

2. LITERATURE REVIEW

2.1 Background

Thanks to technology, maintenance facilities can cater to buses, motor vehicles, trucks, etc. Facilities are designed to consider every maintenance activity, from dispensing transmission fluid to rebuilding an engine. The transit fleet management community is positioned to make some significant advances in the new millennium.

2.2 Summary

2.2.1 Fleet Management Solutions

Maintenance is a complex activity involving such variants as equipment, statistics, cost administration, productive activity, and business. These variants must be well administered in order to be efficient. In the past, maintenance decisions have been limited to the kind of action to use (corrective or preventive) and to the definition of such variables as best frequency, best predictive technique, and best information organization. Today, due to the changing role of fleet management and maintenance, decision-makers must also consider the coordination of the human, physical, logistical, and logical structures of maintenance, which in turn must be combined with previous variables to create an integrated administration. The role of the fleet manager has expanded from “fleet only” to total maintenance management. The research paper generated from research on this topic is named *Fleet Management Solutions* and is available in the Appendix A of this report.

2.2.2 Maintenance Facility Report

With the same purpose of sharing findings and offering recommendations to the large number of private transportation officials engaged in providing public transportation, the objective of this research was to provide a design prototype for small and medium fleet motor vehicle maintenance facilities. The synthesis was intended for use by taxi, limousine, and paratransit facility design consultants and engineers in determining the basic requirements for the design of a fleet maintenance facility.

The report suggests which features in particular need to be taken into consideration when designing fleet motor vehicle maintenance facilities. For example, a common problem found in single roof facility designs is that the engine exhaust from the parking area seeps into the general office area. Increasing exhaust capacity and installing a positive exhaust system may be a method of avoiding this problem. The research paper generated from research on this topic is named *Maintenance Facilities Report* and is available in the Appendix B of this report.

2.3 Conclusion

While there is a number of articles and technical publications for public transit fleet maintenance and facility programs, similar literature is rarely available for the private, for-hire, segment of the public transportation industry.

3. RESEARCH METHODOLOGY

3.1 Introduction

The survey was distributed in an effort to research the types of marketing available to a taxicab company, the negative publicity a taxi company might receive, and the amount of money a taxi company should spend on marketing and communication.

3.2 Survey Design and Data Collection

A questionnaire was developed and sent to 702 TLPA members via U.S. mail. The mailing list was provided by the TLPA. The response rate of 15.2% indicates that 107 members out of 702 responded fully to the survey.

3.3 Data Analysis and Results

Two major findings of the survey were the types of marketing that taxicab companies use the most and the types and amount of negative publicity taxicab companies receive.

3.4 Conclusions

There is a tremendous lack of marketing activity and knowledge within the private sector, for-hire, and public transportation industry. Only the largest of these firms engage in developing and supporting an active marketing program.

4. SEMINARS

4.1 Introduction

Each seminar was created with the purpose of providing insight and guidance for an industry that has gone through tremendous changes over the past few years.

The list of seminars included the following:

- Maintenance
- Sales & Marketing
- Human Resources
- Dealing with the Media
- New and Emerging Options in Dispatching Technologies

4.1.1 "The Maintenance"

"The Maintenance" seminar was held on May 16–18, 2001, in Pomona, California. The focus of this seminar was maintaining vehicles for efficient operation and profitability. Better use of assets through efficient maintenance means less service interruptions due to breakdowns and less missed trips due to extended vehicle downtime. Maintenance also influences the quality of customer service. Clients expect on-time service and choose to avoid unclean and uncomfortable looking vehicles. Preventive maintenance is essential to stay competitive and should be considered in four areas, as follows:

- Condition-based maintenance (identify imminent failure)
- Fixed-mileage maintenance
- Operate-until-failure maintenance (only for components with no safety impacts and without a direct relationship to miles traveled)
- Design-out-maintenance (modify a component or possibly an entire system, possibly with the help of the manufacturer)

Private transportation companies put different weight on each of these methods, sometimes choosing to use only one of them. A combination of methods is a better option, creating several levels of maintenance service.

4.1.2 "Sales and Marketing"

This seminar was held on May 29–31, 2002, in Orlando, Florida. The focus of this three-day seminar was to examine sales and marketing practices as applied to taxicab livery and paratransit industries. This course discussed marketing strategies, market research, sales techniques, and business positioning.

4.1.3 "Human Resources"

Employee lawsuits have become a very common occurrence in industry today, and their frequency is growing daily. Transportation businesses need to know how to protect assets they have built and to avoid costly and foolish mistakes. This seminar, held on May 7–9, 2003, in Orlando, Florida, focused on identifying new approaches to human practices in the workplace. The seminar covered a wide array of topics, such as unions, independent contractor status, sexual harassment, and religion in the workplace. It was an opportunity for the members of taxicab, limousine, and paratransit industry to discuss the legal, political, and practical aspects of dealing with employers and independent contractors. Most of the course was lead by attorneys Jim Foster and Geoff Gilbert of the law firm Mc Mahon, Berger, Hanna, Linihan, Cody & McCarthy, who provided significant and practical advice on a host of issues.

Conference participants rated the course from one through five, with five being the highest score. Overall, the seminar was given a rating of five.

4.1.4 "New and Emerging Options in Dispatch Technology"

Ground transportation companies incur extremely high labor costs handling telephone calls from customers for service, status checks, and other similar functions. Moreover, many firms miss revenue opportunities when their dispatch operations are unable to handle high volumes of calls. Some calls become abandoned–callers who, after waiting on hold for lengthy periods, hang up the phone and call another firm or forego service altogether. Poor customer service often results in a permanent loss of customers.

"New and Emerging Options in Dispatch Technology" was held in San Diego on September 8–10, 2003. The seminar provided information on the latest computerized dispatching technology to relieve the problem of abandoned calls through the use of GPS, cell phones, palmtops, and other advanced mobile data terminals. It included roundtable discussions with industry suppliers on how these technologies apply to companies of varying sizes. Attendees learned detailed information on capital and operating costs as well as innovative ways to finance these new technologies.

4.1.5 "Dealing with the Media"

"Dealing with the Media" was held on November 17–19, 2003, in Baltimore, Maryland. This seminar provided participants with skills essential for responding to media requests and significant public issues faced by industry members. A portion of the training addressed delivering memorable key messages before local regulatory boards or city council hearings. Participants learned media techniques that are aimed at achieving the effect of "call-outs" on the printed page and at creating great sound bites for television or radio.

In addition to building skills for managing with the media and public opinion, attendees participated in sessions designed to heighten awareness of the need to fit their firms into the community through participation in social and political events. Examples of what other successful firms within the industry have done were provided and reviewed.

As a service to the industry, a short video was made of the first seminar (available at http://www.umsl.edu/depts/cts/public.html).

4.2 Seminar Evaluation

Each of the seminars involved a course evaluation and review of the applicability of the materials presented and discussed. Attendees gave superior ratings to all of the seminars, with averages ranging from 4.7 to 5.0 on a 5-point scale on attributes dealing with the seminars' effectiveness.

Typical comments received included the following:

> "I came to this H.R. course hoping to come back with even just two or three useful information tolls, and some knowledge. What I got what so much more than ever expected. Three days was long, but it went by filled with so much useful information. I think we (students) kept them longer than scheduled, and it was also fun. This by far has been the most informative, lively and friendly course." D.J. Varela, Clearwater Yellow Cab

> "My experience was very good. Ray's knowledge and experience in the industry is second to none. He's able to explain complex issues and ideas in practical terms." Michael Massimini, anonymous company.

5. CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

Seminar participants indicated there were no other venues whereby they would obtain this type of training and knowledge.

5.2 Recommendations

The Federal Transit Administration might consider the funding of future seminars for the private, for-hire, and public transportation industry, and that these seminars include local regulators of private transportation providers.

APPENDIX A. FLEET MANAGEMENT SOLUTIONS

Fleet Management Solutions

Prepared for:

The Taxicab, Limousine, and Paratransit Foundation

By

The Center for Transportation Studies at the University of Missouri-Saint Louis

Under Sponsorship from Midwest Transportation Consortium

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FLEET MANAGEMENT SOLUTIONS

Introduction

Maintenance is a complex activity involving such variants as equipment, statistics, cost administration, productive activity, and business. These variants must be well administered in order to be efficient. In the past, maintenance decisions have been limited to what kind of action to use (corrective or preventive) and to the definition of such variables as best frequency, best predictive technique, and best information organization.[1] Today, due to the changing role of fleet management and maintenance, decision-makers also must also consider the coordination of the human, physical, logistical, and logical structures of maintenance, which in turn must be combined with previous variables to create an integrated administration.

Maintenance may be seen as a group of interrelated structures that share the common objective of supporting and/or executing actions to maintain or repair.[1] In the case of fleet vehicles, the variants are even more evident.[2] Factors such as size, responsibility of the task carried out, fleet complexity, market characteristics, and competition level vary markedly from one activity branch to another, or even from among geographical areas.

Traditionally, the information required to manage a fleet of vehicles has been derived from observations made at the maintenance facility, utilizing mileage,

[1] Frederico Freire de Carvalho Matos, (2000) " Methodology for Planning Fleet Maintenance Systems"
[2] Dolce, J., (1998) "Analytical Fleet Maintenance Management." SAE 2° ed. USA

consumables, operator defect cards, and other data.[3] Today, more advanced technology allows vehicles to generate and store observations aboard the vehicles themselves. In this report we discuss some cost-effective technological solutions available to help fleet managers better manage their facilities.

Changing role of fleet managers

New organizational structures and expanded computing options have dramatically changed the nature of fleet management. Twenty years ago, maintaining equipment was generally the only responsibility that the maintenance manager had, and he did this within a budget allocated to him by upper management.

Today, the role of the fleet manager has expanded from "fleet only" to total maintenance management.[4] Fleet managers must not only complete tasks but must also take responsibility for outcomes. The role of a fleet manager has changed:

- From operations specialists to marketing and communications experts
- From hoarding resources to sharing resources
- From a total focus on cost to total customer satisfaction
- From viewing departments as separate entities to embracing cross-functional responsibilities and outcomes
- From a focus on downtime to one on reliable availability
- From shop mechanic to computer technician
- From total ownership of all equipment to the maximization of capital and technology

[3] Abrams E., Hide H., Ho L., McKnight C., O'Sullivan J., Price J., Schiavone J., Stark S., Venezia F.; (2000) "Transit Fleet Maintenance", Transportation Research Board publications

4 Nelson, P. (2000) "Reengineering Fleet Management" TRB Transportation Research E- Circular E-C013

- From owning and operating all fuel sites to a combination of strategies, including the universal card
- From outsourcing warranty work to becoming certified to do it "in house"

In order to keep up with their changing roles and that of technology in fleet maintenance management, fleet managers have had to adopt a systematic approach toward planning maintenance systems, with the objective of optimizing the different aspects involved in maintenance.

Planning maintenance management systems

Planning for fleet maintenance management systems begins with analyzing the requirements of the company (the operational requirements of the vehicles and the needs of the organization) with regard to fleet maintenance.[5] These requirements further translate into technical objectives to be met by the planned system. Several different characteristics are analyzed: the organization, the vehicles, and operation conditions. While assessing the needs of the company, the following parameters need to be considered: environmental demand, commitments to punctuality, supply chain, quantity demand, security requirement, and human resource management.[6]

After analyzing the requirements of the facility, the fleet manager establishes a general idea of the functions and functional flow necessary for fleet maintenance involving, for example, inventory and parts ordering, scheduling for preventive maintenance, etc. Furthermore, each function is analyzed based upon available solution alternatives: manual or computerized management system, basic category of maintenance

[5] Frederico Freire de Carvalho Matos, (2000) " Methodology for Planning Fleet Maintenance Systems.
[6] Riis JO, Luxhoj JT, Thorsteinsson U (1997) " A Situational Maintenance Model." International Journal of Quality & Reliability Management v. 4

(regular inspections, corrective maintenance or preventive maintenance) and the basic repair functions (from non repair to complete repair of the vehicle).[5]

Finally, a fleet management solution is designed or chosen based on manual or computerized management options. Some aspects that need to be considered while choosing a computerized management solution are:

- Functional requirements that need to be met
- Cost effectiveness
- System flexibility
- Ease of use; and
- Training requirements and flexibility.

Computerized fleet management solutions

Fleet management incorporates many of the vehicle-based APTS (Advanced Public Transportation Systems) technologies and innovations for more effective vehicle and fleet planning, scheduling, and operations. It focuses on the vehicle by improving the efficiency and effectiveness of the service provided (the "supply side"), as well as on passenger safety. By making transit more efficient and reliable, it should be more attractive to prospective riders, transit operators, and the municipalities that are served.[7]

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 has never been a more exciting opportunity to make significant advances. Increasing numbers of fleet

[7] Casey, R., Labell L., Holmstorm R., LoVecchio J. (1996) "Advanced Public Transportation systems: The State of art", update '96, Federal Transit Administration

maintenance organizations are using computerized fleet management solutions (62% of fleet maintenance facilities use fuel management programs).[8] Explanations for this practice include:

- Information availability: Computerized fleet management (with the help of the internet) allows real-time information to be made available to mechanics and supervisors on the shop floor, as well as to analysts and managers.
- Better decision-making: Fleet maintenance managers are in a position to make better decisions, if given the access to required information.
- Allows fleet managers adequate staff time to plan, design, and implement major investments. Simply running the operation consumes most available resources.
- Automation also allows fleet managers to evaluate 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.
- Fleet management systems help managers evaluate cost-effectiveness as a function of vehicle age.[9]

Fleet management systems allow for planned and scheduled maintenance. Planned or scheduled maintenance is considerably less expensive than running repairs performed in response to in-service failures. Industry consultants estimate that planned maintenance can effectively reduce per-incident maintenance costs by 50%. Shops that

[8] http://www.fleet-central.com/bf/fuel/stats.htm

[9] Abrams E., Hide H., Ho L., McKnight C., O'Sullivan J., Price J., Schiavone J., Stark S., Venezia F.; (2000) "Transit Fleet Maintenance", Transportation Research Board publications

take a proactive approach to this work by proper planning and scheduling can improve overall productivity by as much as 15% to 20%.[10]

There are many computerized fleet maintenance/management solutions available in today's market, providing such services as: maintenance programming and scheduling, work order management, fuel management, cost management, inventory management, warranty management, and human resource management.

Today's fleet management systems have evolved into powerful, high-tech tools that impact both the day-to-day operation of a maintenance department and the overall performance of a transit agency.[11] Fleet financial data once important only to the accounting department is now generating profit-and-loss information at the repair-shop level. Data that was once difficult to access is now at one's fingertips and can easily be manipulated into a variety of management formats.

Along with this accessibility has come the ability to analyze data, through querying the database for all sorts of information, resulting in big-picture, life-cycle cost figures as easily obtained as the cost of a single oil filter. Meanwhile, integrated features like shop-floor bar-coding and automated fueling systems not only increase system ease of use, accuracy and timeliness of data being collected, they also boost workplace productivity along with the quality of the work.[11]

[10] http://www.richer.ca/Enrich_overview.htm
[11] Paulits J., (1999) " Transit agencies turning to fleet management systems for tighter cost control", Mass Transit

Comparison Table

The table below compares some of the available software solutions, based on the range of desired services provided. An overview of the four software programs and their components follows.

Software / Services	Enrich Fleet Management System	AutoManager-Lite	RTA Fleet Management Software	Vehicle Tracker by Squarerigger
Preventive maintenance	+	+	+	+
Materials/Parts/Inventory management	+	+	+	+
Fuel management	Optional	+	+	+
Work order management	+	?	+	+
Reporting/Budgeting (Cost management)	Optional	+	+	+
Human Resource management	Optional	N/A	N/A	+
Time keeping	Optional	N/A	+	+
Accident management	+	+	N/A	N/A
Software Package Price	N/A	$4400-6900	N/A	$2100-7150

❖ "Enrich Fleet Management System" from Richer Systems Group

Target Audience: medium to large fleet size maintenance facility

Package Includes:

1. Core system for preventive maintenance
2. Integrated applications to manage vehicles, equipment, and component parts

(Optional modules available at additional cost)

THE CORE PROGRAM

Preventive maintenance

Enrich provides the capability of recording and acting on any measurement applicable to the transportation industry.

Potential pre-defect triggers include:

- Brake pad thickness to trigger impending brake job
- Engine oil analysis to trigger engine repairs prior to failure
- Tire tread depth to signal rotation or replacement
- Engine ECM fault codes to identify defects
- Fuel economy deterioration to trigger maintenance

Warranty recovery

The system will advise technicians and supervisors about warranties in effect for work being performed on a vehicle and/or component and automatically generates recovery

letters, and calculates all costs incurred, including replacement and/or repair of the part, and the labor involved.

Parts and inventory optimization

A perpetual on-line inventory control system keeps track of all parts at all sites and the automatic updates saves data entry time and improves the accuracy of inventory tracking.

On-line vehicle history/repair assistance

The program maintains complete information on each vehicle and its component parts. Technicians can view images of parts or consult repair manuals from within the on-line work order screen.

Work order management

Enrich generates work orders for scheduled planned maintenance, work orders for parts rebuilds, and on-demand work orders for unscheduled maintenance and repairs. Each work order records the parts, labor, and material costs associated with each separate task on the work order.

OPTIONAL MODULES

- Asset Management
- Lease Rental
- Fuel Tax / Fuel Billing
- Payroll
- Human Resources
- Electronic Time Keeping
- Ad Hoc Report Writer
- Financials

Further information can be accessed at their website, *www.richer.ca*

❖ "AutoManager-Lite" from eFleet

Target Audience: Smaller fleets - 20 to 250 vehicles.

Package includes: All listed modules. Price is based primarily on size of fleet.

CORE MODULES

Vehicle Management

Displays summary information on vehicle servicing, driver history, financing, and performance details. The Vehicle Management module also stores all fuel card details. Including products approved for purchase and odometer/PIN prompts.

Cost Management

Provides the Fleet Manager with control of servicing, repairs, fuel and financing costs. Cost Management stores line-by-line invoice detail and maintenance history for each vehicle.

Fleet Reporting suite

Customized reports can also be created within the system, using the AutoManager 'Query Wizard'. This can be used for viewing or printing records from the system. AutoManager also has an 'Export' facility. This means you can export any data to other systems, such as Microsoft Excel and Access.

Fuel Management

Allows for the electronic import of transactions from your chosen fuel suppliers.

Accident Management

Process and store insurance details, claims history, third party details, repair details, and records required actions and notes. Accident Management provides the Fleet Manager with comprehensive reporting for accident analysis.

Driver Management

Stores all Driver Details, and allows for the allocation of Drivers to Cost Centers or Company Divisions providing extensive Cost Center analysis and FBT Reporting.

PRICE

50 vehicles or less: $4400.00; 51 - 100 vehicles: $5500.00; 100+ vehicles: $6900.00. All prices are inclusive of GST. [Prices as of 7/1/02]

Further information about the product is available at *www.efleet.com.au*.

❖ "RTA Fleet Management Software" from Ron Turley Associates

Target Audience: General fleets, including trucking and taxi industries.

Content: RTA Fleet Management Software is a highly customizable package, with many user-definable features and options. Included are full ranges of reports, which give you immediate feedback on your fleet's performance.

CORE MODULES

Vehicles Module

Contains vehicle fleet information: each vehicle's history, current status and scheduled maintenance. PM's can be figured by days, hours, miles, kilometers or even gallons of fuel used. When a service is performed, the computer instantly updates the vehicle file, schedules future service, and resets the PM meter. Shop, labor, parts, tire, fuel per mile and a wide variety of other costs are also readily available.

Parts Module

The Parts module allows for automatic materials management. Parts used are automatically deducted from inventory, and inventory reorder points can be personally set or automatically set by the computer. The program tracks warranty parts and tells when a warranted part has been replaced or needs to be replaced. The system also tracks parts failure statistics, quantity used, warranty and price history, thus simplifying inventory control. The software creates part number and bin location tags in a standard

or bar code format thereby avoiding mistakes in part stocking, processing, and retrieval usually encountered with bar coded labels.

Work Orders Module

Updates the vehicle repair history, deduct parts used from parts inventory, updates and resets the vehicle's "PM meter", calculates and displays mechanic productivity, updates all repair cost reports, produces an audit trail, and creates customer invoices automatically. Records and paper work are completed as and when the work is performed, not as a separate task, there by making work orders less work.

Fueling Module

Provides the control of fuel inventory and consumption. It tracks information about fuel use, i.e. the fuel delivered to, or used from, each tank, or dispensed from every pumps, as well as fuel purchased on the road. Fuel taxes are automatically calculated and charged from fuel tickets. Miles and gallons are used to update PM schedules and to provide information for vehicle cost reports. Updates to the vehicle cost per mile are calculated by the computer as fueling entries are made.

ADDITIONAL ADD-ON MODULES

Motor Pool

Keeps track of vehicle maintenance and fleet equipment. Custom billing rates, reservations, invoices, check in and checkout are a few of the features of this package.

IQ Report writer

Helps create custom printed reports, generate charts, and produce graphs. Information can easily be transferred to other program, due to its flexible formatting feature.

Multi- User System

Allows the use of the RTA software in more than one location, such that information can be accessed and updated from multiple computer terminal workstations, spreading the work to extra work areas.

Paperless Shop

Allows the fleet manager to track work as it is being done. Paperless Shop acts as a time clock and work order, thus eliminating the need for paper in the shop. Tracks start/end time, lunchtime, breaks and other user- defined categories. Paperless Shop is a great tool for tracking productivity and shop floor execution and control.

Tool Module

Allows maintenance and tracking inventory of tools within the RTA system. It records the purchase information, tracks availability status of the tools, the range of tools used and the costing.

RECENT UPDATES IN VERSION 5.8 (see website for a complete list)

4-digit Region Codes

Has the ability to group facility records into regions. Up to 4-characters can be used to categorize region codes. The region code is specified in the facility record (MFM or

8211) and user record (SUM or 8121). Users will be allowed access only to the facilities in their region or division. The End of Period processes for Vehicles and Parts have been adjusted to allow periods to be closed by region or by facility. The PM reports have also been modified to work with the region codes.

Facility Cost Summary (RA or 8214)

The Facility Cost Summary report has been modified to include facility overhead in the total costs.

PRICE

N/A

Further information about this software can be accessed from *www.rtafleet.com*.

❖ Squarerigger Corporation's "Vehicle Tracker"

General features

1. Maintain accurate history of equipment maintenance
2. Capture all costs related to equipment operations
3. Identify costs by fleet, group or individual units, and identify abnormal costs
4. Provide service and labor cost analysis for informed management decisions
5. Generate reports for governmental safety compliance
6. Track work orders, fuel, tires, parts, labor, employees, vendors and vendor prices, expiration dates, departments and customers

Preventive maintenance features

1. Flexible scheduling
    a. Set by day, miles, hours or kilometers
    b. Cascading (PM's within PM's) links eliminate duplication of work
    c. No limit to the number of PM's you can create
2. 'Next Service Due' report lists equipment based on miles, days, hours or combinations
3. Meter change/rollover accurately handled.
    a. PM's are based on the new readings
    b. "Total miles" stay accurate
    c. Cost per mile and mile per gallon values are unaffected
4. Full meter reading history regardless of source

a. Bad readings are immediately obvious as they are displayed in red
b. Edit all values from one screen

5. Mass assign PM's to all vehicles or a select group
6. PM forecasting based on average usage per normal work day

Repair features

1. Assign multiple mechanics, each with different labor hours, to a single service
2. Reason code can be assigned to each service, not just to the work order
3. Each service on work order may have a different date and/or meter reading
4. Service procedure checklist may be printed for mechanics signature
5. VMRS compliant but may include your own codes
6. Compliant with hazardous waste (HAZMAT) tracking
7. Custom labor rates (including flat rate pricing) tailored for each customer
8. Custom parts markup tailored for each customer
9. Rapid entry of random costs without a work order
10. Flexible work order billing by department or customer
11. Customizable line item billing
12. View part and service history while in the work order
13. Add parts, services, equipment or customers from inside a work order, 'on-the-fly'
14. Mass work order billing

Parts inventory features

1. Issue parts from any warehouse, in any unit of measure regardless of how purchased
2. Automatically alert and generate Return Merchandize Authorization (RMA) for part warranties
3. Buy out of stock or non-stocking parts, which automatically generates a purchase record, receives and issues the part – all 'under the covers'
4. Use flat rate, margin or markup pricing
5. Select valuation method – LIFO, FIFO or last paid
6. Provides inventory level and valuation for any requested day
7. Complete audit trail of all part transactions
8. Stock levels may be different for each warehouse
9. Barcode parts or bins
10. Automatically create part requisitions based on stocking levels and order points
11. Automatically reorder parts and consolidate purchase orders to produce one purchase order per vendor
12. Sell parts with the over-the-counter sales function
13. Mass PO printing

Fuel tracking features

1. Eliminates data entry by importing outside vendor or Fuel Island Assistant™ fuel records directly into Vehicle Tracker™ fuel tracking
2. Links to automated fuel systems like Gasboy, Fuelman, PetroVend, etc.

3. Thorough analysis reporting can be summarized by any group and/or date range you choose
4. Easily transfer interstate fuel tax sums to state reporting forms
5. Fast, reliable, data entry with pick lists and automatic calculations
6. Full detailed IFTA data report

Tire tracking features

1. Cradle-to-grave tire wear analysis
    a. Tread depth log by 32nd of an inch for each tire
    b. Tread wear tracked by position on vehicle.
2. Recap tracking, sales tracking
3. Quick tire rotation
4. Miles per 32nd and cost per 32nd reports

Detailed analysis reporting

1. Mechanic productivity for services, comparing mechanics times to budgeted hours or company averages
2. Inventory level justification – slow moving or dead parts identification
3. Vehicle cost per unit of measure (miles, hours, kilometers)
4. Miles per gallon
5. Tire cost per mile

Other features

1. Full equipment component tracking includes parts, specifications, capacities, serial numbers, etc.
2. Customizable BIT & DOT report templates
3. Reports have powerful yet simple filtering to see only those items of interest
4. Fully customizable security may be tailored for each user
5. KwikView gives specific information fast and easily for each vehicle through an "Explorer" type interface

Current pricing information

Up to 50 vehicles: $2100, ($3600 with inventory tracking); 100 vehicles: $5200 with inventory tracking; 150 vehicles: $5850; 200 vehicles: $6500, 250 vehicles: $7150.

Future pricing information

Software will be available for small users (<50 vehicles) as Vehicle Tracker "Classic Edition", at a reduced price (but with less tech support).

Further information about this software can be accessed from:

http://squarerigger.com/products/VTWin/index.htm

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APPENDIX B. MAINTENANCE FACILITIES REPORT

Maintenance Facilities Report

Prepared for the Taxicab, Limousine, and Paratransit Foundation
By the Center for Transportation Studies at the University of Missouri-St. Louis
Under Sponsorship from Midwest Transportation Consortium

EXECUTIVE SUMMARY

Purpose of the report

The objective of this research is to provide a design prototype for small and medium fleet motor vehicle maintenance facilities. This synthesis is intended for use by taxi, limousine and paratransit facility design consultants and engineers in determining the basic requirements for the design of fleet maintenance facilities.

Further, this report will summarize the research findings, with regard to the space needs of the maintenance facility, the functional relationships between the spaces, and will take note of the key design consideration factors that are important for the planning of the facilities.

Abiding by government regulations, including the National Building Code, ADA regulations, the Clean Air Act Amendments (CAAA), the Clean Water Act (CWA), Environmental Protection Act (EPA) regulations for above and underground storage tanks and Occupational Safety and Health Administration (OSHA) regulations, is critical to the design of transit fleet maintenance facilities. A list of the key design features that need to be considered based on these regulations have been included in Appendix I.

INTRODUCTION

Just a little more than a hundred years ago, America's public transit was animal powered, with horses and mules pulling streetcars over miles of track. These cars and horses were serviced and housed in barns (fleet maintenance facilities of former times). As technology progressed, combustion engines and electricity replaced animal power in transit maintenance facilities.[1] Old streetcar barns have been replaced by sleek, efficient, and environmentally friendly maintenance facilities—highly functional buildings with comfortable working environments. They carefully take into account the functions they perform on day-to-day basis, including preventive maintenance and inspection, daily servicing of vehicles and major repairs. Today, there are maintenance facilities that cater to buses, motor vehicles, trucks, etc; facilities designed to consider every maintenance activity from dispensing transmission fluid to rebuilding an engine.

The transit fleet maintenance community is positioned to make some significant advances in the new millennium.[2] Changes in technology offer much potential for supporting both traditional management activities and several equipment capabilities that have recently become available, like paperless work order systems, computer networks to track location and fuel consumption, and power-saving motion sensors.[1] However, the full 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

[1] "The New Transit Maintenance Facilities"; *MDG in motion*, Official Publication of Maintenance Design Group, MDG, http://www.maintdesign.com

[2] ED Abrams, Henry Hide, Louisa Ho, Claire McKnight, Jim O' Sullivan, Jim Price, John Schiavone, Stephen Stark, Frank Venezia; *Transit Fleet Maintenance*. TRB, National Research Council

study was that the success of a maintenance organization would depend on its ability to adapt to change.[3]

With the increasing complexity of vehicle design and electronic technology many challenges are ahead. Keeping abreast of such changes requires continual training, the provision of effective diagnostic tools, and the implementation of uniform fleet maintenance programs to ensure the achievement of optimum efficiencies. The fleet management software packages available today address this issue and provide effective fleet management solutions.

This report will attempt to draft prototype designs considering the minimal space and functional requirements for small and medium fleet maintenance facilities. (Fleet size 50 –250 motor vehicles). It will also discuss the desired functional relationships between these spaces to maximize efficiency in operating these facilities.

SPACE REQUIREMENTS

The design of a maintenance facility begins with a brief analysis of the space requirements of the site. Usually, the maintenance facility occupies ¼ of the site, with ½ the site allotted for parking and vehicle storage and ¼ for employee parking.[4] The site may be selected based on (a) ease of access and proximity to service area, (b) availability of utilities; for example, water, sanitary sewer, storm sewer, electric power, natural gas etc., (c) topography (preferable that the terrain be level) and the surrounding neighborhood with respect to environmental concerns and adjacent land use

[3] Finegold, D., M. Robbins, and L. Galway. *TCRP Report 29: Closing the Knowledge Gap for Transit Maintenance Employees: A Systems Approach*. TRB, National Research Council, Washington, D.C., 1998, 62 pp.

[4] Spielberg, F. and S.J. Andrle, "Transit Garage Planning and Guidelines, a Review," SG Associates, Inc. and Clark, Nexsen, Owen, Barbie & Gibson, for Office of Planning, Urban Mass Transportation Administration (August 1987).

compatibility. After site selection, the space requirements of the facility are determined. The space requirements for a fleet maintenance facility can be broadly categorized as:

I. Administrative space

II. Transportation services

III. Maintenance services

IV. Fleet storage

There requirements can be provided as separate spaces under the same roof in which case it is called the single roof facility, or may be provided in different buildings, which is not a cost-effective solution for small maintenance facilities. For the purpose of analyzing the functional relationship between these areas, it is first important to understand the function of these areas.

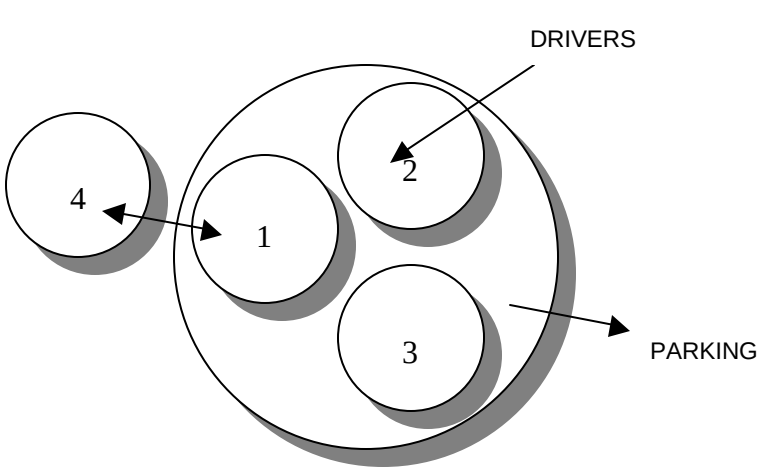
I. Administrative space

The administrative service area may include a number of functions such as administration, accounting and data processing, marketing and planning, public information, personnel and others. Conference areas and boardrooms are optional. The size and the function of the maintenance facility determine which functions are included in the administrative component. For example, if the maintenance facility manages solely the fleet for a particular company, then the need for marketing and planning departments is ruled out. Also, in the case of small maintenance facilities, conference and boardrooms may not serve the purpose. The size of the administrative service area depends on the number of administrative personnel on-site. The recommended space is approx. 260 ft sq. per administrative employee.[4] Central core administrative area is often

preferred. A central core administrative area reduces travel time from work-bays and provides better supervision.

II. Transportation services/Operations services

The Transportation Service Area usually includes the common areas for drivers, such as a waiting room, lockers and restrooms, the dispatch area, the trainers and the supervisor's office.[4] The following diagram reiterates the necessary link between the transportation and administration. Visual and pedestrian access is also illustrated between the driver's area and the Parking.[5] The dispatch area also requires adjacency and visual contact with the driver's waiting room.



1. TRANSPORTATION
2. DRIVERS WAITING AREA
3. DISPATCH
4. ADMINISTRATION

Relationship with other areas

The transportation services office is located close to the administrative office, so that the drivers do not have to pass through the maintenance shops when traveling

[5] Regional Transportation Commission of Clark County (RTC)…Maintenance facility Design

between the transportation services and the car pickup area or the fleet storage area. It is typically located close to the vehicle drop off and pickup area so that the drivers save time and energy walking to and from their vehicles**.**

III. Maintenance service

This is where the vehicles are serviced and repairs are made. In addition it houses the support functions associated with repairs. The functional spaces included in this area are the repair bays or maintenance shops, the machine shop, the parts storage, the maintenance offices, the wash bays, the preventive maintenance bays, and the mechanics welfare room.

A. Running Repairs and Inspection Bays

Function

The repair bays are the most important areas in the facility. Of all the maintenance functions, the largest amount of space is devoted to the repair bays. Most bays will be equipped with automatic vehicle lifts (Fig.2) or lower level work areas (pits). Most operations favor a mixture of pits and hoists in a shop. The pits are better for quick pull-on, pull-off work, while the hoists are better for most other work.

Fig. 2. Vehicle lift system


Fig.3. Underground pits system

Portable wheel lifts appear to provide more flexibility. These lifts only require a solid level floor and electrical power to convert a normal work area into a lift/pit type work area. This provides considerably more flexibility in arranging work-bays. The lifts do have some restrictions. They take more time in raising vehicles, take up more floor space and limit access to the underside of the vehicles. See APPENDIX II for more information.

Typically, eighty percent of the repair bays in the facility are non-special bays. The special bays include bays for steam cleaning or degreasing, paint booths with space for paint preparation, body shop repair bays, the dynamometer repair bay, repair bays for fare-boxes and radios, and bays for welding. Many of these special bays should be enclosed for safety. In large maintenance facilities, these functions are provided in separate bays, but in small maintenance facilities, these functions may be provided for in a single enclosed bay, or sometimes may not be provided.[6]

Relationship with other areas

Repair bays are provided close to the inspection and preventive maintenance bays. Also important is access to the parts room and the parking and fleet storage. Repair bays are designed and located such that maintenance personnel can easily access them, with parts cleaning area (shared) and a workbench w/vise (per bay) provided adjacent to the bays.

[6] Abrams, Edward M.; Spielberg, Frank, ' *Regulatory Impacts on Design and Retrofit of Bus Maintenance Facilities*, Transportation Research Board, National Academy Press, 1994.

Key design features

Fig.4.Interconnected Underground Pits

Repair bays may be provided with lifts or pits or they may be flat. (Fig.5 & Fig.6) Some pits may be interconnected below the floor grade, forming common work areas. (Fig.4) This gives the workers more space, provides ready access to storage areas, and

Fig.5. Two Post Electro Hydraulic lift

Fig. 6. Flat repair bays

makes it easier to ventilate the work area. One approach for pit construction is to design the pits such that the floor of the pit is even with the floor of the shop. To do this, the entrance and exit of the pit areas are usually elevated. Using this type of technique eliminates the need for many of the special safety features necessary for belowground pits.[7]

Repair bays are also equipped to handle a large range of functions. To accommodate this flexibility, most repair bays are similarly designed. 15′- 0″ vertical clearance must be provided, especially when automobile lifts are used. For every 60-75 cabs, 1 repair bay shall be provided, bay size being 16′ wide by 30′ long.[8]

The repair bays in the smaller maintenance facilities may be multi function bays and can be designed to accommodate inspection functions, or separate bays may be provided. A separate bay must be provided for preventive maintenance. This bay is designed for refueling, checking and replenishing fluids, interior and exterior cleaning etc. These services may be provided in an inline pattern or adjacent to each other. For example, maintenance bay for fueling, fluid checking and replenishing, and interior cleaning may be provided adjacent to the automatic wash bay where the exterior cleaning takes place. In some cases, the fueling function is carried out in a separate building or part of the building.

Work-bay access is important to productivity. Where space permits, "drive in – drive out" work-bays are reported to be the most efficient.[9] Also, work-bays that have individual access are preferred over those that must be accessed through another work

[7] US Department of Transportation, *'Bus support Facilities, Conditions and needs'*, Publication no. DOT-T-94-14, January 1993. Source: National Transportation Library URL: http://ntl.bts.gov/data/835.pdf

[8] Maintenance Design Group

[9] US Department of Transportation, *'Bus support Facilities, Conditions and needs'*, Publication no. DOT-T-94-14, January 1993. Source: National Transportation Library URL: http://ntl.bts.gov/data/835.pdf

area. This second aspect is even more important where vehicles frequently enter or exit the work-bays as in the case of running repair bays.

B. Parts Room

Function

The parts room is a secure area for receiving, storage and issue of parts, and materials. It provides storage inventory, supply and exchange of small parts and maintenance supplies. It typically contains bins, shelving units and cabinets. Tires, body parts and spare major components, such as engines and transmissions, are generally stored in another area.

Relationship with other areas

It is located near the maintenance-repair area for ready access by mechanics and on an outside wall to provide access to deliveries. The parts storage room is provided adjacent to or included in the repair bays area.

Key design features

Vertical clearance of 10’ is required (8’ for mezzanine level). Wire mesh enclosures may be provided to store secure items and warranted items. If the parts storage room is provided at the mezzanine level, a parts lift may be provided for transportation of heavy parts. Walls and floor are required to be soil and grease resistant, for easy maintenance.

Security of parts is an important aspect that needs to be considered. Wire mesh secure enclosures may be provided within the parts room for secure items storage, warranty storage, etc.

C. Shop area

The shop area is a large space accommodating repair shops for the battery brake, component rebuilds, electrical, tires, and welding and overhaul. These are support areas to the repair and inspection bays. Usually, they provide for shop equipment like workbench w/vise, parts cleaning tank, buffer/grinder with dust collector, hydraulic press, drill press etc. The shop area is usually adjacent to the repair bays and the parts room.

IV. Vehicle Parking

Vehicle parking area occupies ½of the site. Most of the fleet maintenance facilities provide outdoor parking, though in some cases, parking is provided indoors, where outdoor temperatures drop below freezing more than 100 nights per year. There are advantages and disadvantages to both outdoor and indoor bus parking.

Outdoor bus parking creates problems because the vehicles are cold in the winter and hot in the summer, thus increasing the engine run-time required to stabilize the interior temperatures. The problems and cost of these conditions can be greatly reduced with indoor parking. However, indoor parking is a significant capital investment. In some climates, covered but not enclosed parking represents a compromise.

Another aspect that needs to be paid attention to in the design of indoors parking areas is the ceiling height. Low ceilings in parking areas create exhaust emission

problems. It is common to reduce the height of the ceiling in bus parking garages to as low a level as possible. This reduces construction cost and heating cost. However, low ceilings make it extremely difficult to move air in sufficient volume to create an acceptable environment during pullouts. Usually it has been suggested that the problems with engine exhaust emissions were directly proportional to the lower ceiling height of the parking garages.[10] A minimum of 9′0″ height clearance should be provided.

[10] US Department of Transportation, '*Bus support Facilities, Conditions and needs*', Publication no. DOT-T-94-14, January 1993. Source: National Transportation Library URL: http://ntl.bts.gov/data/835.pdf

Key design features that need to be taken into consideration

- **Ventilation problems in single roof facilities**

Single roof facilities have operations, maintenance, vehicle parking, etc. all assigned to separate areas but all in one enclosed building. A common problem found in these designs is that the engine exhaust from the parking area seeps into the general office area. Increasing exhaust capacity and installing a positive exhaust system may be some methods of avoiding this problem.

- **Facility life span and changing requirements impact design**

Because of the extended life and rapidly changing requirements of facilities, flexibility and adaptability are very important design characteristics. Also, ongoing modifications and rehabilitations are needed to keep facilities functional. Based on the extended age of many facilities, fleet maintenance facilities should be designed for extended lives.[11] This design consideration includes designing the facility systems (i.e., electrical systems, ventilation, parking, work-bays, etc.) to exceed minimum or current requirements. Also, with changing regulations (ADA, yard run-off, alternative fuels, etc.), changing service demands, and changing vehicle types, it is difficult to make capacity or equipment projections for a facility that is intended to last for many years. The facilities should also be designed with maximum flexibility to meet changing needs.

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[11] US Department of Transportation, '*Bus support Facilities, Conditions and needs*', Publication no. DOT-T-94-14, January 1993. Source: National Transportation Library URL: http://ntl.bts.gov/data/835.pdf

- **Concrete parking lots are more cost effective.**

Concrete lots cost more initially, but are reported to last much longer. As a result, many systems recommend the use of concrete parking lots because of the improved life-cycle cost. Aspects of transit operations that tended to quickly degrade asphalt lots are as follows[12]:

  - Petroleum product spills, such as those that occur with normal transit operations (e.g., leaking engines), help dissolve the asphalt,
  - Large amounts of water runoff result after vehicle washing. The water is especially damaging to asphalt yards during freezing temperatures.
  - Warm weather and the weight of heavy-duty vehicles quickly degrade the surface. (This aspect needs to be paid attention to if the facility extends its services to include heavy-duty vehicle maintenance.)

- **Many aspects of facilities should be designed to exceed minimum building codes.**

Most architectural aspects of transit buildings (i.e., ventilation, battery room exhaust, electrical capacity, etc.) are designed close to the minimum code requirements. However, in heavy-duty applications, such as a transit garage, these are often found to be inadequate. Over time, capacity often has to be increased at considerably more expense. This has been found to be particularly true of electrical capacity. Over time, tooling and fixtures are added which require additional electrical power. The cost of providing the necessary capacity initially is much less than having to increase capacity at a later date.

[12] US Department of Transportation, *'Bus support Facilities, Conditions and needs'*, Publication no. DOT-T-94-14, January 1993. Source: National Transportation Library URL: http://ntl.bts.gov/data/835.pdf

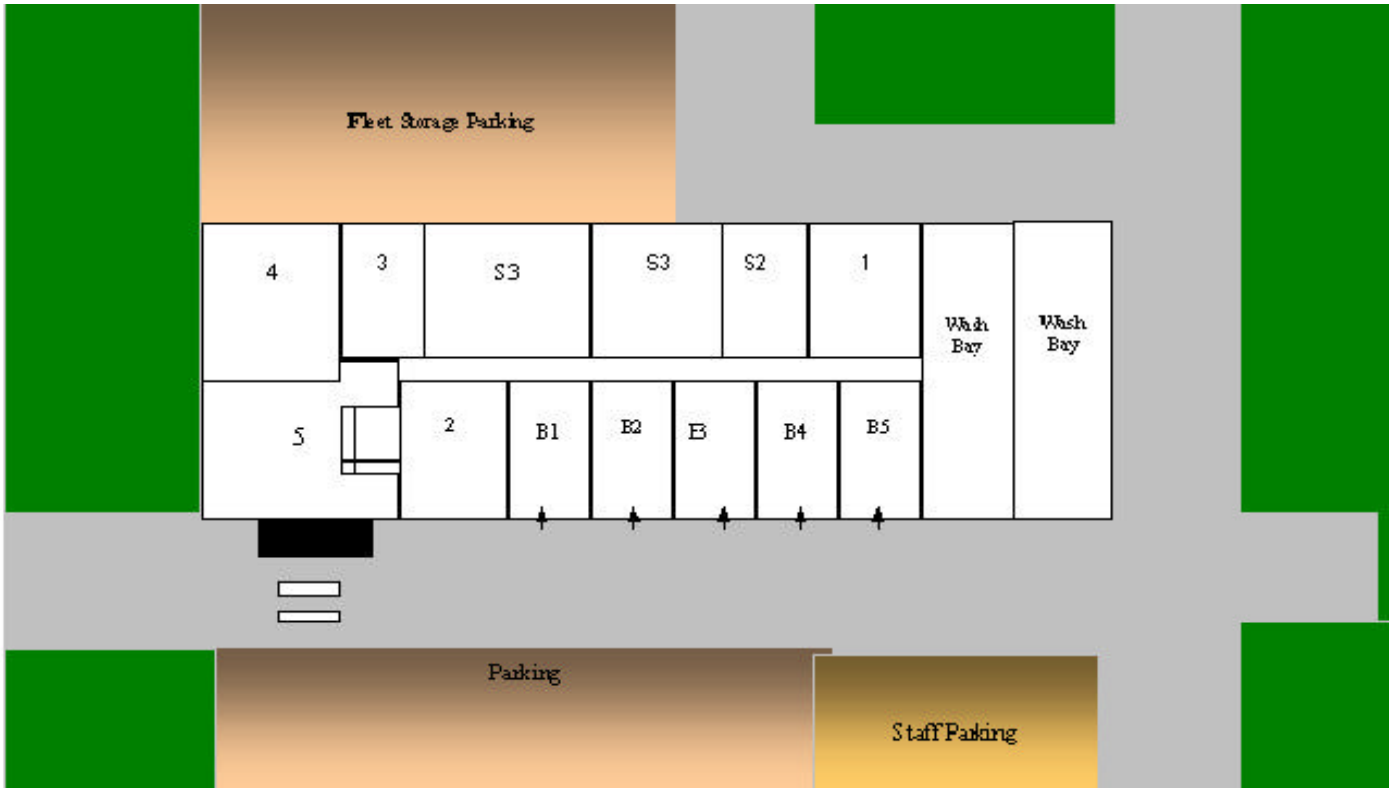
- Increased consideration should be given to future needs as part of site selection process.
- More energy conservation measures needed.

There are several private companies that offer to analyze and equip transit facilities with more energy efficient equipment/processes. These companies charge nothing and only share in the utility savings. Typical examples of approaches used in such conservation efforts are light timers and zoned heat/air conditioning. It is obvious from these examples that more operating efficiencies could be gained in most transit facilities through the efficient use of energy

- The facility should be designed to meet American with Disabilities Act (ADA) Regulations, Clean Air Act Amendments of 1990, Clean Water Act and Clean Air Act Amendments of 1990. (APPENDIX I)
- The underground fuel storage tanks shall be designed and handled to meet the Environmental Protection Agency (EPA) Regulations on Underground Storage tanks. (APPENDIX I)

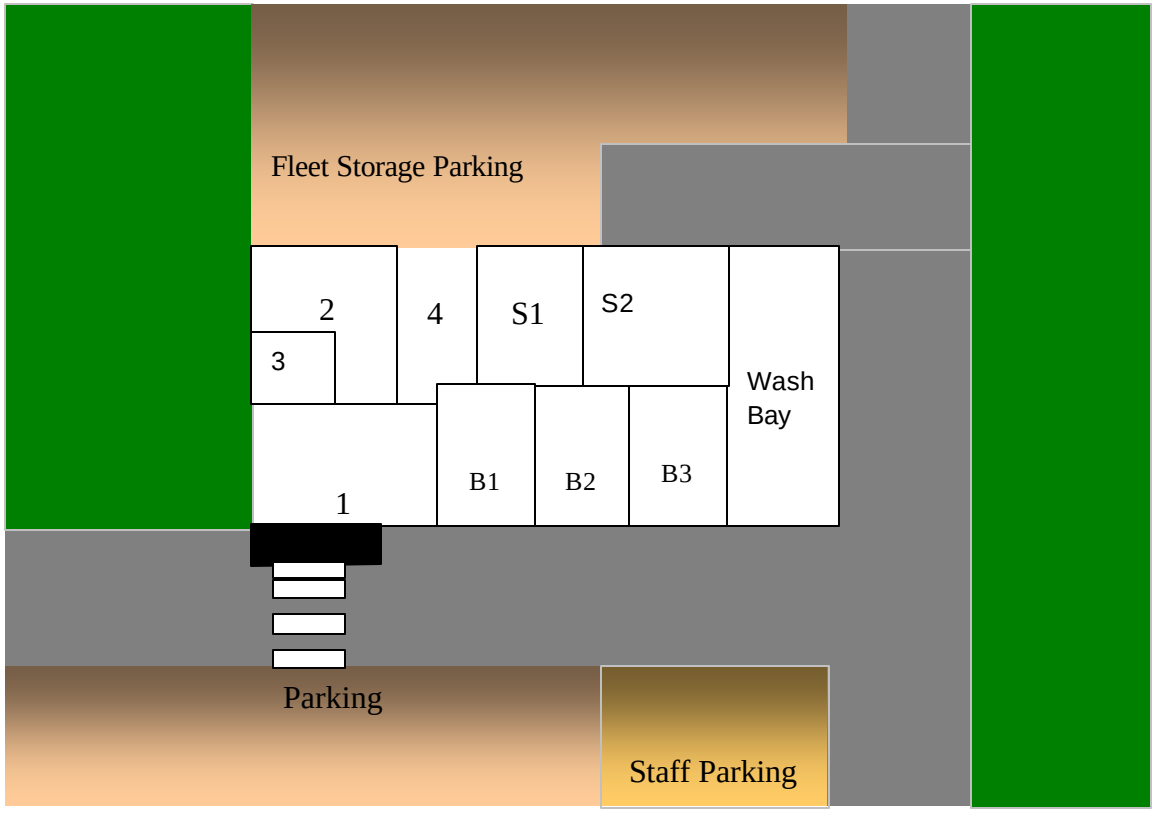
Design Prototype for a Medium Capacity Maintenance facility

Fleet Size: 200-25



Design Prototype for a Small Capacity, Fleet Maintenance Facility

Fleet Size: 50-100



APPENDIX I

Regulatory Impacts on the Design of Maintenance Facilities

American with Disabilities Act (ADA) Regulations

- Larger rest rooms
- Parking areas will accommodate fewer cars in the same space
- More space required for elevators if any
- Wider walkways
- Special features like signage, door hardware, all add to the cost of the facility

Clean Air Act Amendments of 1990

The Clean Air Act is the comprehensive Federal law that regulates air emissions from area, stationary, and mobile sources. The biggest impact will be on facility maintenance area modifications

- Accommodate cars or small buses using alternative fuels
- Fuel handling
- Hazardous vapor venting
- Explosion -proof fixtures
- Special sensing devices
- Automatic controls to provide early warning of trouble
- Pay more attention to providing clean air throughout the facility
- Special exhaust systems in the fueling area and repair area
- Pits designed with floor exhaust
- Make up air system

Clean Water Act

The Clean Water Act regulates the amount of chemicals/toxics released by the facility via direct and wastewater discharges. These standards usually set concentration-based limits on the discharge of a given chemical by the facility. If a facility is discharging directly in to a stream or river, (usually not the case, due to their size, maintenance facilities are likely to be discharging any wash waters to a sanitary sewer system, not to a pipe which goes to a stream or river) it is required to obtain the National Pollutant Discharge Elimination System (NPDES) permit. Other requirements include:

- Recycle wash water
- Provide facilities for processing the site drainage before draining into the municipal sanitary sewer system.
- Using oil/water separators for the drain water to flow into before being discharges into the sewer system.
- Floors where vehicles are repaired or fueled must be provided with drains so that any spills are captured.
- The storage and distribution of oils, fluids, and lubricants must also be carefully considered. (In some maintenance facilities, all vehicle fluids are distributed to repair bays from a central storage area by visible fluids are distributed to repair bays from a central storage area by visible overhead piping and are dispensed from pull-down hoses. This minimizes the spills as well as saves money due to bulk purchasing of engine oils and fluids.)

Environmental Protection Agency (EPA) Regulations on Underground Storage tanks (used to store fuels)

- Double walled tanks with spill prevention features… underground piping to and from the tank must also be double walled
- Leak detectors and level monitors
- Consider using above ground storage tanks for storing fuels (steel)

- Material used for the construction or lining of these tanks must be compatible with the substance to be stored
- Other acceptable materials for constructing UST's- Fiberglass- reinforced plastic, steel tanks clad with Fiberglass reinforced plastic

Occupational Safety and Health Administration (OSHA) Regulations Occupational Safety and Health Administration (OSHA) Regulations

- Eye protection: An eye wash area must be provided near the maintenance workshops.
- Pit protection: Chained-off area around pits should be provided when they are not in use.
- Clear air around electrical/mechanical equipment: Shields must be provided around certain machinery such as grinders.
- Safe working surfaces: Non-skid working surfaces must be provided, especially in the repair bays, the shop area and the vehicle wash area.
- Required and relevant signage should be provided around the facility.
- Lift-locks should be provided for automatic lifts, also safety stands need to be provided underneath the vehicle when it is raised on a lift.
- Good sprinkler systems (fire extinguishers in the case of small facilities) and fire lanes should be provided around and through the building.

APPENDIX II

Lift Design Options

Cost estimates based upon current market conditions for different types of lifting systems are outlined below. These costs are greatly influenced by government regulation and local soil conditions.

INSTALLATION COSTS

Type of lift	Lift Capacity	Lift Cost	Installation Cost
In-Ground Two-Post	43,000 lbs.	$15,000	$15,000
Above-Ground Two-Post	25,000 lbs.	$9,000	$1,000
Above-Ground Four-post	50,000 lbs.	$35,000	$5,000
Mobile Column	50,000 lbs.	$25,000	none
Parallelogram	50,000 lbs.	$45,000	$5,000

Lift designs

The three major players in the heavy-truck lift field are Mohawk Resources Ltd. of Amsterdam, NY; Advantage Lift Systems based in San Diego, CA; and Rotary Lift, Madison, IN. Mohawk offers aboveground, two-post, four-post and no-post scissor lifts. Advantage markets aboveground parallelogram and in-

ground non-hydraulic designs. Rotary has both aboveground and in-ground designs. All types have disadvantages as well as advantages.

Four-Post Above-Ground Lifts

Advantages: These are easy to load and can be used for both PM's and service. Portable designs generally have few side obstructions. Platform lifts can service all vehicles. Adjustable runways can lift forklifts with narrow tire width. Rolling jacks provide "wheel freeing" capability for tire and brake service.

Disadvantages: Somewhat wide. Corner posts can get in the way. Tire work is sometimes hard to do. Crossbeams can inhibit front-end work.

Parallelogram Above-Ground Lifts

Advantages: These can accommodate most fleet vehicles. They can be portable and have no outside posts to hinder tire work. Relatively small space requirement, they can be flush mounted and have lights in the platform.

Disadvantages: The platform can get in a technician's way and some designs have a continuous base that can be a trip hazard or inhibit some work. They need additional space fore and aft due to movement of the superstructure when raising and lowering the lift.

Mobile Column Above-Ground Lifts

Advantages: These offer multiple lift application. They're portable and generally good for repairs that would tie up bays. The use of jack-stands allows one lifting unit to be used in multiple bays, both indoor and outdoor.

Disadvantages: They're relatively slow to set up, have many moving parts and leave electric cables on the floor. Tire work can be difficult.

In-Ground Lifts

Advantages: These require minimum floor space and offer a clear floor when the lift is not in use. Wheels are free as soon as the vehicle is lifted. There are no posts or legs to inhibit side access.

Disadvantages: Poor for steam cleaning and offer no lights. They are often slow to set up and may not lift all vehicles. Pistons get in the way of work for some jobs.

Selection Factors

There is no single lift design that will fill all needs. Here are some factors to be considered:

- Type of vehicles to be lifted and the amount of time it will be used
- Initial cost
- Is the facility, owned or leased? Does it require layout changes? What are the soil and water conditions?
- Space available in the facility for the lift, including ceiling limitations, and the amount of work area that will be fully or partially restricted. Vehicle turning radius in and out of the building could be a factor.
- Maintenance and repair of lift

- Noise levels produced
- Warranty
- Service availability
- Will work be performed outside?

All major lift suppliers have developed programs, including computer-aided designs, to assist fleet managers in making the correct selection.

Tom Phillips, Vice-President of Marketing at Rotary Lift, suggests that the consideration of the personal preferences of owners, managers and technicians be added to the list above.

Non-Hydraulic In-Ground Lifts

This lift design is a solution to the problems of oil leakage associated with in-ground lifts. The non- hydraulic in-ground lift's electromechanical design requires no hydraulic fluid, thereby eliminating environmental risks caused by fluid leakage. The system is suspended from the shop floor and does not require a foundation under its lifting mechanism. Since the entire lift mechanism can be removed, repairs or relocation require no jackhammer, concrete work or extensive downtime.

Ten Safety Tips

1. Operating controls are designed to close when released. Do not block or override them.
2. Never overload a lift. The manufacturer's rated capacity is shown on the nameplate affixed to lift.
3. Positioning of vehicle and operation of lift should be done only by trained personnel.
4. Never raise a vehicle with anyone in it.

5. Keep the lift area free of obstructions, grease/oil and other debris.
6. Before driving a vehicle over a lift, position its arms and supports to provide an unobstructed clearance.
7. Load the vehicle on a lift carefully. Position lifts supports to contact at recommended lifting points. Raise the lift until supports contact the vehicle. Check supports for secure contact. Raise the lift to desired working height. CAUTION: If work will be done under the vehicle, the lift should be raised high enough for its locking device to be engaged.
8. Note that with some vehicles, the removal or installation of components may cause a critical shift in the center of gravity and result in instability. Refer to the lift manufacturer's recommendation.
9. Before lowering a lift, be sure tool trays, stands etc. are removed from under the vehicle. Release any locking devices before attempting to lower lift.
10. Before removing a vehicle from the lift area, position arms and supports to provide unobstructed exit.

APPENDIX III

FLEET MAINTENANCE

Vehicle and Equipment Operation, Maintenance and Repair

Your facility can contribute contaminants to runoff when vehicles and equipment are improperly operated, maintained or repaired. Leaky and poorly maintained equipment and improper maintenance work areas might result in an illegal discharge.

General Pollution Prevention BMPs

- Inspect all vehicles and heavy equipment frequently for leaks.
- Conduct all vehicle and equipment maintenance at one location away from storm drains, preferably on a paved surface under cover.
- Move activities indoors, or cover equipment areas with a permanent roof. Conduct maintenance only in areas designed to prevent storm water pollution.
- Inspect and clean equipment to prevent leaks and excessive buildup of contaminants. Keep drip pans and containers under areas that might drip.
- Use drip pans or dropcloths to catch drips and spills if you drain and replace motor oil, radiator coolant, or other fluids on site.
- Never pour materials down storm drains. Connect process equipment areas to the sanitary sewer or a facility wastewater treatment system.
- Avoid hosing down work areas. Clean small spills with rags; conduct general clean up with damp mops and clean larger spills with absorbent material.
- Use non-toxic substitutes for chemicals when possible. Recycle greases, oil & filters,
- Antifreeze, cleaning solutions, batteries and hydraulic & transmission fluids.
- Do not use diesel to lubricate equipment or parts.
- Clean up spills immediately to minimize safety hazards and deter spreading
- Train employees on discharge prohibitions.

Vehicle and Equipment Fueling

Spilled fuel can contribute contaminants to runoff from your facility. Improperly stored rags used to clean up spilled fuel may also result in an illegal discharge.

General Pollution Prevention BMPs

- Covering fueling areas.
- Install perimeter drains or slope the surrounding pavement inward with drainage to a sump or an oil-water separator.
- Pave fueling areas with concrete rather than asphalt or apply a sealant to protect asphalt from spilled fuels.
- Install vapor recovery nozzles to control drips.
- Discourage "topping off" fuel tanks.
- Use a drip pan to collect drips and avoid spills.
- Use absorbent materials or mop up small spills, and for general cleaning rather than hosing down the area. Remove the absorbent materials promptly.
- Use a rag cleaning service for contaminated rags used to clean up spills, which cannot be disposed of in trash.
- Transport industrial equipment to a designated fueling area rather than using mobile fueling.
- Clean up spills immediately to minimize safety hazards and deter spreading.
- Train employees on proper fueling and cleanup procedures.

Vehicle and Equipment Washing and Cleaning

Your facility can contribute contaminants to runoff if wash water from equipment and vehicle cleaning is rinsed onto parking lots or into gutters or storm drains. Improperly stored rags may also result in an illegal discharge.

General Pollution Prevention BMPs

- If possible use off-site commercial washing and steam cleaning.
- Use designated wash areas, preferably covered, to prevent contact with storm water. Berm wash areas or use other measures to contain wash water.
- Designate a washing site for vehicles where water will drain by gravity to the sewer system.
- Never discharge wash water to the storm drain. Discharge it to the sanitary sewer after contacting your local sewer agency to find out if pre-treatment is required, or if possible, filter and recycle it.
- Alternatively, divert wash water to an open lawn or other vegetated areas so that it can percolate into the ground.
- If it is not possible to divert wash water to the sanitary sewer or a vegetated area, use at-grade storm drains fitted with filter fabric bags. These bags can be hung down into the drains' catch basins to filter out solids from the wash water runoff. The solids can be removed when the bags are full.
- Protect curb gutter inlets with filter fabric to trap solids from the wash water runoff.
- Post signs in the washing area that states that oil changes are prohibited there.
- Wash vehicles with biodegradable, phosphate-free detergent.
- Use non-toxic cleaning products – baking soda paste for battery heads, cable clamps, and chrome; baking soda mixed with a mild, biodegradable dishwashing soap for wheels and tires; white vinegar or lemon juice mixed with water for windows.
- Use a bucket (not a running hose) to wash and rinse cars to conserve water.

- Use alternative washing and cleaning methods to reduce the potential for non-storm water discharges. If possible, use "dry" cleaning methods, such as wiping down, rather than hosing vehicles or equipment.
- Avoid pressure washing if possible. Conduct pressure washing only if you are equipped to capture and properly dispose of all wash water. This area should be bermed to collect the wash water and graded to direct the wash water to a treatment facility. In addition, use high-pressure, low-volume water to reduce overspray.
- Another way to recycle water is to use wash water from the final wash step for the first wash step, which doesn't require clean wash water. Likewise, use final rinse water for the first rinse step, which doesn't require clean rinse water.
- Make sure that the drains at your facility are installed with grit traps and are routed through an oil separator.
- Properly contain and dispose of clean up materials (rags, towels, absorbent materials, etc.).
- Label all storm drain inlets "No Dumping".
- Educate employees on proper washing methods to prevent pollution.

APPENDIX IV

TIPS: Pollution Prevention Guide for

Fleet Maintenance Facilities

Antifreeze

- Recycle antifreeze either on-site or off-site. If more than 1,000 gallons per year of antifreeze is used, then the payback period will generally be less than one year.

Parts Cleaning

- Reuse solvent by installing filtration or distillation units.
- Cover sinks to prevent solvent evaporation loss.
- To prevent spillage, remove parts from washers slowly.
- Consider alternatives to hazardous solvents. Many nonhazardous solvent substitutes are available, including high flash point hydrocarbon solvents (greater than 150 degrees F) and aqueous-based (water-based) solvents. (Note: Non hazardous solvents can become hazardous as a result of contamination from, for example, carburetor cleaner, gasoline, or hazardous solvents.)
- Consider installing a bioremediation parts washer that uses enzymes to eat oil and grease.

Oil Conversion and Filtration

- Contract with an oil recycler for waste oil collection and recycling.

- Institute an oil analysis program to ensure that oil is only changed when necessary. Reliable, low cost oil analysis equipment is available.
- Consider installing bypass filtration systems to extend oil life. Bypass filtration systems generally remove impurities as small as 1 micron in size.
- Drain and crush used oil filters and send to a recycling company. Certain companies recycle every component of the filter, including residual oil, metal, and the filter component.
- Install reusable screen filters for the main oil filter.

Aerosol Products

(Pressurized aerosol cans are considered hazardous and cannot legally be thrown in the trash. Cans may be depressurized by spraying remaining propellant or by special equipment that allows the can to be punctured in a safe manner.)

- Purchase chemicals (such as spray lubricant) in bulk and apply with either pump sprayers or new specialized spray cans which can be pressurized up to 200 pounds per square inch with shop air.
- Empty and depressurize used aerosol cans. Send the empty cans for metal recycling.

Facility Maintenance and Cleaning

- Minimize spills and clean up by using drip pans.
- Use reusable absorbents and recovering spilled fluids with wringers for recycling. If wringing out flammable solvents, be sure to electrically ground the wringer.
- Sweep shop floors instead of hosing them down with water.
- Build a solids tray to reduce solids in the sump. Reassess the need for sumps. If you don't need a sump, plug it.

- Send contaminated shop rags to an industrial laundering facility for cleaning and reuse.
  (Note: The facility must be in compliance with all federal and state wastewater discharge regulations.)

Batteries

- Store lead-acid batteries, upright and off ground with a leak containment system around the area.
- Extend lead-acid battery life with advanced battery management programs. Trickle charge systems, solar trickle charge systems, and brass connectors can significantly extend battery life by improving conductivity and reducing sulfation of the lead plates in the battery.
- Consider new deep-cycle batteries, which can last much longer than conventional batteries.

Source: P2 Tips for specific Businesses and Processes

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Sources for Appendices:

Appendix I

Regulatory Impacts on the Design of Maintenance Facilities, TRB Publications

Federal Transit Administration; http://www.fta.dot.gov/library/legal/dfregs.htm

§ American with Disabilities Act

§ Nondiscrimination on the Basis of Disability in Programs and Activities Receiving or Benefiting From Federal Financial Assistance--
Subpart C—Enforcement 49 CFR PART 27;
http://www.fta.dot.gov/library/legal/dfregs.htm

§ Transportation Services for Individuals with Disabilities (ADA) 49 CFR 37

§ Accessibility Specifications for Transportation Vehicles 49 CFR 38

Environmental Protection Agency; http://www.epa.gov

Clean Air Act Amendments of 1990; http://www.epa.gov/airmarkt/arp/regs/caaa.html

Clean Water Act, 40 CFR 122; http://www.epa.gov/earth1r6/6en/w/40cfr122.pdf

Environmental Protection Agency (EPA) Regulations on Underground Storage tanks (used to store fuels) 40 CFR 280; http://www.epa.gov/swerust1/fedlaws/cfr.htm

Appendix II

www.mohawklifts.com/whenlift.htm

Appendix III

http://www.dfwstormwater.com/pdfs/fleet_bmps.pdf

Appendix IV

www.twua.org/p2/Index2.html, Pollution Prevention for Wastewaters