



1990

Local Government Fleet Assessment

by Frank E. Kirk

The University of Tennessee
MUNICIPAL TECHNICAL ADVISORY SERVICE

in cooperation with the Tennessee Municipal League

The Municipal Technical Advisory Service (MTAS) is a statewide agency of The University of Tennessee's Institute for Public Service. MTAS operates in cooperation with the Tennessee Municipal League in providing technical assistance services to officials of Tennessee's incorporated municipalities. Assistance is offered in areas such as accounting, administration, finance, public works, ordinance codification, and wastewater management.

The LOCAL GOVERNMENT FLEET ASSESSMENT is available free of charge to Tennessee local, state, and government officials and to others for a fee. Contact MTAS for information on fees.

Municipal Technical Advisory Service
The University of Tennessee
600 Henley Street
Suite 120
Knoxville, Tennessee 37996-4400
(615) 974-0411

LOCAL GOVERNMENT FLEET ASSESSMENT

by

Frank E. Kirk

1990

**MUNICIPAL TECHNICAL ADVISORY SERVICE
The University of Tennessee**

in cooperation with the Tennessee Municipal League

ABSTRACT

This report, a review and analysis of the fleet operations of local governments in Tennessee, demonstrates the potential for fuel and cost savings resulting in long term benefits of reduced operating costs and improved service levels. Ten cities and counties were selected for a detailed investigation of total fleet operations with comparative records maintained to identify fuel consumption and total cost-per-mile of operation. The report presents recommendations for possible fleet management improvements based on the data collected and interviews conducted with operating personnel and local elected officials.

CITATION

Kirk, Frank E., *Local Government Fleet Assessment*. Knoxville: Municipal Technical Advisory Service, The University of Tennessee, 1990.

Reprinted August 1990 by the Municipal Technical Advisory Service, Knoxville, Tennessee; UT authorization no. E14-1050-00-011-91.

Originally published May 1990.

TABLE OF CONTENTS

Acknowledgements	vii
Introduction	1
Fleet Management Policy	2
Driver Efficiency Programs	12
Natural Gas Vehicles	15
Fleet Replacement Analysis	16
Fleet Policy Conclusions	17
City of Cowan	18
Hawkins County	22
City of Jackson	34
City of Lebanon	41
McMinn County	45
City of Memphis	48
Polk County	53
Roane County	58
Sequatchie County	66
Weakley County	73
Data Summary	80
Fleet Analysis Summary	81
Bibliography	82
Appendices	85

LIST OF TABLES

Table 1	City of Cowan Vehicles And Equipment	19
Table 2	Hawkins County Department of Education, Comparison Between Diesel and Gasoline Powered Buses	29

LIST OF FIGURES

Figure 1	Hawkins County Highway Department Vehicle Expense	23
Figure 2	Hawkins County Sheriff's Department Vehicle Expense	24
Figure 3	Hawkins County Department of Education Fuel and Maintenance Data	26
Figure 4	Hawkins County Sheriff's Department Scattergram of Miles Per Gallon and Vehicle Age	28
Figure 5	City of Jackson Fleet Expense for Study Period	36
Figure 6	City of Jackson Relationship Between Total Miles and Cost Per Mile	38
Figure 7	City of Lebanon Vehicle Operation Expense for the 1988 Fiscal Year	42
Figure 8	Roane County Department of Education Vehicle Expense	59
Figure 9	Roane County Sheriff's Department Vehicle Expense	60
Figure 10	Roane County Highway Department Vehicle Expense	61
Figure 11	Sequatchie County Highway Department Vehicle Expense	66
Figure 12	Sequatchie County Department of Education Vehicle Expense	68
Figure 13	Sequatchie County Sheriff's Department Vehicle Expense	69
Figure 14	Weakley County Sheriff's Department Vehicle Operating Expense	75
Figure 15	Weakley County Department of Education Vehicle Expense	76
Figure 16	Weakley County Highway Department Vehicle and Equipment Expense	77

ACKNOWLEDGEMENTS

The author thanks the following individuals for their assistance in preparing this report: Gary Davis, Project Coordinator with the Energy Division, Department of Economic and Community Development; Energy Coordinators and elected officials from the ten communities involved who took time from busy schedules to assist in the collection of fleet data; Randy McGill, who gathered the fleet data and performed the analysis; and MTAS staff Joe Walsh, Assistant to the Executive Director; Anne F. Hawkins, Information Management Consultant; and Debe Linn, Senior Editorial Assistant.

Local Government Fleet Assessment

Government is public business. Every service large or small is important and each deserves the full attention of the departments and people providing these services. Costs for most public services continue to increase so local government must do a better job with less money. Look for savings in departments that employ a lot of people or use large volumes of equipment. This report examines fleet operations and details ways to reduce fuel use and costs. A good records system and sound management practices can produce lower fleet costs which in turn will result in lower fuel consumption.

Motorized vehicular equipment is essential to delivery of most local government services. Fleet operations are the largest expense item in operations. Public health, safety, and welfare are dependent upon reliable transportation equipment. Police protection, fire fighting, refuse collection and disposal, public works construction and maintenance, school buses, and inspectors must all have adequate vehicles and equipment. Health vans, ambulances, bookmobiles, and mobile recreation units that take services to people are also becoming more popular. All of these services are important and as demands and needs increase, better and more efficient use of motorized equipment must be employed.

The need for a good management and record system is obvious. Sound decisions can be made if sufficient and reliable information is available. The low cost of computers and software programs have made automated information systems affordable and practical. Computer applications in fleet management allow individual pieces of equipment to be evaluated. With detailed information, decisions can be made on the basis of cost and performance data, utilization rates, down time, and frequency of repair. Many departments in this study were spending more time and effort keeping records than would have been required if a well-designed automated records keeping system had been used. The final test of any record system is, "what decisions are made using these records?"

A computer will not necessarily reduce the work load or the number of clerical

workers and in itself it is not an answer to all problems. Information can however be produced at budget time to document and justify equipment needs. Also, major repair work can be scheduled on a priority basis when operational costs are easily visible to management and supervisors.

Selecting the right program is important. Management needs information to make budget and policy decisions. This report provides information which details the basics of developing a records and management system.

This study assesses fleet management programs, repair facilities, and fleet policies of ten Tennessee local governments. The selected communities vary greatly in geographic size, and population, and should be representative of other Tennessee cities and counties.

Fleet Management Policy

Introduction

A questionnaire was distributed to ten Tennessee local governments by Frank Kirk and Randy McGill, contractors with The University of Tennessee Municipal Technical Advisory Service, to determine policy and fleet practices of each participant. Only one of the ten governments questioned had a written fleet policy. It was clear that each had set procedures and guidelines which were carried out by the various departments within the jurisdiction. Every department had a record system of some kind. However, these records were rarely used to make management decisions. Without exception, the study found strong need for better record keeping systems and written fleet policies.

Why a Written Policy?

Policy statements and the administration of them are the responsibility of elected officials. Good written policy requires a joint effort between elected and appointed officials. It is more than a clear understanding between both parties; it is the beginning of a better managed department. With the policy, elected officials can better understand the operational procedures, needs, and problems facing each department. Supervisors can be reminded that the electorate will always have input in the policy making process. A written policy can quickly and concisely answer questions, solve problems, and clearly identify responsibility for the problems.

Centralized Motor Pool

This report reveals a strong need for centralized motor pools in Tennessee local governments. Centralized is defined as a department under the direction of a manager but not necessarily under a single roof. "Pool" does not mean that equipment must be "checked out" every day from the pool. For the most part, pool equipment could be permanently assigned to various departments for the life of the equipment. There are several advantages of a centralized motor pool. They include:

- economy of mass purchases;
- identification of obsolete units;
- rotation of vehicles between user divisions based on age and projected use;
- centralized and timely records;
- better labor distribution;
- better skilled mechanics;
- single agency management control;
- better evaluation of specifications;
- reduction in the number of vehicles;
- improved scheduling for preventive maintenance;

- better inventory control of spare parts and supplies;
- improved security and control;
- improved equipment utilization and distribution;
- reduction of outside equipment rentals for routine tasks;
- use of special equipment for specialized tasks;
- comparison of operating costs for all classes of vehicles;
- decreased down time.

There is often opposition to creating a motor pool. Department supervisors may feel they must give up control over their service centers and that favoritism would dictate repair priorities. Department heads might think they will not be included in equipment purchases. As previously stated, "motor pool" leaves the impression that all vehicles must be checked on a daily basis.

One or two departments might convince officials that a motor pool will hamper operation to a point that normal service can not be effectively or efficiently delivered. The absence of one department does not mean that a fleet management program cannot be created for others. A well-managed department, as a demonstration and example for other departments to follow, is often the best way to start a program.

A strong management team is needed to establish and maintain a department of fleet management. A professional fleet manager must have the support of elected officials and department heads. Input from department heads, chief administrative officer, and purchasing and budget staffs must be a part of management's plan.

A fleet management department must be self-supporting based on rental or lease charges to other departments. Funds would be initially allocated to start the department-- users would then pay a rental charge to establish a revolving fund. Rates must include all direct and indirect operation costs.

Review rates periodically to determine if they are fair and sufficient. Determine rates by mileage, hours, or by special monthly cost formulas for single-purpose vehicles like fire engines and large cranes.

Advantages of a fleet management program include:

- A greater selection of equipment is available and users only pay for the equipment rented;
- Departments do not bear the total burden of specialty equipment that is required but seldom used;
- Equipment costs become easier to predict from year to year;
- All departments can make efficient use of all equipment owned by the local government;
- Good equipment utilization makes it possible for management to determine when it is more efficient to purchase or lease equipment

Getting Down to Basics:

ORGANIZATIONAL CHART: Develop an organizational chart including every department involved in fleet management or that uses motorized vehicles. Use the organizational chart as a guide for responsibility and authority.

REPAIR SHOP INVENTORY: Maintain an inventory and location map showing all buildings where equipment is repaired or stored. This should include a list of shop equipment and tools (not hand tools). Include descriptions of the major kinds of repairs that can be performed at each facility.

REPAIR CENTER SERVICES: Determine the types of repairs and services that each facility provides and the vehicles they might serve for each department.

CONTRACT SERVICES: Bid outside repair services on a periodic basis. Bids should be taken by the job if the types of repairs are clearly established. Establish an hourly rate to cover unforeseen circumstances or for emergency repairs. Another option is to bid the work on an hourly rate with a price not to exceed a fixed amount. It may be desirable, and possibly necessary, to take bids from specialty shops for such work as transmission repairs. This will depend on the number of local shops and the capabilities of local repair shops compared to the skills and equipment available in-house.

SCHEDULED REPAIRS: Establish priorities for scheduled and unscheduled repairs. It is the responsibility of the equipment operator to notify the repair center of any problem that may require immediate attention. The shop supervisor should determine what repairs are needed and notify the user department supervisor of the estimated time the equipment will be out of service.

PREVENTATIVE MAINTENANCE: Establish a preventative maintenance schedule for each vehicle and indicate, using a checklist, what must be done to each vehicle. Schedules are tied to mileage, hours or time for low mileage, and special equipment. Establish the responsibility for shop and users that operate the equipment.

EQUIPMENT OPERATORS DAILY CHECK LIST: Establish a check list procedure that is the responsibility of the vehicle operator. The checklist must be signed and dated. Sample forms are included in Appendix B.

PRODUCTION STANDARDS: Most private repair shops have job production standards used to determine the pay that each mechanic receives for each job. These same standards can be used to set production standards for government operated shops.

INCENTIVES: Higher productivity is the answer to keeping costs in line. To reward individuals for high performance the following are suggested:

- Compensation can be through additional pay for work that exceeds established production standards. Compensation may also be offered in the form of extra vacation days.
- Recognize individuals who perform above average by posting their names on bulletin boards or through releases prepared for the local news media.
- Security is built in for employees who consistently exceed production standards. Provide workers falling below production standards with additional

training and on-the-job assistance from supervisors and give the opportunity for self improvement.

- Advance top production workers first.

TRAINING: Establish procedures to assure all fleet personnel receive training on a regular basis. A skilled mechanic may only require an orientation program to become familiar with operational and record keeping procedures. The programs may vary considerably between the small one or two-man shop and the full service departments in larger operations. Management and operational personnel must attend workshops to stay current with changing technology. For more information contact The University of Tennessee Center for Government Training (615/251-1401).

SAFETY PROGRAM: The safety program should include the shop, the motor equipment, and the equipment operators. The fleet manager should be responsible for carrying out the safety program.

FUEL RECORD SYSTEM: Enforce detailed accounting of fuel use. Odometer or hour meters must be recorded on a regular basis for all motorized vehicles except certain specialty equipment. These records should have a direct link to the central accounting system.

FLEET ACCOUNTING SYSTEM: A detailed cost accounting system should include personnel costs, fringe benefits, parts and supplies, garage expenses, insurance, and outside contractor services. This information should be combined with fuel costs to determine a cost-per-mile or a cost-per-hour for all equipment. These cost records can be

used to set rental rates for equipment assigned to each department and to determine the real cost for maintaining each vehicle.

EQUIPMENT COST REVIEW: Establish a review board to analyze rental rates, repair priorities, services provided by fleet management, evaluation of equipment utilization, specifications, purchasing, etc. The review board should consist of the user department heads and representatives from the accounting and purchasing departments.

FIELD SERVICE: Establish a procedure for providing field service for disabled vehicles or vehicles that must receive maintenance in the field. Set priorities for field service based on: lifesaving vehicles, equipment that must maintain production schedules, (i.e., refuse collection trucks), and vehicles that support a large labor force. These priorities are similar to the priorities that would be used for scheduling shop repairs.

PARTS INVENTORY CONTROL: Establish a parts inventory control system. This should include the kinds and quantities of parts to be kept in inventory, the availability of parts at local suppliers, annual contract purchases, salvaged parts that can be used on present fleet vehicles, and the disposal of obsolete parts.

SURPLUS EQUIPMENT: Determine the procedures to dispose of surplus equipment. Public auction, sealed bids, trade in at time of purchase of new equipment, and sell as scrap junk are some of the options. A new option is to sell surplus equipment to other local government agencies without taking bids.

SECURITY: Maintain an inventory of all nonexpendable tools and equipment. The department may assign tools on a permanent basis or employees may be required to provide their own tools. The department may purchase the initial set of tools and the

employee would be held responsible for replacement. Although difficult to accomplish, every effort should be made to keep other employees out of the repair centers.

BUILDINGS AND GROUNDS: Establish responsibility for maintaining fleet service buildings and outside grounds. Include a statement about disposing of abandoned equipment and miscellaneous junk that may accumulate inside and outside the shop areas. Regular inspections for fire prevention and equipment safety should include a checklist of all major equipment items.

24-HOUR VEHICLE ASSIGNMENT: There is sufficient justification for assigning vehicles to key personnel on 24-hour call. Police cars traveling to and from the officer's home is, in effect, a patrolman on extra duty each day while visibility of the marked car in the neighborhood can improve public relations and security. Utility, street, and drainage repair are not normally emergencies or life threatening circumstances but it is important to restore service as soon as possible or protect the public. Utilities out of service lose revenue, lose treated water, and sustain damages from sewer backups or overflows. It is important that work crews respond to these kinds of emergencies as quickly as possible.

Employees who are on 24-hour call and do not have ready transportation will be unnecessarily delayed and may be required to make several trips from home to office if transportation is not provided by the local government. Also, if employees are required to work in locations other than their regular office, and at times other than the normal work day, they should be compensated or provided with a vehicle for such work assignments.

The policy for 24-hour vehicle assignment should contain the following:

1. State in each job description if a vehicle will be furnished.
2. A request must be initiated by the department head through a formal, written procedure.

3. Furnish a copy of the fleet policy to the assignee.
4. The vehicle must not be used for private purposes at any time.
5. Passengers must be for official business only.
6. The assignee is responsible for traffic violations except under unusual circumstances.
7. Insurance coverage will be provided by the local government.

USE OF PRIVATE VEHICLES: It may be desirable to pay a monthly car allowance or mileage to some employees. This is particularly true for low mileage vehicle assignments such as engineering, planning, code enforcement, and parks and recreation. Records will show that the cost per mile (cpm) for low mileage vehicles is much higher than for high mileage vehicles. Any reduction in the fleet inventory can have long term advantages that will lower fleet operations costs.

There are a number of factors to consider before paying a car allowance:

1. Does the employee own or have access to a relatively late model conventional vehicle suitable for the intended use?
2. The employee is responsible for all maintenance and operation costs.
3. The employee must show proof of acceptable insurance coverage.
4. A clear understanding must be made regarding the use of government owned vehicles by the employee receiving a vehicle allowance.
5. Documentation should be complete, especially if compensation is based on mileage.

MILEAGE PAYMENT TO EMPLOYEES: Payment of mileage offers the good feature of a flat rate vehicle allowance, but does require a record keeping system. Mileage payments can be justified when fleet vehicles are not available. Frequently the trip can be completed before a fleet vehicle can be obtained. A ceiling should be established on the mileage to be

paid for any given period of time for various job classifications. A common practice is to pay the same rate allowed by the Internal Revenue Service (IRS) or the State of Tennessee. This compensation method may not be fair for the person making occasional short trips around town or within the county.

DRIVER EFFICIENCY PROGRAMS

It is local government's duty to maximize fuel economy and efficiency in daily operations. Driver efficiency training programs can reduce fuel consumption by 15 percent. This can be a substantial savings to local governments.

The Tennessee Department of Economic and Community Development Energy Division has a vehicle available that can be used for training to lower fuel consumption. The vehicle is equipped with an instrument package accurately recording fuel usage. This approach makes it possible to develop a competitive attitude between equipment operators to save fuel. It is also the first step in a program to recognize and reward personnel for learning good driving techniques.

A number of publications and training programs are available to assist anyone interested in starting driver efficiency programs. A publication, Conserving Energy In Fleet Operations by the New York State Energy Office covers driver efficiency, record keeping, life cycle costing, driver efficiency programs, route planning, benefits and use of engine diagnostic equipment, general vehicle maintenance, and diesel maintenance. The following outline shows a sample of the information contained in a chapter on driver efficiency programs:

Self Learning Approach

1. Must furnish written materials for all drivers
2. Each driver has a permanent record to continue training
3. Topics covered should include: starting and getting away, idling, road speed management, shifting, and traffic handling

Classroom Approach

1. Classroom setting with a trained instructor
2. Class should not exceed two hours
3. Cover material that is hard to understand
4. The instructional meeting approach is more expensive but it is worth the extra cost

Driver Motivation

1. Driver Achievement Identification
2. Recognition or Awards
3. Rewards

Driver Achievement Identification

1. The highest average miles per gallon (mpg)
2. The greatest percent improvement in mpg
3. The highest accumulative mpg
4. Meet a set mpg goal
5. Be within a certain top percentage of drivers

Program Support

1. Public recognition
2. Newsletters and posters
3. Link fuel savings and driving techniques with recognition and rewards

Driver Training Information

1. Show success of other programs
2. Explain basic contents of training program and the benefits

Starting the Engine

1. Check oil and coolant
2. Check fan and accessory belts

For diesel engines

1. Bleed water from air lines
2. Periodically bleed sediment and water from filter and tank bottom

To start the engine

1. Don't keep cranking
2. Follow the instructions for your vehicle
3. Fast idle for 20-30 seconds
4. Drive off slowly until engine and other parts warm up
5. Heavy-duty diesel engines, idle at 600 revolutions per minute (rpm) for 3-10 minutes

Idling and Rolling Out

1. Short warm-up time (idling equals zero mpg)
2. Move slowly to warm-up vehicle
3. Don't wind out the engine in each gear
4. Do not idle more than one minute except in traffic

Accelerating

1. Apply accelerator pressure slowly and evenly
2. Hold pedal steady until you've almost reached your desired speed
3. Release pressure smoothly
4. Never pump the accelerator

Progressive Shifting

1. Shift to the next highest gear as soon as the engine speed and vehicle speed are enough to pick up the load
2. Keep it smoothly rolling in the next higher gear

Automatic Transmission

1. Operate in drive position except on steep hills
2. Steadily gain speed then level off

Speed Management

1. The faster the speed, the more fuel needed
2. Trucks at 65 miles per hour (mph) use 32% more fuel than at 55 mph
3. Hold a steady cruising speed

Stopping

1. Anticipate stopping or slowing in traffic
2. Begin coasting as soon as possible

Hills

1. Increase speed gradually while on the level
2. Shift down only when near the bottom of the efficient speed range
3. Don't "strain" to pass another vehicle

Operating in Traffic

1. Observe ahead 12 seconds (a city block) and one quarter mile on the highway
2. Select smooth flowing lanes
3. Avoid unnecessary use of the brakes

Tailgating

1. Requires frequent use of brakes
2. Uneven use of accelerator
3. Major cause of accidents

The Fuel Economy Payoff

This program and other fleet management programs will save fuel and lower other costs. The driver efficiency program is consistent with all of the reasons for developing a department of fleet management recommended in this study. There are many training programs, literature, films, video tapes and slide presentations offered and available in Tennessee at little or no cost.

NATURAL GAS VEHICLES

Natural gas vehicles (NGVs) are a proven technology to provide an economic, clean burning, and safe alternative to gasoline and diesel fuel. The systems have been in use since the 1940's, although some of the first internal combustion engines were designed to run on natural gas before the advent of petroleum fuels.

The key benefits to using natural gas as a vehicle fuel are: economy, clean burning, safety, and an abundant domestic supply. During the fuel shortage in the mid 1970's, many fleet managers began successful natural gas conversion programs. There are a few NGV systems operating in Tennessee. There are problems with most light trucks and passenger cars using natural gas fuel because of the complex electronic equipment designed for regular gasoline powered engines. American manufacturers and suppliers of conversion equipment, compressor equipment, and parts for NGVs have decreased in number due to a lack of consumer demand. For these reasons converting to NGV systems is not advisable.

The development of an engine compatible with both natural gas and gasoline would solve most of the current problems related to the use of NGVs. As technology exists today, NGVs are the best answer to air pollution and a long term answer to a local fuel that could drastically reduce foreign oil imports. It is doubtful that the automobile manufacturers will do anything about fuel compatibility problems unless forced through very strict air pollution standards or another oil embargo. Until changes are made, natural gas use as a vehicle fuel is not a recommended option.

FLEET REPLACEMENT ANALYSIS

An example of a method to determine vehicle replacement priorities has been developed by the American Public Works Association and was published by the Association in the September 1975 Equipment Management Manual. A copy of the section on replacement analysis is included in the appendix of this study. A copy of the complete

manual can be obtained from the American Public Works Association, 1313 East 60th Street, Chicago, IL 60637. Before beginning an analysis of vehicle replacement, a community must maintain records, including fuel use and mileage, for each vehicle.

FLEET POLICY CONCLUSIONS

A written policy forces management to think and plan. Department heads can then be informed about exactly what is expected of them. A written policy clearly defines the responsibilities of everyone involved in fleet operations. A policy need not be an extensive document but should be a joint effort of everyone involved. All parties should agree on the content and meaning before it is presented to elected officials for approval.

The descriptions of the elements of a fleet management policy, included in this study, are provided as a guide for the establishment of a written policy. It is not necessary to use all of the headings, and other subjects may be added. Some sections may establish responsibility for developing a program for approval. Others, like a fleet accounting system, may require extensive work before the program can be implemented. The final written policy could include goals and objectives, rules and regulations, and duties and responsibilities.

The following sections include reviews of the fleet operations in the ten communities included in the study group. Each review should be considered independently as recommendations for each individual community. Many cities and counties in this study have excellent programs, so the recommendations consider the strengths and weaknesses of each community. Summary data at the conclusion of the study provide comparisons of each community which was a part of the study.

City of Cowan

Cowan, located in Franklin County, is the smallest of the ten local governments in this study. The 1980 population of the City of Cowan was 1,790. The total fleet consists of seventeen vehicles.

The Street Department garage is used for vehicle repair and maintenance work. The building has 2,100 square feet of space and was purchased by the city in 1986. The building was constructed in the late 1940's. Some additional work is performed at the Fire Hall. Police vehicles use the Street Department garage for minor repair work. All maintenance work performed on water department vehicles is contracted.

Due to the small number of vehicles, as well as budget constraints, most repair and maintenance work is performed by employees of each department. The Street Department has one foreman and three employees who also serve as mechanics when necessary. The Police Department has four full-time and two part-time employees. The police officers perform minor maintenance work on the two patrol cars and all major repair work is contracted locally. The Fire Department is operated by an appointed fire chief and 22 volunteer firemen. Vehicle maintenance is performed by the fire chief and volunteers using the fire hall, or area adjacent to the fire hall, as a shop. The Water Department has four employees and all vehicle maintenance is contracted.

Budget constraints have prevented the acquisition of new equipment for several years. When bid specifications are needed, they are prepared by the mayor and the department heads. Bids are distributed to a wide area including Nashville and Chattanooga. The newest piece of equipment, purchased by the Board of Public Utilities, was a used 1988 John Deere tractor. Some equipment has been purchased through State of Tennessee surplus including a 1973 one-ton truck which is used for street patching and for carrying mosquito spraying equipment.

Table 1 shows the year, model, and vehicle type for the 17 vehicles and equipment items owned and maintained by the city.

TABLE 1. CITY OF COWAN VEHICLES AND EQUIPMENT

Vehicle Number	Year	Vehicle Description
Utilities		
101	1969	Ford 1/2 ton pick-up
102	1979	Ford 1/2 ton pick-up
103	1988	John Deere tractor
Police		
12	1987	Ford Crown Victoria
11	1984	Ford Crown Victoria
Fire		
1001	1985	Ford F-800
1002	1967	Ford
1003	1948	GMC tanker
Street		
1	1981	GMC 7000 2 1/2 ton
2	1973	Chevrolet 1 ton
3	1974	Chevrolet 2 ton
4	1975	Dodge D600
5	1979	Chrysler Newport
6	1976	John Deere Backhoe
7		Ford 3400 Tractor
8		MTD 18 hp mower

City of Cowan Vehicle Data

Six vehicles operated by the City of Cowan had sufficient mileage and fuel data to use for comparison purposes. Cowan is a small community and the total miles traveled by each vehicle is very low. As a result, the mpg averages were lower than other communities and the cost per mile (cpm) averages are higher.

The six vehicles traveled a mean of 2,287 miles during the study period. The highest number of miles by a single vehicle was 5,626. The lowest number of miles was 114. The mean fuel consumption was 335.82 gallons. The highest fuel use during the study period was 618 gallons and the lowest was 38 gallons. The mean mpg for all vehicles was 5.877. The highest mpg was 9.49 and the lowest mpg was 2.13. The two police vehicles had a mean of 9.295 mpg. Mean cost-per-mile (cpm) for all vehicles was \$0.519. The mean cpm for the two police vehicles was \$0.155.

Recommendations

1. Cowan will grow in the future and growth will bring additional demands for city services and the vehicles required to provide services. These additional needs should be anticipated through a capital budgeting system to gradually accumulate funds for new vehicle purchases.

The overall age of the vehicles operated by the city results in lower mpg totals and higher cpm of operation. The small size of the city also contributes to higher per mile cost averages due to the limited use of vehicles for highway trips.

2. The computer system recently installed in city hall should be used for the entry of monthly fuel and mileage records for all vehicles. The computer generated report should then be reviewed by the mayor and commission to determine savings which could result from improvements to each vehicle or through vehicle replacement when possible. An increase in average mpg for the two police vehicles, from the current 9.295 mpg, to 15 mpg could result in a savings of 122

gallons of gasoline each month. If average monthly miles traveled during the study period are maintained throughout the year, the potential gasoline savings would amount to 1,464 gallons.

3. Written checklists should be maintained with each vehicle so that operators can record a daily inspection of the vehicle. The written inspections should be submitted to a designated individual who can then assist in scheduling repairs or preventative maintenance. Cowan does not have a staff mechanic, but the current system of having employees repair vehicles seems to work well and keeps the vehicles operational. As more vehicles are acquired in the future there will be a greater need for a review process to assist in scheduling the repairs and regular service for vehicles due to the limited resources available. Sample forms are included in Appendix B.

Hawkins County

Hawkins County is located 63 miles northeast of Knoxville. The county population, based on the 1980 census, is 43,751. Hawkins County governmental departments operate a fleet of 219 vehicles with the largest number, 112 vehicles, assigned to the Department of Education. The other primary vehicle users are the Sheriff's Department, with 26 vehicles, and the Highway Department which operates 78 vehicles. A new operation will be a Sanitation Department supervised by the County Executive and financed through the general fund.

Hawkins County Highway Department

The Hawkins County Highway Department operates a maintenance and repair shop in a 3,000 square foot building constructed in 1966. The facility is staffed by a shop foreman, three mechanics, and one tire-changer. The shop foreman reports directly to the highway superintendent who serves as an elected official. The shop has basic equipment for engine rebuilding and repairs. Other equipment includes jacks, hoist, tire-changer, air tools, and welders. Hand tools are furnished by the Highway Department. Repair work is contracted only in situations where engine rebuilding is needed rapidly to place equipment back in service. All wheel alignment work is contracted because the equipment is not available in the shop.

Vehicles are replaced when the highway superintendent determines that operating costs are excessive. No new vehicles were budgeted from 1985 through 1987. The fiscal year (FY) '88 budget included \$211,000 for vehicle purchases and the FY '89 budget includes \$100,000 for capital outlay which could include vehicles. Specifications for new vehicles are prepared by the highway superintendent. Most heavy equipment bids include vendors outside Hawkins County and most light equipment is bid locally. Some vehicles are purchased through state and federal surplus.

Repair work is requested by operators through use of a work order system. Preventative maintenance work is performed on all vehicles and includes oil, grease, and brake inspections. A small inventory of repair parts is maintained by the Highway Department, but most parts are purchased on an as-needed basis and are obtained locally by the shop foreman and mechanics. A shop form is used to charge parts to specific vehicles.

Figure 1 indicates the small variation in total expenditures for fuel (gas and diesel), maintenance, and lubricants during the FY '85 through FY '89 period. FY '89 totals are almost unchanged from the FY '85 amounts.

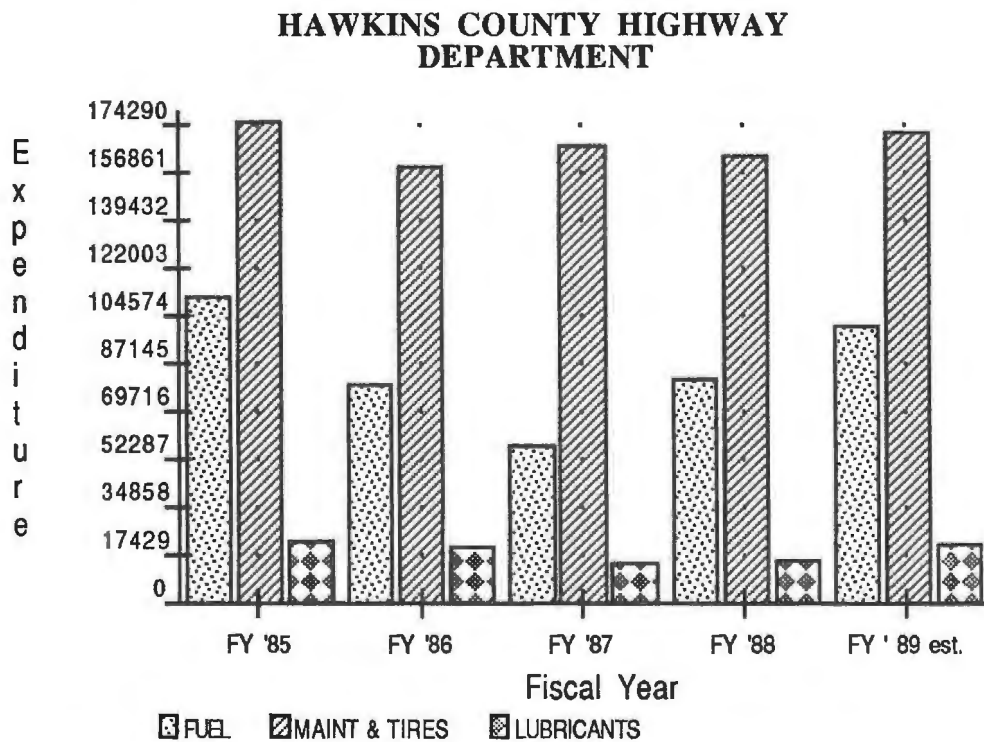


Figure 1. Hawkins County Highway Department vehicle expense

Hawkins County Sheriff's Department

The Hawkins County Sheriff's Department has assigned specific vehicles to each officer and supervisor. The objectives of this method of vehicle assignment are to decrease the total mileage for each vehicle, to achieve accountability, and to increase patrol officer presence in the community.

The chief deputy is primarily responsible for vehicle assignment and maintenance. The majority of all maintenance work during the past eight months has been performed by county jail trustees. The Sheriff's Department does not have a maintenance facility so most repair work is performed behind the jail. The chief deputy makes decisions on which repair jobs must be contracted to local private repair shops.

The sheriff and chief deputy prepare specifications for new vehicles and are now in the process of recommending a lease/purchase system for 20 vehicles. The Sheriff's Department has previously purchased new vehicles through the State of Tennessee police vehicle contract. Surplus vehicles are disposed through auctions or are retained for salvage of repair parts.

Preventative maintenance work is based on vehicle mileage. Each driver maintains vehicle warranty records in the vehicle. Monthly records for each vehicle are extensive and indicate total fuel use, repair parts, contracted maintenance, mpg, and cpm. These records are maintained by the chief deputy and provide an excellent management tool when vehicle assignments are made and when new vehicles are acquired by the department.

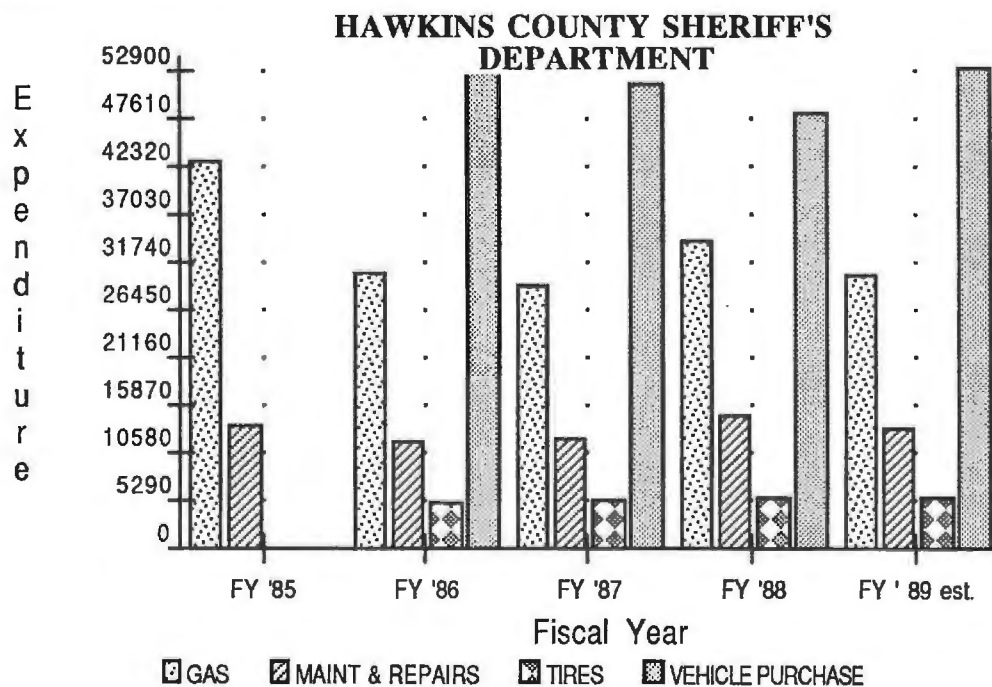


Figure 2. Hawkins County Sheriff's Department vehicle expense

Hawkins County Department of Education

The Hawkins County Department of Education operates a school maintenance shop in a 5,600 square foot building that was constructed more than 40 years ago. The shop is staffed with six mechanics, two general laborers, and one supervisor. The Department of Education maintains five fuel pump and storage tank locations. Both gasoline and diesel are available at the maintenance shop and at Church Hill. Gasoline only is available at Bulls Gap, Surgoinsville, and Clinch.

The maintenance shop has several problems related to the age and design of the structure. Space for inside repair work is limited and the physical layout makes multiple repair jobs difficult. The inventory of shop equipment is very basic but major repair work, including complete engine rebuild, is performed in the shop. Front-end alignments are contracted to local private shops. Hand tools are not provided by the Department of Education. The normal repair parts inventory is limited and most parts are obtained from local dealers on an as-needed basis.

The Department of Education has previously replaced six buses each year. Due to the requirement to retire buses more than 15 years old, 31 buses will need to be replaced during the next three years. The criteria for replacement has been the age of each bus rather than mileage or operating costs. Specifications for new buses are prepared by a school board committee. There has been an effort to standardize the fleet and to convert the entire bus fleet to diesel engines. Bids are open to any vendor, regardless of location. Maintenance trucks and some automobiles have been purchased through state and federal surplus. Department of Education surplus vehicles are salvaged for usable parts and then sold through public auction.

Most preventative maintenance work is performed during the summer months due to time constraints during the regular school year. Most drivers do not complete a daily checklist indicating bus condition. Fleet maintenance records are not computerized but an extensive manual record keeping system is used. Records and reports include fuel, oil,

parts, contract maintenance, and labor hours for each vehicle. Work orders are used in the shop and all parts and labor are assigned to specific vehicles.

Figure 3 shows the gradual decrease in maintenance and repair expense from the 1987 fiscal year through the 1989 fiscal year. Most other fleet expenses have remained level except fuel expense which has varied due to price changes and increased mileage provided by the diesel buses added to the fleet.

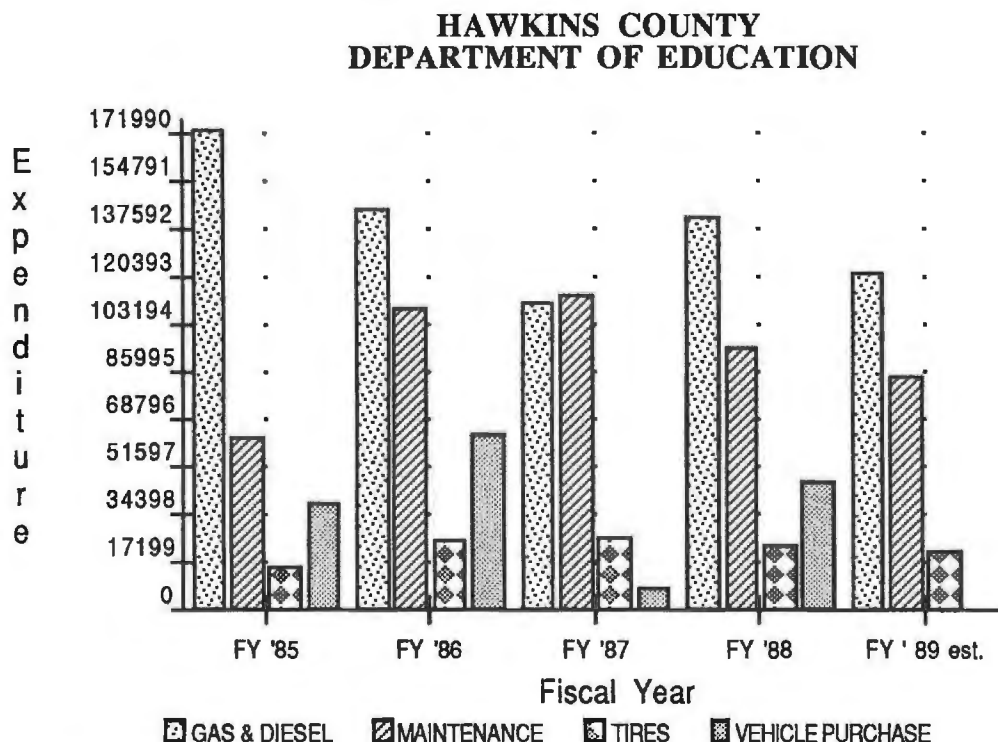


Figure 3. Hawkins County Department of Education Vehicle Expense

Hawkins County Fuel and Maintenance Data

Sheriff's Department

Several vehicles in the Hawkins County fleet were omitted from statistical analysis due to missing or incorrect mileage totals recorded from one or more months of the study period. Also, other vehicles were omitted when total mileage for the period was either extremely low or the vehicle was not used. There are 26 total vehicles in the Sheriff's

Department fleet and 21 were used for analysis. During the months chosen for analysis, these 21 vehicles traveled a total of 174,612 miles. The mean number of miles traveled was 8,314.86 miles per vehicle. The minimum number of miles was 1,533 and the maximum was 21,300. The mean number of gallons of fuel used during the study period was 442.55 with the lowest being 111.5 gallons and the highest at 903.3 gallons. Total fuel use amounted to 9,293.6 gallons. The mean mpg for the 21 vehicles was 19.34. The highest mpg was 29.77 and the lowest was 12.77.

As previously stated, most repair and maintenance work is performed by trustees from the county jail. For this reason, the total maintenance expense is comprised almost entirely of parts expense. For the study period, the total maintenance expense was \$4,322.44. Mean expenditures were \$205.83 per vehicle. The lowest maintenance expenditure was zero and the highest was \$558.17.

Total cost, which includes fuel, maintenance, and oil, amounted to \$10,364.48 for the study period. The mean total cost was \$493.55 for the 21 vehicles. The lowest total cost was \$84.58 and the highest was \$828.48. Mean cpm for the period was \$0.062. The highest cpm was \$0.142 and the lowest was \$0.024. The lowest age of any of the 21 vehicles was one year old. The highest age was ten years. The mean age was 3.67 years.

Figure 4 indicates the relationship between mpg and vehicle age for the 21 vehicles studied. Each dot represents a vehicle. The vertical scale is mpg and the horizontal scale is vehicle age in years. One of the reasons for the higher mpg demonstrated by the newer vehicles appears to be the assignment of the newer vehicles to high mileage patrols. The study results indicated a correlation between total miles and mpg. Another reason for the lower mpg for the older vehicles, and also for lower total miles, was that the older vehicles were out of service for repairs for extended periods.

HAWKINS COUNTY SHERIFF'S DEPARTMENT SCATTERGRAM OF MPG AND VEHICLE AGE

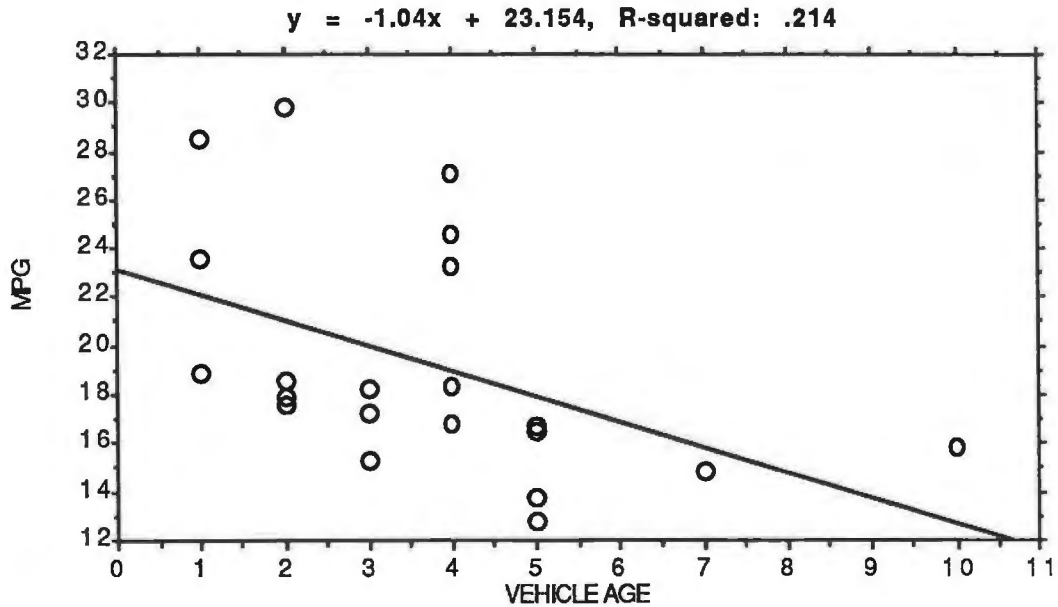


Figure 4. Hawkins County Sheriff's Department Scattergram of Miles Per Gallon and Vehicle Age

Differences between the older and newer vehicles become more apparent when all vehicles are grouped by age. For vehicles more than four years old, the mean mpg was 15.083. For the 15 vehicles four years old or less the mean mpg was 21.042. The mean number of miles traveled by vehicles more than four years old was 6,240.17. The mean number of miles traveled by vehicles four years old or less was 9,144.73.

The difference in mpg during the study period could have resulted in a savings of 1,779.35 gallons of fuel if all vehicles had achieved a mpg level of 21.042. An annual projection, based on the study period, results in an estimated savings of 7,117.4 gallons. Based on the current per gallon fuel cost of \$0.76, the potential fuel savings would result in a cost savings of \$5,409.22.

Department of Education

Of the 112 vehicles in the Department of Education fleet, there were 78 buses with adequate records for use in this study. Vehicles other than buses were not included in these comparisons. The primary problem with fuel and mileage records was several driver's failure to record the ending monthly mileage. The mean age of all buses included was 8.03 years. The newest bus was one year old and the oldest was 15 years old. The mean mileage driven during the study period was 4,319.95 miles. The highest mileage driven for the study period was 12,710.9 and the lowest was 395 miles. Total mileage during the study period was 336,956. The bus fleet consumed 52,192.47 gallons of fuel during the study period. The mean for all buses was 669.13 gallons. The highest use by a single bus was 1,764.8 gallons and the lowest use was 51 gallons. The mean mpg for all 78 buses was 6.8 mpg. The highest was 18.38 mpg and the lowest was 2.3 mpg.

The total operational cost, including fuel, oil, and maintenance, for the study period was \$53,773.35. The mean total cost per bus was \$689.40. The highest cost for a single bus was \$1,720.85 and the lowest was \$62.84. The mean cpm was \$0.189. The highest cpm was \$0.582 and the lowest was \$0.046.

One item of interest in the Hawkins County bus fleet was the comparison between gasoline powered buses and diesel powered buses. Of the 78 buses included in the study, 53 were gas-powered and 25 diesel-powered. The following table shows the comparison between the two types and the differences which result.

**TABLE 2. HAWKINS COUNTY DEPARTMENT OF EDUCATION,
COMPARISON BETWEEN DIESEL AND GASOLINE POWERED BUSES**

	Gasoline	Diesel	Difference
Miles Per Gallon	6.371	7.716	1.345
Cost Per Mile	\$0.196	\$0.173	\$0.023

Seventy-eight buses traveled a total of 336,956.3 miles or an average of 84,239.08 miles per month during the study period. The diesel powered buses traveled 110,975.3 miles and the gasoline powered buses travelled a total distance of 225,981 miles. The difference in mpg between gasoline and diesel powered buses could result in a savings of 6,183.26 gallons of fuel during the study period or 1,545.82 gallons per month (gpm). This projection does not include the effect of any other variable, such as total miles, and the effect of other variables on mpg or cpm. If the potential fuel savings could be obtained, the resulting cost savings would be approximately \$1,174.82 per month based on current fuel costs.

Highway Department

The Hawkins County Highway Department operates a fleet of 78 vehicles. This total includes heavy equipment and graders as well as trucks and other equipment. During the study period there was very little use of much of the heavy equipment due to adverse weather conditions. As a result there are 29 vehicles with sufficient records to include in this study.

The vehicles included in the study traveled a total of 88,222 miles during three months of the study period. The mean number of miles traveled was 3,042.14. The largest number of miles traveled by a single vehicle was 7,064 and the smallest total miles was 415. The 29 vehicles used a total of 10,789 gallons of fuel. The mean fuel use by all vehicles was 372.03 gallons. The highest use by a single vehicle was 928 gallons and the lowest use was 84 gallons. The mean mpg was 8.442. The maximum mpg was 12.6 and the minimum was 4.05. The Highway Department fleet used a total of 330 quarts of oil during the study period. Mean oil use per vehicle was 11.38 quarts. The maximum use by a single vehicle was 29 quarts and the minimum was one quart of oil.

A total of 325 hours of labor were recorded for maintenance on the 29 vehicles. Mean labor hours per vehicle was 11.2. Total parts cost amounted to \$2,766.75. Mean

parts cost per vehicle amounted to \$95.41. The mean cpm for the 29 vehicles was \$0.164. The maximum cpm was \$0.377 and the minimum was \$0.059.

Recommendations

Programs and Facilities

Hawkins County operates three different vehicle repair and maintenance sites. Each of the three have equipment or personnel which could assist the total fleet operation if the facilities were physically closer to each other. The Highway Department has tire changing equipment which could assist the Department of Education. The Sheriff's Department has the use of trustees from the county jail for vehicle maintenance. The Department of Education has mechanics on staff who are skilled in diesel engine repair and maintenance.

Hawkins County should take advantage of the opportunities offered by the various departments by initiating a fleet management program. The initial program would involve the appointment of a fleet management board with representatives from the Department of Education, the Sheriff's Department, the Highway Department, and the office of the County Executive. The fleet management board would have the responsibility of making recommendations to the county commission for the consideration of a county fleet management policy. The written policy would outline the responsibilities of each department. It would also provide specific guidelines for mileage reimbursement, safety, personal use of county owned vehicles, and many other items listed in the policy chapter of this study.

Following the recommendation of a policy statement, the fleet management board should review the repair facilities now owned by Hawkins County and determine possible methods for combining current repair work in existing facilities or construction of new facilities for use by all departments. Combine does not necessarily mean consolidate. Use of a central location for repair facilities could provide a convenient way for all departments

to use existing equipment and provide justification for purchase of additional repair equipment. Use of county jail trustees at a central location, when they are available, can provide a low cost method for all departments to increase the use of a daily preventative maintenance checklist.

Vehicle Replacement

Data gathered as part of this study indicate potential fuel savings through replacement of all Sheriff's Department vehicles more than four years old. The Sheriff's Department and county commission are considering the lease of new vehicles to replace all older cars now in operation. This method of vehicle replacement, with a four year lease period, appears to be a good approach for Hawkins County. The assignment of a specific vehicle to each officer of the Sheriff's Department has reduced total miles-per-vehicle to a level that would safely allow the life expectancy of each vehicle to last four years.

The Department of Education is presently facing the replacement of a large number of buses. The experience, both in fuel savings and lower repair costs, of operating diesel buses should be enough evidence to demonstrate the need to continue converting the bus fleet to diesel power.

The Highway Department has been forced to operate a large number of trucks due to the many gravel roads in Hawkins County. Current plans for road improvements appear to include more money for asphalt surfaced roadways throughout the county. Constant transportation of crushed stone makes up a major portion of the Highway Department budget, but does not provide a permanent solution to the problem. The Highway Department, along with the county commission, should continue to review the savings in truck cost, operators salaries, fuel, and crushed stone cost to determine if additional funds could be available for asphalt paving in the future.

Records

Hawkins County now collects and maintains many fuel use records. Each vehicle is recorded, and except for errors in original entries, the data are accurate and are maintained. However, final results of the data collection are not in a useful decision-making format by the department heads, the county executive, or county commission.

The Sheriff's Department uses a manual system which provides useful information on mpg and cpm for all sheriff's vehicles. Other departments maintain vehicle records but have larger fleets and cannot provide the staff necessary to maintain a manual fleet management records system. The Department of Education maintains a very extensive record system which includes labor hours and job descriptions for each vehicle repaired. The bus shop also retains records on preventative maintenance checks performed on each vehicle.

Hawkins County should consider the purchase of a computerized fuel management system to be used by all departments. Several systems are now available and each will allow any department to use any county-owned fuel facility. The final result of the use of such a system is a detailed report on fuel consumption and mpg of all vehicles. Many systems also allow entry of maintenance data so that decisions on vehicle replacement or assignment can be made based on total operating cost and cpm of operation of each vehicle. Another benefit of the computerized card system is the control it can provide over all fuel use. The ability to balance accounts between fuel dispensers and fuel deliveries may also provide documentation to help meet record requirements of ownership of underground fuel storage tanks.

Any record keeping system must rely on accurate and usable vehicle odometers. Each department should maintain the odometer or hour meter on each vehicle and training should be provided on the proper methods for completing existing fuel tickets, and maintenance time, and parts records. Sample forms are included in Appendix B.

City of Jackson

The City of Jackson is located 85 miles northeast of Memphis. The city population, according to the 1980 census, is 49,131. Jackson operates a fleet of more than 200 vehicles and equipment items. This study includes data gathered from three months of a five-month data collection period. The three months chosen were the most complete, with sufficient mileage, for the greatest number of vehicles. Nineteen vehicles or equipment items were removed from the final results due to insufficient total mileage or inaccurate mileage or fuel data.

Facilities

There are three primary shop facilities owned and operated by the City of Jackson. The public works garage performs major repair work on vehicles and equipment and is located adjacent to public works offices. Hand tools are adequate but other repair equipment is very limited. Technical work, such as engine analysis, must be contracted to private shops in the Jackson area. The fire department garage, which is jointly used by the Police Department, has newer facilities and more advanced equipment for technical repair work. Mechanics have access to computerized engine analysis equipment and, except for unusual circumstances, very few repair jobs are contracted.

The Jackson Transit Authority garage is located in an older facility but appears to have adequate space, both inside the main shop and under the rear shed, for multiple repair jobs. Most repair work, including major engine repair, is performed in the shop.

A separate shop is also used for the repair and maintenance of tractors and mowers. The shop has a full-time staff and a small inventory of repair parts.

Fleet Policies

The City of Jackson has not compiled a written fleet management policy. Most decisions related to the operation and maintenance of the fleet are based on past practices. The mileage reimbursement amount for the use of personal vehicles has been documented

and is currently \$0.24 per mile. This amount was chosen because it is the amount allowed by the IRS for mileage deduction. There is no written policy related to the assignment of city-owned vehicles for 24-hour use.

Specifications for new vehicles and equipment are prepared by the purchasing agent in cooperation with the department heads. There has not been an effort to standardize the fleet due to the requirement to accept low bids for most items. There are no geographic considerations given to prospective bidders. The bid list for each vehicle and equipment item is developed by using bid lists from previous purchases and through newspaper advertisements.

Some vehicles have been purchased through state or federal surplus but the number is low compared to the total fleet size. The State of Tennessee purchasing contracts can also be used when there is a potential for savings compared to the local bid process.

Bids requested for fuel in all departments, and prices throughout the study period, were among the lowest of any of the ten communities in the study group. Fuel prices obtained by Jackson ranged from a low of \$0.548 for regular and unleaded gasoline in January, 1989, to a high of \$0.798 for regular gasoline in May, 1989.

Records of repair work and fuel consumption are completed manually through work orders by each shop and are transferred to a computerized system by the accounting department. The method of recording fuel use and total maintenance costs changed during the study period and now indicates total costs, excluding insurance and administration, by specific vehicle.

Fleet Data

During the three-month period chosen for review, Jackson's fleet traveled 369,802 miles and consumed 42,977 gallons of gasoline and diesel fuel. The fleet used 236.5 quarts of oil and repair parts cost \$4,022.46. The total cost of fleet operation for the period, including fuel, oil, parts and labor, was \$34,798.41. The study period did not

include summer months when street repair equipment was heavily used. For this reason, it is not possible to use averages from the study period to project annual cost amounts.

Maintenance and repair costs are extremely low when compared with total operational costs. Figure 5 shows each expense as a percentage of the total fleet cost during the study period. Insurance and administrative costs are not included.

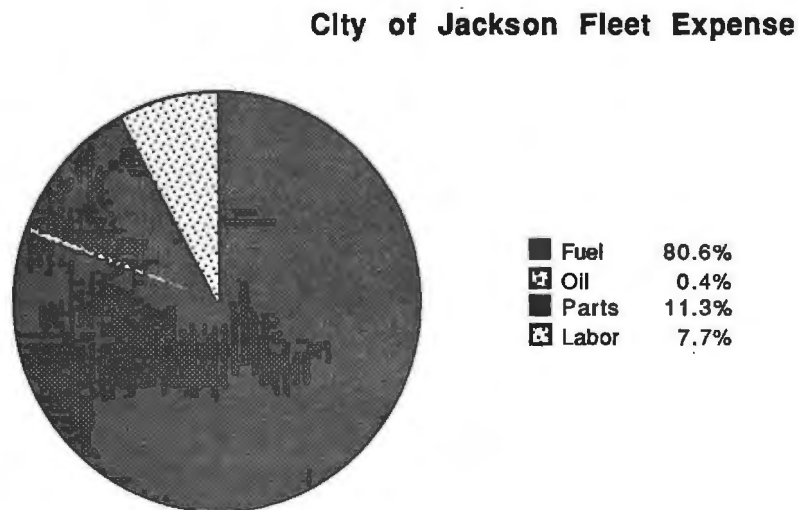


Figure 5. City of Jackson Fleet Expense for Study Period

The mean number of miles traveled by the 181 vehicles remaining in the study was 2,043.11. The lowest number of miles was 32 and the highest was 11,424. Total miles for all vehicles was 369,802. A total of 42,977 gallons of gasoline and diesel fuel was used during the study period. The lowest use was 16.1 gallons and the highest use for the period was 1,032.2 gallons. Average fuel use was 237.44 gallons. The fleet averaged 8.638 mpg with the lowest being an average of 1.16 mpg and the highest being an average of 24.34 mpg.

The average parts cost for the period was \$20.84 per vehicle. The lowest parts cost was zero and the highest was \$435.70. The average labor cost was \$14.17 with the lowest again at zero and the highest at \$204.84. Average total cost for the period was \$192.26.

The lowest total cost was \$11.30 and the highest was \$924.07. Total cost for the 181 vehicles included in the study was \$34,798.41 for the period.

One of the most important variables for management use in the review of fleet operations is the cpm (or cost-per-hour if available). The mean cpm for the Jackson fleet during the study period was \$0.11. The lowest cpm was \$0.03 and the highest was \$0.51. Cost-per-mile can be both an indication of under-utilization of vehicles and a signal of which vehicles should receive priority consideration for removal from the fleet. When using cpm as an indicator, care must be taken to compare vehicles within the same classification or use. Heavy trucks and other equipment operated by the Public Works Department will consistently remain higher than police vehicles. Fire trucks and pumpers will also remain larger due to the high vehicle weight as well as the extremely low miles traveled.

Within each vehicle classification, and within each department, a periodic review of cpm averages will assist in making management decisions concerning which vehicles should be removed from the fleet. For high mileage vehicles it is a simple matter of calculating the savings, which could result from replacing an older, high maintenance vehicle. For low mileage vehicles the decision may be more difficult. The service provided may not allow the removal of a vehicle, such as a reserve fire truck, from the fleet regardless of the cpm of actual operation.

Eighty-three police vehicles were included in the summary above. The police vehicles were then reviewed separately and resulted in a mpg of 9.83. The mean cpm for these vehicles was \$0.099.

Figure 6 illustrates the relationship between mileage and cpm for all vehicles included in the study. The highest cost per mile totals were experienced by the vehicles with the lowest total mileage. While the mean total mileage for all vehicles was 2,043.11 miles, the Police Department accounted for the highest total miles per vehicle. Vehicles with extremely low total miles were not included in these calculations. Also, several

vehicles and equipment items assigned to the Public Works Department were excluded because they were not operated during the study period. The relationship does not show significant strength for all vehicles and is included for illustration of the relationship only.

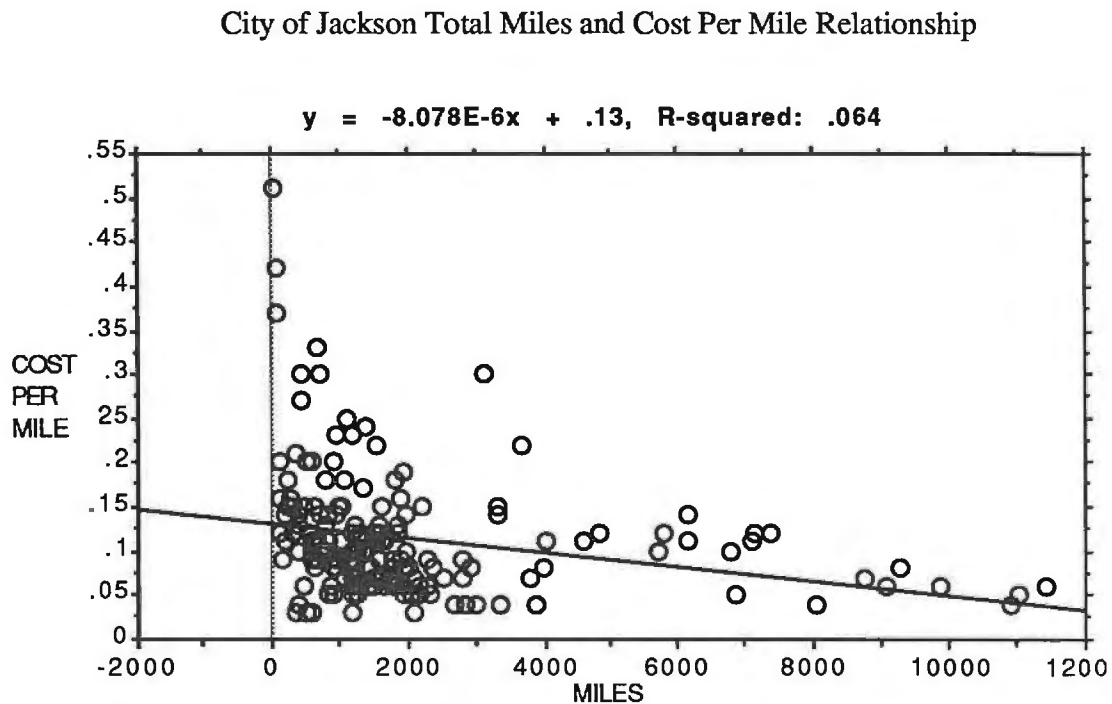


Figure 6. City of Jackson Relationship Between Total Miles and Cost Per Mile

Recommendations for City of Jackson Fleet Operations

Jackson, by owning and operating a fleet of more than 200 vehicles and equipment items, has opportunities to lower total costs by increasing the amount of management review devoted to vehicles and their operation. Some current procedures, such as the constant bid process for fuel purchases, would be difficult to improve on. The items which follow are based on both the observation of the Jackson fleet as well as data and policies collected from the nine other communities participating in this study:

1. Continue to add detailed information to the existing computer system which

will allow monthly review of cpm or cost per hour totals by specific vehicle.

2. Create a fleet management board consisting of the department heads from all major city departments. The board would initially be responsible for recommending a uniform fleet management policy for consideration of adoption by city council. The fleet policy would include: detailed information concerning the maintenance and repair shops owned by the city and the priority for use by any department; procedures for assignment of vehicles for 24-hour use and the criteria which would require such assignments; compensation amounts and procedures for establishing a monthly compensation system in lieu of permanent vehicle assignments; procedures for the removal of vehicles and equipment from the individual department fleets and transfer to a central vehicle and equipment pool for use by all departments; a uniform system of charges for vehicle use and vehicle repair and maintenance for all departments and all repair shops.
3. Appoint or assign a fleet manager who would work with the fleet management board and have the authority to recommend changes to the total fleet operation. Jackson has repair shops which can perform specialized jobs but they are not currently used by all departments. Work is contracted because no single department has enough vehicles to justify the purchase of specialized equipment. The fleet manager would be responsible for assigning repair work to the facility equipped to perform the service. The most important duty of the fleet manager would be to review monthly reports to determine which vehicles in the total fleet should have the highest priority for replacement and which vehicles are under-or over-utilized.
4. Begin a demonstration project which would involve the permanent assignment of police vehicles to officers for 24-hour use. The initial assignments may only be a portion of the entire department, but would allow cost comparisons

to be made over a six to 12 month period. Police vehicles normally accumulate the highest number of total miles of any government vehicle due to the continuous use of each vehicle. The individual assignment method is costly to initiate but has proven to be successful nationally and is now in use by many Tennessee cities and counties.

5. Consider the use of computerized fuel monitoring systems. Computerized systems are now available from several vendors and have the software capability to transfer all fuel data to other spreadsheet formats. There is a considerable amount of time now devoted to the completion of fuel tickets and the entry of this information into the existing computer system. The final results of the existing system does not prove useful as a decision-making tool for management. Several Tennessee communities, including one participant in this study, are now using computerized fuel monitoring systems. The easiest method to control fuel use, and reduce the total fuel budget, is through the use of systems which detail how each gallon was used.

City of Lebanon

Lebanon is located 30 miles east of Nashville. The city population, according to the 1980 census, is 11,872. Lebanon operates a central vehicle repair facility which serves all departments. The garage is staffed with one supervisor, one foreman, two mechanics and one general laborer, who works primarily on vehicle lubrication. The garage performs limited work on Fire Department vehicles because most fire equipment is presently under warranty. The garage has four large bays and one office.

Major shop equipment includes air tools, jacks and stands, and a press. Hand tools are furnished by the employees. The shop does not have electronic engine analysis equipment. Repair work performed in the shop includes complete engine rebuilds, transmission and clutch repair, and regular service including oil and filter changes. Work contracted includes wheel alignment, tire replacement, and muffler repair and replacement.

Decisions to replace vehicles are made by the director of public works following recommendations by the garage supervisor. Replacement is usually based on the general condition of the vehicle. Specifications for new vehicle purchase are written by the purchasing agent. Selection of vehicles is based on the low bid submitted. Surplus vehicles are disposed through periodic auctions.

Preventative maintenance is scheduled for each vehicle every 2,000 miles or once each month when possible. There is no daily checklist used by vehicle operators to verify the condition of the vehicle or equipment.

The vehicle record system is separated between fuel use and maintenance. Fuel records begin as daily fuel reports completed by the pump operators. The daily fuel reports contain the vehicle number, type and amount of fuel, oil, odometer reading, and name of vehicle operator. The daily fuel report is then submitted to the accounting department where it is summarized, by vehicle, for department billing on a monthly basis.

Maintenance records are maintained by the garage supervisor. The filing system includes separate cards for each vehicle. Each repair is entered on the vehicle card along

with parts used and hours worked. The maintenance records are not summarized with the fuel use records.

The total fleet operation is funded through monthly billings to each department. The city departments using the fuel and maintenance facilities include street, sanitation, electric, gas, police, sewer plant, water plant, maintenance and, on a limited basis, the Fire Department. There are no "pool" vehicles in the fleet, but charges are established for the use of vehicles by other departments within the city.

Figure 7 shows the expenditures for repairs and maintenance, gas and oil, and parts for selected city departments and agencies for the 1988 fiscal year.

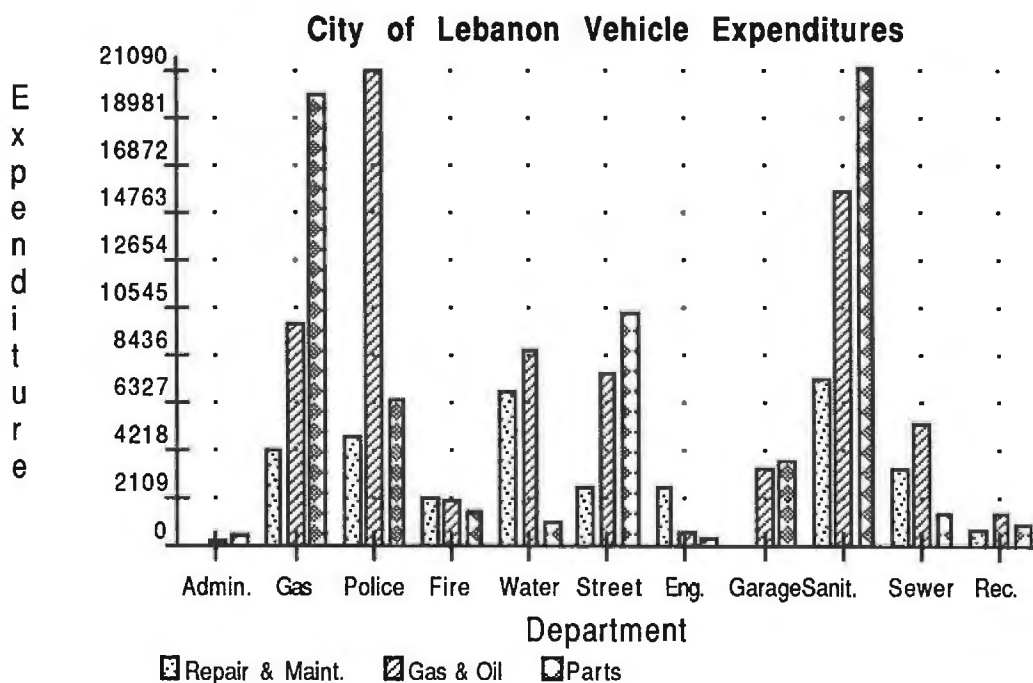


Figure 7. City of Lebanon Vehicle Operation Expense for the 1988 Fiscal Year

City of Lebanon Fuel and Maintenance Data

Thirty-eight vehicles were included in the analysis of fuel and maintenance during the study period. Vehicles were omitted when mileage records could not be calculated

from the daily fuel reports. The current record keeping system used by Lebanon does not summarize total mileage by vehicle.

The 38 vehicles included traveled a mean of 5,894.66 miles during the study period. The minimum number of miles was 727 and the maximum was 23,166. Mean fuel consumption was 814.98 gallons which resulted in a mean of 7.67 mpg. The lowest mean mpg for a single vehicle was 1.38 and the highest was 24.55. Mean total cost of operation, including fuel and maintenance, was \$629.22. The highest mean cost for a single vehicle was \$2,296.51 and the lowest was \$117.75. The mean cpm for the 38 vehicles was \$0.174. The highest cpm was \$1.52 and the lowest cpm was \$0.028.

Seven police vehicles were included in the preceding calculations and were then reviewed separately. For these seven vehicles, the mean number of miles traveled was 15,381.29. Mean mpg was 9.88 and mean cpm was \$0.092.

City of Lebanon Recommendations

Lebanon has established an efficient vehicle maintenance operation including a central shop facility which provides service for all departments. The shop is well-equipped and maintains written records of maintenance performed on each vehicle. Preventative maintenance is scheduled and records are retained to demonstrate excessive repairs required for individual vehicles and equipment items.

This central shop facility, and maintenance records system, could become a total vehicle information system through the combination of existing fuel records with existing maintenance data. Fuel records currently begin as daily fuel record sheets completed by fuel pump operators. The fuel records are then transferred to the accounting department for use in billing each department. The system is complicated and time consuming and does not result in a calculation of mpg or cpm for individual vehicles. The current system would be difficult to use for management decisions concerning vehicle replacement or transfer to lower mileage uses.

Lebanon should consider the use of a computerized fuel monitoring system located at the existing fuel pumps. The computerized system would eliminate the current daily fuel reports. The result would be a daily or monthly summary of fuel use by vehicle and by operator. The summary information would also show mpg by vehicle.

The computerized system should be linked to a personal computer, located in the maintenance shop. All current written maintenance records could be entered, along with the fuel data, to provide a history of total cost and cpm for each vehicle. The monthly mpg and cpm summaries could be used to determine the need for vehicle replacement and special maintenance, and would provide information on the most cost effective vehicles when new purchases are considered. The time required to use the system would be no greater than the time now used to complete the written fuel and maintenance reports.

The administrative review of vehicle operational costs may only result in small changes in average mpg or cpm, but the changes can have significant benefits due to the total miles driven. For example, if all current police vehicles travel a combined total of 10,000 miles per month, and if gas mileage could be increased from the current 9.88 mpg to 12 mpg, the improvement could result in approximately 2,146 gallons of fuel saved each year.

Sample record forms are included in Appendix B.

McMinn County

McMinn County is located 59 miles southwest of Knoxville. The county population, according to the 1980 census, is 41,878. The county vehicle records system does not include data indicating fuel consumption by vehicle or vehicle mileage. For these reasons there are no calculations related to operational cost included as a part of this study.

McMinn County has three major departments which operate separate vehicle fuel and maintenance facilities. The Highway Department and Department of Education have separate repair shops and the Sheriff's Department uses local repair shops through a maintenance contract.

Highway Department

The Highway Department garage is located in the same building with their administrative offices. The garage is staffed with one foreman and six mechanics. There is also one mechanic's helper, one parts clerk, and one custodian. The facility was constructed more than 30 years ago.

Department of Education

The McMinn County Department of Education operates a maintenance shop in a building that was constructed approximately 20 years ago. The shop performs maintenance on 120 vehicles and equipment items. The shop is staffed with one supervisor, four mechanics, and two helpers.

The Department of Education operates only gasoline powered buses. Fuel pumps are located at Etowah, Riceville, Calhoun, Niota, and at the bus garage. The bus garage performs all types of maintenance, including major engine repairs, transmission, and glass work. The shop is equipped with a steam cleaner, engine stands, and air tools. Hand tools are furnished by the Department of Education.

All buses are scheduled for lubrication every other week. Oil and filters are changed every four weeks, an average of approximately once each 2,500 miles. There were no engine failures during the 1988 - 1989 school year.

Sheriff's Department

The McMinn County Sheriff's Department operates 20 vehicles. Seven cars are assigned to specific individuals. Four new cars are purchased each year based on the general condition of the vehicle.

Maintenance is performed by local repair shops based on a maintenance contract. There are no records maintained on fuel consumption or total cost by vehicle.

McMinn County Recommendations

McMinn County should begin using a fuel and maintenance records system that would apply to all departments. These records would result in summary information that could be reviewed by department heads, the county executive, and county commission.

One method of beginning a fuel record system would be through the installation of a computerized fuel monitoring system which would automatically record fuel consumption and mileage by vehicle. The first step in installing an automatic fuel monitoring system should be the review of current pump and storage tank locations to determine if some existing sites could be combined within the Athens area. A computerized fuel system would require the use of a card, along with an employee identification number, to start the fuel pumps. The system selected should also require the entry of the current vehicle odometer reading before the pump could be used.

Results of the monthly fuel summary, along with reports generated by the remote fuel sites operated by the Department of Education, could be provided to the Finance Department. The Finance Department could then add information on maintenance costs by vehicle so that a complete record of mpg, total cost, and cpm could be generated. The

accuracy of the system would depend on the methods used by the Department of Education and Highway Department to record maintenance costs, including maintenance hours, for each vehicle. Existing records maintained by the Highway Department do not include this information. The Department of Education maintenance shop records all repairs based on flat rate hours indicated by standard repair manuals.

McMinn County should also review the types of equipment purchased by each department to determine if more sophisticated repair equipment, such as an electronic engine analyzer, could be purchased and used by all departments. Preventative maintenance programs can provide the best long-term method to decrease fuel use. Newer vehicles will require more equipment and training in order to provide adequate maintenance and repairs to avoid down time.

A method which could initiate the use of joint equipment purchases would be through appointment of a fleet management board. The board could consist of representatives of the Sheriff's Department, Highway Department, and Department of Education. The fleet management board would be responsible for recommending to the county commission a uniform fleet management policy. The policy would address items such as reimbursement for the use of personal vehicles, training for operators and maintenance personnel, preventative maintenance programs for all departments, as well as new equipment required to perform vehicle maintenance and repairs.

Sample fuel and maintenance record forms are included in Appendix B.

Memphis

Memphis is located in the southwest corner of Tennessee. City population, according to the 1980 census, is 646,356. Memphis provides vehicle maintenance through the centralized Division of General Services. General Services has three major departments: Support Services, which includes accounting, data entry, parts storage and management analysis; Heavy Equipment, which includes five repair shops; and Light Equipment, which includes three major repair shops and smaller repair and maintenance facilities at the four police precincts. This study involves only the south precinct of the Police Department. Within the south precinct, 20 patrol vehicles were selected by the Department of General Services for review of fuel and maintenance data.

Memphis has a written fleet management policy. An organizational chart also details the specific reporting procedures for all sections of the General Services Division. Fleet policy decisions are made by the administrator of the General Services Division along with the managers of the Light Equipment and Heavy Equipment Departments.

Repair priorities are established by the foremen and leadmen for each of the departments. All types of repairs, except radios, are completed by the General Services Division. The four police satellites and sanitation satellite shops complete all types of repairs except body work. The Division is fully equipped for any type of repair. There are separate departments for hydraulics, transmissions, welding, and body work. Large tools are furnished by the Division and small tools are the responsibility of the employee.

Vehicle replacement is based on age, mileage, vehicle hours, and operating costs. Light vehicles are normally auctioned or salvaged when total miles reach the 65,000 to 90,000 range or five to seven years in age.

Specifications for new vehicles are normally developed by the division using the vehicles. Uniform specifications for new vehicles and equipment were developed in 1986, 1987, and 1988. Strong emphasis is directed towards standardization of the fleet to take advantage of volume buying as well as minimizing inventory investment.

A bid list for new vehicles and equipment is compiled from listings of previous vendors, vendors who have requested to be placed on the bid list, and vendors who have demonstrated their vehicles or equipment or that provide specialty products. No vehicles are acquired through state or federal surplus programs. The policy for bid acceptance is "best low bid" rather than strictly low bid.

Preventative maintenance is scheduled for each vehicle based on mileage. Records of all vehicle maintenance are computerized and are compiled by the General Services Division. Computerized work orders are used to record labor and parts cost for each repair completed. A twelve-month on-line record is then retained for each repair and parts transaction. The flow of a single repair includes:

1. vehicle record opened on computer for new work order
2. copy of work order given to mechanic
3. mechanic and Parts Department record parts and labor
4. work order approval by foreman after completion of repair
5. work order forwarded to Data Entry Department for entry of charges

Completed work orders are summarized and used to make management decisions concerning:

1. life usage of vehicles
2. disposal of vehicles
3. use of specific product lines

Records are used as part of an automatic method to detect repetitive repair work. A separate print-out can be provided to list work by repair type or by vehicle.

The General Services Division is not self-supporting. A budget for operations is prepared and approved by city council. Each piece of equipment is assigned to a specific department and is not the property of the General Services Division. Future vehicle needs are based on requests by each division and are not necessarily based on the operational cost of each vehicle.

Job descriptions are provided for each repair and maintenance position in the General Services Division. Future manpower needs are based on a statistical analysis of the historical and current information related to repairs, skilled labor, maintenance and unskilled labor.

Fuel records begin as written entries on a fuel record sheet located at the fuel pump at the south precinct. The information is recorded by a fuel attendant when staff is available. At times the records are not completed or are not legible. The written entries are sent to the General Services Division each month for entry in the record for each vehicle.

Memphis South Precinct Fuel and Maintenance Data

The 20 vehicles included in this study traveled a total of 66,261 miles during the portion of the study period used for analysis. The mean number of miles per vehicle was 3,313.05. Total fuel consumption was 4,840.9 gallons. Mean fuel consumption was 242.05 gallons with the lowest at 43 gallons and the highest at 469.7 gallons. The mean mileage for all vehicles was 14.38 mpg. The lowest mpg for a single vehicle was 8.64 and the highest was 21.29.

The mean cpm for the twenty vehicles was \$0.04. The highest cpm was \$0.062 and the lowest cpm was \$0.024. Cost per mile totals included only fuel and maintenance.

Memphis South Precinct Recommendations

1. The computerized work order system used by the General Services Division is a model for other communities in Tennessee. The system provides detailed maintenance histories for each vehicle. The system could be improved through the establishment of an accurate method of recording fuel consumption. Accurate fuel records, by vehicle, could assist in the use of a total cost approach to determine both vehicle replacement needs as well as operating characteristics of vehicle types.

A remote recording device was previously installed at the south precinct and suffered from constant repair and maintenance problems. Computerized fuel monitoring systems now available seem to have overcome these problems and can provide a reliable record of fuel use, vehicle number, operator, and total mileage. Some systems transfer fuel data to standard spreadsheets for transfer to other systems used for accounting or maintenance records.

The General Services Division is currently installing remote fuel recording equipment at the High Street Garage. A demonstration of the use of fully computerized recording equipment, using vehicle cards, and employee numbers, would be possible at the High Street facility with very little additional construction or cost. Consideration should be given to the use of High Street as a demonstration site for such equipment. If successful, similar equipment should be installed at the south precinct. Selection of the demonstration equipment should include an investigation of the possible transfer of fuel data to the work order computer system to avoid monthly entry of fuel and mileage data.

2. Consideration should be given to the combination of vehicle repair services and vehicle ownership. The General Services Division provides complete repair services for the south precinct but does not control the selection of vehicles or vehicle ownership.

The General Services Division should be responsible for providing patrol cars for use by the officers of the south precinct. This responsibility should include the review of historical data to determine the proper specifications, vehicle purchase, vehicle maintenance and fuel, and final disposal of surplus or salvage vehicles.

The role of the General Services Division would be much like that of a commercial rental car company. Everything related to the operation of patrol vehicles would be provided by General Services. The officer would have a clean and properly equipped vehicle for the for job performance and would have a single department to contact if problems occur.

The complete maintenance and ownership approach should include methods for constant evaluation. Administrative staff of the south precinct should be provided with monthly reports which show total mileage and cost by vehicle. They should also be provided with a timely response to questions or concerns about the operation of vehicles and priority of repairs.

3. The General Services Division and the administration of the south precinct Police Department should consider the assignment of vehicles to individual officers as a demonstration project. Proper care and concern for each vehicle is difficult when there is little control over responsibility. The use of each vehicle for multiple shifts causes total mileage to rapidly accumulate.

The use of a limited number of cars for a demonstration of specific vehicle assignment could provide a method to compare total cost with the current "pool" approach. The initial cost may be high, due to the need to add vehicles, but the long range cost reduction, due to extended vehicle life and personal accountability, may provide a cost savings and increased reliability.

Polk County

Polk County is located 37 miles east of Chattanooga. The county population, according to the 1980 census, is 13,602. Polk County is unique geographically from the other nine communities included in this study. The county is divided by a mountain range which has resulted in the use of separate county facilities on each side of the mountain. Both the Highway Department and Department of Education maintain vehicle maintenance facilities on each side of the mountain.

The county does not presently have a written fleet policy. Mileage reimbursement for the use of personal vehicles is currently \$0.21 per mile. Vehicle records are maintained by the Sheriff's Department, Highway Department, and the Department of Education.

Highway Department

The Polk County Highway Department operates repair facilities in Benton in a shop that is 15 years old and which contains approximately 1,800 square feet of office and shop space. The second facility, at Copper Basin, is approximately 40 years old and has around 900 square feet of usable shop space.

Each of the facilities used for vehicle and equipment maintenance is staffed with one mechanic. Hand tools are furnished by the employees. Major equipment items, such as floor jacks, air tools, and a drill press, are furnished by the Highway Department.

Major repairs are completed at each shop. Repair work includes complete engine rebuilds as well as minor maintenance. Frame work and wheel alignment are contracted.

Several vehicles and equipment items have been acquired through the State of Tennessee surplus program. Recent acquisitions include two pick-up trucks, two carryalls and one rubber-tired road tractor. There have been no new vehicle or equipment purchases by the Highway Department since 1985.

Preventative maintenance is performed on Highway Department vehicles and equipment every 30 days. Vehicles are scheduled at both repair shops for oil changes and lubrication. The Highway Department maintains a very small parts inventory.

Department of Education

The Polk County Department of Education operates one bus garage near the High School in Benton and a separate garage near Copper Basin High School. Each garage is staffed with two mechanics.

Equipment at the bus garages includes air tools and floor jacks. There are no tire changing tools at either location. Employees provide their own hand tools.

Work performed at the bus garages includes complete engine rebuilds and welding. Very little work on buses is contracted. Local parts stores are used for supplies and no inventory is maintained at the garages.

A complete preventative maintenance check is made of all buses each month. Oil is changed each 3,000 miles. Maintenance records are maintained for vehicles under warranty.

Sheriff's Department

The Sheriff's Department does not have a vehicle repair facility. Most maintenance is performed by trustees from the county jail. Some work is contracted to repair shops in both Benton and Copper Basin.

The chief deputy and sergeant are primarily responsible for vehicle repair and maintenance. Reports are maintained on all vehicles which include mileage and total fuel consumption. Records for the sheriff's and chief deputy's vehicle are divided between the Benton and Copper Basin offices.

Polk County Fuel and Maintenance Data

The Polk County Department of Education does not maintain bus records in a format which would allow a comparison of either miles per gallon or cost per mile. The following summaries include vehicles from the Sheriff's Department and Highway Department fleets.

The Polk County Sheriff's Department maintains complete records indicating miles traveled and fuel used for each vehicle. Six vehicles were used for analysis as part of this study.

Sheriff's Department

The six Sheriff's Department vehicles traveled a total of 33,398 miles during the study period. The mean number of miles traveled per vehicle was 5,566.33.

Mean fuel consumption for the period was 423.83 gallons. Mean mpg was 12.94. The highest mpg was 15.85 and the lowest mpg was 8.71.

The mean cost per mile for the six vehicles was \$0.68. The highest cpm mean was \$0.095 and the lowest mean for a single vehicle was \$0.052.

Highway Department

The nine Highway Department vehicles included in the study traveled a total of 9,016 miles during the study period. The mean mpg was 5.83. The highest mpg was 17.20 and the lowest mpg was 4.40. The highest cpm was \$0.362 and the lowest was \$0.085.

Recommendations

Polk County should install new fuel storage tanks in both Benton and Copper Basin. The location of these storage tanks should be made in anticipation of future joint facility use by all county departments.

The Polk County Sheriff's Department presently repairs patrol vehicles near the county jail in Benton, using trustees from the jail to make repairs. The Highway Department garage is located near the jail and is equipped with air tools and other equipment.

The Department of Education Benton bus garage is not located in close proximity to either the Highway Department garage or jail. The bus garage is not well-equipped and does not have adequate space for repair work. The bays are small in width and the building is not well-suited for repair work on large buses.

Polk County should begin a review of these existing facilities and determine if funding from all departments would allow the future construction of a central maintenance facility in the area between the county jail and Highway Department garage. If cooperation between departments would allow such combinations, then the county should consider a future site while locating new fuel storage tanks this year.

No department within Polk County can justify the kinds of equipment needed to make repairs to newer, more sophisticated engines. The problem is further complicated due to the need to have separate maintenance facilities in Benton and Copper Basin. The joint purchase of additional shop equipment, such as an electronic engine analyzer, could be possible if all departments were using central facilities in both Benton and Copper Basin.

The Polk County Sheriff's Department averages more than 10,000 total miles of travel each month. Average mpg during this study period was 12.94. If additional maintenance could be performed on each vehicle which could result in an increase to an average of fifteen miles per gallon, the potential exists to save 1,273 gallons of fuel each year.

Record keeping by the Department of Education should also be improved in order to allow the school board to review monthly totals of mpg and cpm for each bus. High

cpm averages can help designate which buses to replace first or can assist in determining which buses are the most economical to use for special trips.

Roane County

Roane County is located 36 miles west of Knoxville. The county population, according to the 1980 census, is 48,425. Roane County has three departments which operate the majority of all vehicles. For the purposes of this study there were 125 vehicles which had sufficient fuel and mileage records for analysis. Small fleets operated by the ambulance service and sanitation crews were not included. The Department of Education operates the largest fleet and 62 school buses were included in the study. Also included were 43 vehicles operated by the Highway Department and 20 vehicles operated by the Sheriff's Department.

Department of Education

The Roane County Department of Education operates a bus repair garage in a building also housing the administrative offices of the school system. The building was constructed approximately 20 years ago. The garage is staffed with one supervisor, three mechanics, and one route supervisor. The garage supervisor and route supervisor each report to the superintendent of education. The bus garage has very little technical equipment but most major repairs are completed in-house. Decisions concerning contract repair work are made by the garage supervisor.

The Department of Education garage is not self-supporting and is totally funded through the school budget. Roane County also provides bus transportation for the City of Harriman school system. The cost of providing service to the City of Harriman is separately funded by the Roane County Commission. Bus trips for activities other than regular school student transportation are reimbursed on a cost basis by the school requesting the special trips.

The records maintained by the bus garage were changed during the course of this study and now include total miles and total fuel for each bus. Maintenance records include parts and labor cost but some contract maintenance may not be reflected in the garage

records. Several buses were omitted from the final analysis due to incomplete records provided by the bus drivers.

Fuel is available at the bus garage and at remote sites throughout the county. Continuous monthly fuel records are maintained by each bus driver. All fuel storage tanks are for gasoline only. There are no diesel buses in the Department of Education fleet.

Figure 8 shows the comparison between gasoline, tires, and vehicle parts for the period 1987 through 1989. Changes to each of these expense categories were very minor throughout the period.

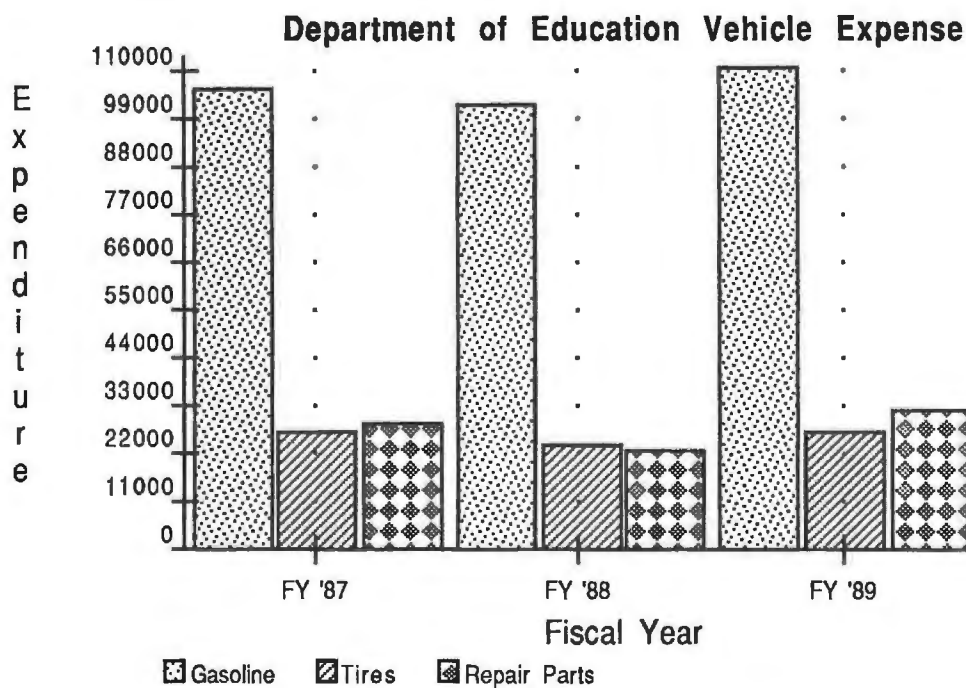


Figure 8. Roane County Department of Education Vehicle Expense

Sheriff's Department

The Roane County Sheriff's Department does not operate a garage or maintenance shop. Repair work is performed by local maintenance shops and vehicle dealers in the Kingston area. Like Hawkins County, Roane County assigns a specific vehicle to each

officer. Except for unusual circumstances, the vehicles are only used for one work shift each day.

Records maintained by the Sheriff's Department are limited and are not in a format allowing review for management decisions. The daily fuel tickets are collected and filed each month and are not summarized by vehicle. Maintenance and repair records are retained by the accounting department located in the courthouse.

Figure 9 shows the comparison between gasoline, tires, maintenance, and repair parts costs from 1987 through 1989. Parts expense, as a line item, was added to maintenance in 1989.

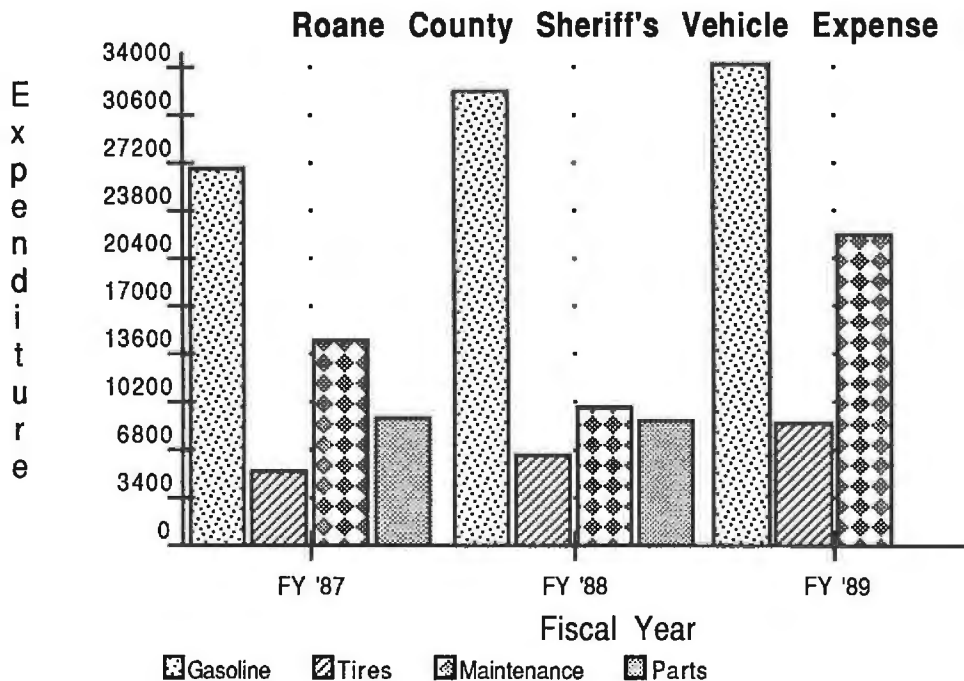


Figure 9. Roane County Sheriff's Department Vehicle Expense

Highway Department

The Highway Department shares a general service facility with the Roane County Ambulance Service. The building was constructed in 1979 and opens on

each side to provide eight service bays. The Highway Department garage has limited equipment, including a three-ton hoist, but does not have tire changing or engine analysis equipment. Large tools are furnished by the department and small tools are furnished by the employees.

The garage is staffed with two mechanics and two general laborers. Work performed in the garage includes partial engine rebuilds and preventative maintenance. Major repair work, such as engine head and valve repair and track work for dozers, is contracted. Preventative maintenance work is planned for each 3,000 miles or 30 days for each vehicle, but the schedule is not maintained at all times. Preventative maintenance includes oil change, filter replacements, and a general check of all systems. Records are not maintained to verify the actual preventative maintenance schedule for each vehicle.

Figure 10 shows the comparison between expenditures for diesel fuel, parts, gasoline, and tires for the 1986 through 1989 period. Parts expense for the period exceeded both the cost of diesel fuel and gasoline.

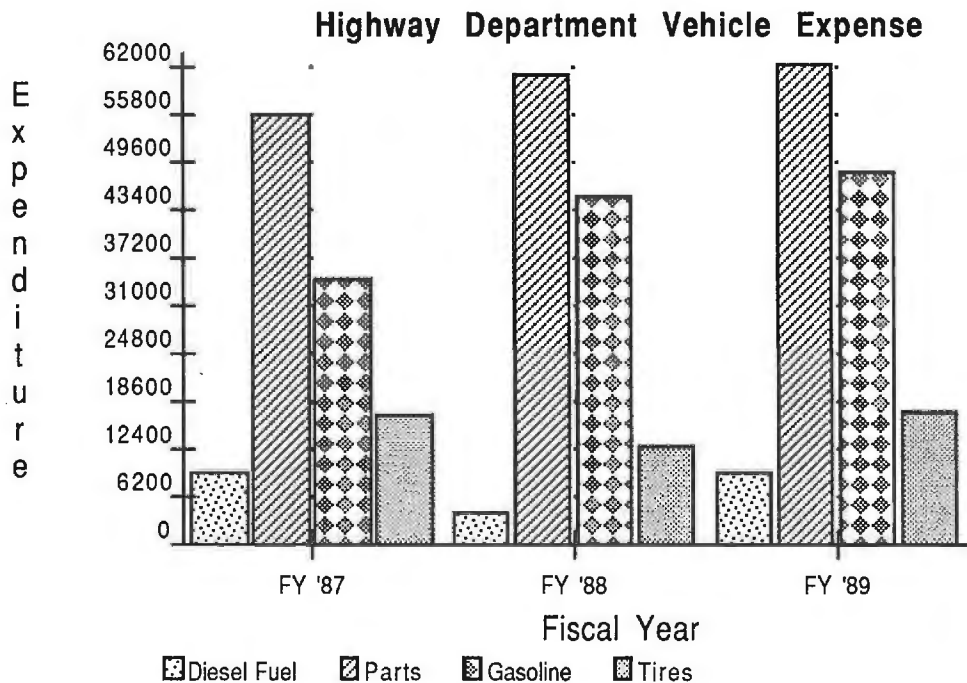


Figure 10. Roane County Highway Department Vehicle Expense

Roane County Fleet Data

Department of Education

Sixty-two vehicles operated by the Roane County Department of Education had sufficient records and mileage for use in this study. Total miles driven during the study period were 133,595 miles. The highest number of miles by a single vehicle was 5,232.5 and the lowest number of miles by a single vehicle was 410. A total of 34,654.8 gallons of fuel was consumed during the study period. Mean fuel consumption was 558.95 gallons per vehicle. The mean mpg for all vehicles was 3.79. The highest for the period was 9.28 and the lowest was 2.05.

Total cost of fuel, oil, repair, and maintenance for the period was \$22,773. The mean cost per bus was \$367.31. The highest cost for a single bus was \$1,046.16 and the lowest cost, for a bus that was only operated for a limited time during the study period, was \$72.00. Mean cpm for the 62 buses was \$0.181. The highest cpm was \$0.331 and the lowest cpm was \$0.065.

Sheriff's Department

Sufficient records were available for the analysis of 20 vehicles operated by the Roane County Sheriff's Department. During the study period these vehicles traveled a total of 205,160 miles. Mean fuel consumption for the period was 790.81 gallons. The maximum consumption by a single vehicle was 1,366.6 gallons and the lowest consumption was 362 gallons. Mean mpg for the twenty vehicles was 13.068. The highest mpg was 24.29 and the lowest was 9.53.

Total cost of operating the vehicles was \$12,603.20 for the period. Mean cost per vehicle was \$630.16. The maximum cost for a single vehicle was \$1,007.13 and the lowest cost for a single vehicle was \$262.09. The mean cpm for the twenty vehicles was \$0.064. The highest was \$0.102 and the lowest was \$0.031.

Fourteen Sheriff's Department vehicles had a mean mpg of more than 12 mpg. Six vehicles had a mean of less than 12. Mean cpm for the 14 vehicles with more than 12 was \$0.056. Mean cpm for the six vehicles with a mean of less than 12 was \$0.082.

Highway Department

Roane County Highway Department vehicles traveled a total of 44,205.6 miles during the study period. Most heavy equipment did not operate during the months of December, January, and February. The mean number of miles for all vehicles was 1,028.

A total of 13,766.3 gallons of fuel was used during the study period. The mean for the 43 vehicles included in the study was 320.15 gallons. Total cost for gasoline, diesel fuel, parts, and repairs for the period was \$20,277.87. Mean cost per vehicle was \$471.58.

Due to the large number of Highway Department vehicles which do not have odometers, there were only 16 vehicles with available mileage records. For these 16 vehicles the mean mpg was 6.77. Mean cpm was \$0.219.

Roane County Fleet Recommendations

Policies and Procedures

Roane County, like most Tennessee county governments, operates each department as a separate entity. The vehicle repair garages described previously have no association with each other in terms of personnel or equipment.

Roane County should begin to view the entire vehicle fleet at one time to determine if cost savings are possible for each department. The recommended method to begin this approach is through the appointment of a fleet management board. The board would consist of representatives of each of the major fleet operations: the Department of Education, Sheriff's Department, and Highway Department.

The fleet management board should formulate and propose fleet policies. Policies

should be proposed in written form and considered for adoption by the Roane County Commission and Roane County Department of Education. Items recommended for inclusion in the policy statement are listed in the Policy chapter of this study.

Facilities

The fleet management board should also consider the joint use of existing repair facilities. Each of the separate departments do not have sufficient vehicles to justify the purchase of specialty equipment, such as engine analysis computer equipment, but all departments working together could take advantage of joint equipment use.

A review of the possible joint use of existing facilities should include the possibility of the future construction of a central facility to be used by all departments. The Sheriff's Department does not presently have a vehicle repair facility and probably could not justify a separate facility for less than 30 patrol cars. The Sheriff's Department does have the use of trustees from the county jail. These trustees can provide an available labor force for preventative maintenance and vehicle cleaning for all departments.

Equipment

The Roane County Department of Education should consider the cost and benefits of converting the school bus fleet to diesel-powered buses. The Roane County bus fleet averaged 3.79 mpg during this study. Hawkins County operated 25 diesel buses during the same period and averaged 7.716 mpg. There are many factors influencing the mpg that can be achieved by any vehicle including terrain and highway miles. If all other conditions were equal, and if Roane County had achieved 7.716 mpg for the entire bus fleet, then more than 4,335 gallons of fuel could have been saved each month.

The system used by each department to record fuel use and total maintenance for each vehicle does not generate a report useful in making management decisions. The

records are maintained, including separate fuel entries for each vehicle, but are not summarized and do not indicate cpm or mpg.

All departments operating vehicles in Roane County should consider the joint purchase and installation of computerized fuel pumps. This purchase could result in an easy to use records system without the manual entries now made by each vehicle operator. A computerized fuel system could provide vehicle cards and employee identification numbers to replace the current manual system. The entry of maintenance records on the same system would provide a complete summary of the mpg and cost of operation of each vehicle. The computerized fuel system could also provide all departments with the use of all fuel storage sites throughout the county. The monthly total of all fuel use is automatically separated for billing to each department based on total use.

Sequatchie County

Sequatchie County is located 30 miles north of Chattanooga. The county population, according to the 1980 census, is 8,605. Sequatchie County has three primary departments operating vehicles: the Sheriff's Department, Department of Education, and Highway Department. There is also a Sanitation Department operating two garbage trucks.

Highway Department

The Highway Department performs vehicle maintenance in a building that previously served as a Tennessee Department of Transportation garage. The building has approximately 2,500 square feet of shop space and offices are located on the first and second levels.

Figure 11 shows the expenditures for fuel and maintenance by the Highway Department from 1987 through 1989. The totals shown for 1989 are budgeted amounts.

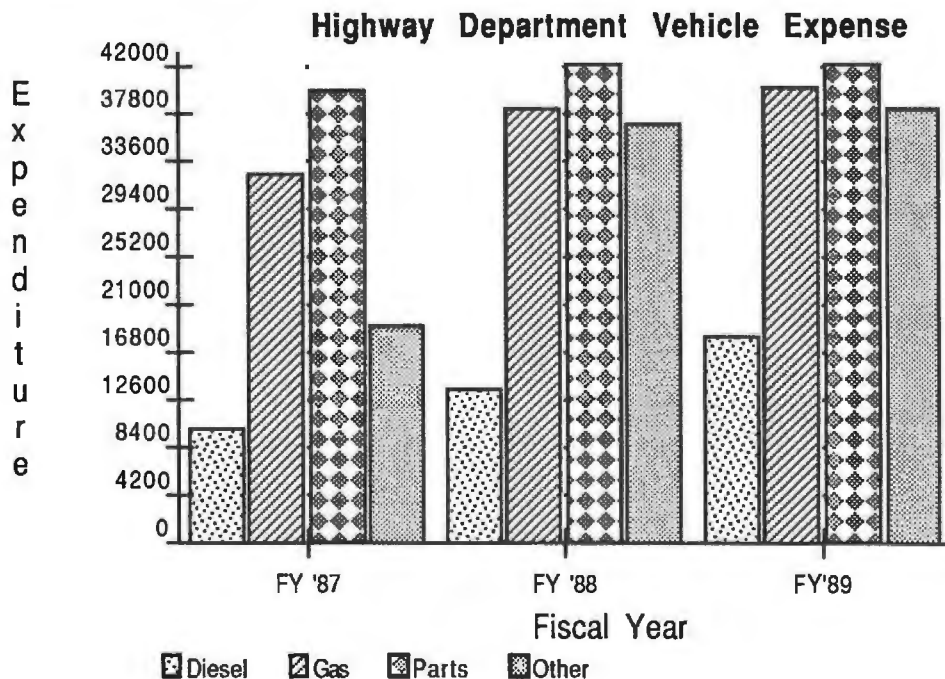


Figure 11. Sequatchie County Highway Department Vehicle Expense

Department of Education

The Sequatchie County Department of Education operates a vehicle repair shop for maintenance of 20 buses, two service trucks, and lawn mowers. The shop is located in a 2,400 square foot building which was originally constructed approximately 40 years ago as a school maintenance facility. The shop has one large bay for buses and one smaller bay for other equipment. The shop also serves as a storage area and parts room. Part of the shop area includes a large abandoned freezer unit that now serves as additional storage space.

The shop is equipped with air tools, welding equipment, and an electronic engine analyzer. Work performed includes complete engine rebuilds, transmission repair, and routine maintenance. Contracted work is limited to frame and body repairs. Hand tools are not furnished by the county.

One fuel storage tank is located at the bus shop and serves all Department of Education vehicles. The supervisor and mechanic refuel all buses. Drivers do not use the fuel pump. The supervisor of the shop maintains all fuel and maintenance records. There is currently one diesel bus in the Department of Education fleet and no diesel fuel storage tanks. Future plans are to increase the number of diesel buses in the fleet and to install a diesel tank along with a new gasoline storage tank.

The employees of the shop also serve as volunteers for the local fire department. As volunteers, they repair and maintain fire trucks at the bus garage.

Figure 12, on the following page, shows the expenditures for vehicle maintenance for the 1987 and 1988 fiscal years and the budgeted amounts for FY 1989.

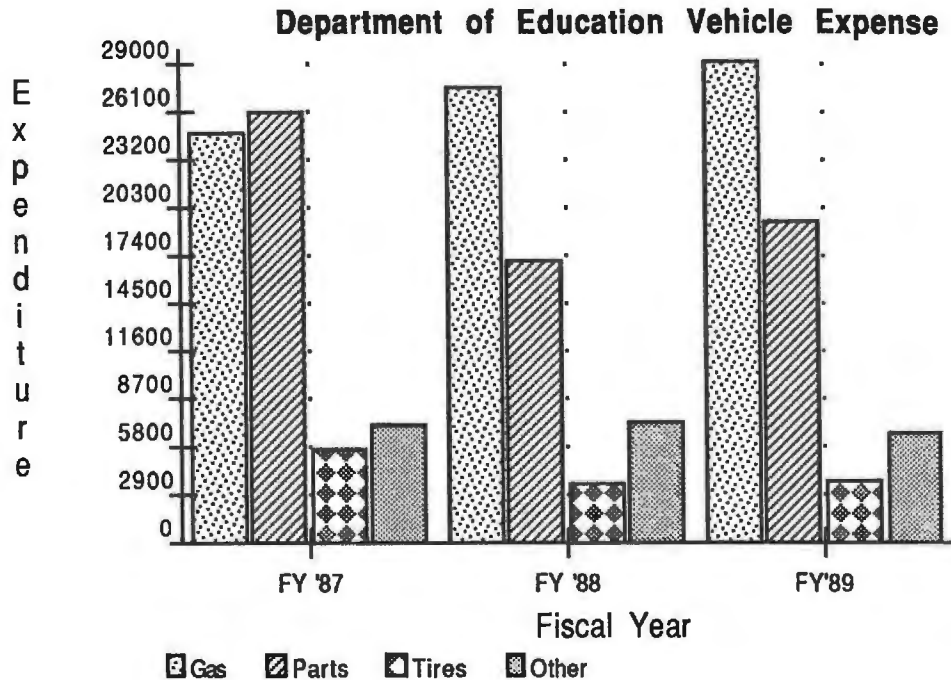


Figure 12. Sequatchie County Department of Education Vehicle Expense

Sheriff's Department

The Sequatchie County Sheriff's Department contracts all vehicle maintenance except oil changes and minor repairs. The Sheriff's Department does not have a separate repair facility or garage.

Fuel for the Sheriff's Department vehicles is provided by the Sequatchie County Highway Department. County owned ambulances also use the Highway Department fuel pumps.

Figure 13, on the following page, shows the 1987 through 1989 vehicle expenditures for the Sheriff's Department. Maintenance costs have decreased throughout the period.

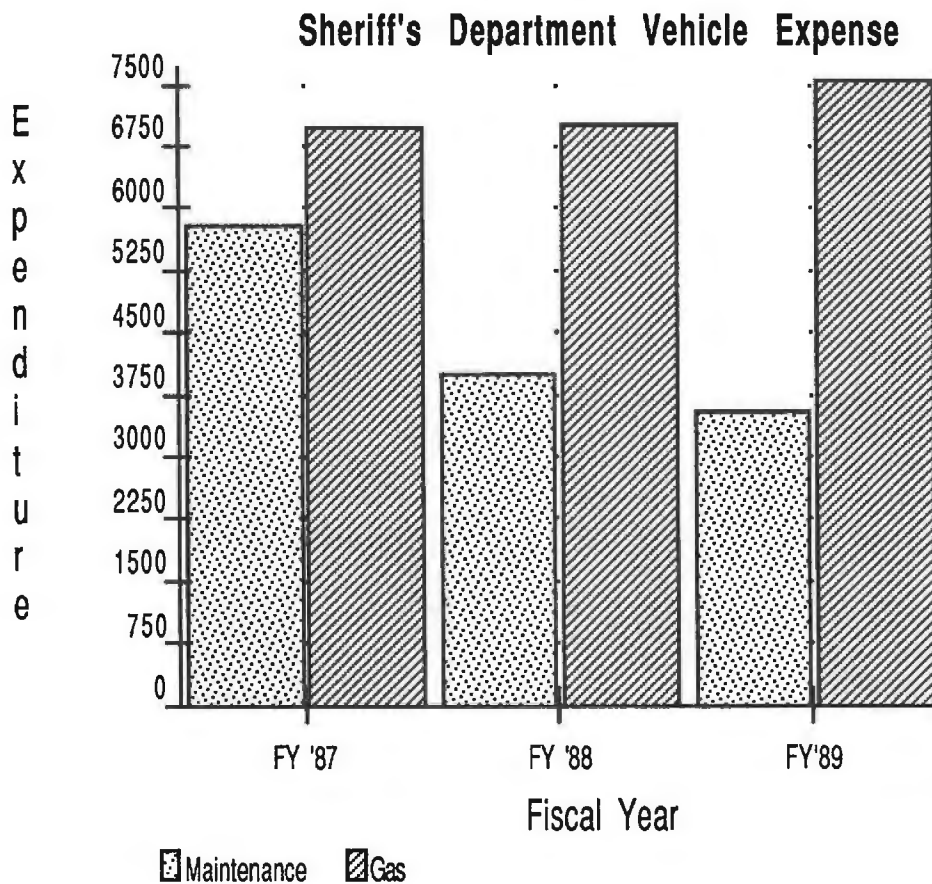


Figure 13. Sequatchie County Sheriff's Department Vehicle Expense

Sequatchie County Fuel and Maintenance Data

Highway Department

The Sequatchie County Highway Department does not record fuel or mileage totals so there are no Highway Department vehicles included in these comparisons. Many of the Highway Department vehicles and equipment items are refueled from a tanker which does not have metering equipment. Vehicles used for this study include 19 school buses, two sanitation vehicles, and three Sheriff's Department cars. One Sheriff's Department car and one school bus were eliminated from this report due to a lack of data for one or more months of the study period.

The mean age of all vehicles included was 5.125 years. The newest vehicle was

one year old and the oldest vehicle was 11 years old. The mean number of miles was 2,096 and the mean fuel consumption was 390.54 gallons. The mpg for all vehicles was 5.83. Mean cpm for all vehicles was \$0.135.

Department of Education

The 19 buses included in this study were an average of 5.526 years old. The oldest was 11 years old and the newest was one year old. The mean number of mpg was 4.493 for all 19 buses. The lowest mpg was 3.17 and the highest mpg was 8.43. Mean cpm was \$0.155. The highest cpm was \$0.226 and the lowest cpm was \$0.108.

Sanitation Department

There are two vehicles used for sanitation collection and disposal. One vehicle is a Peterbilt 320 which is one-year-old. The other vehicle is a Chevrolet C30 that is nine-years-old.

The Peterbilt truck averaged 5.43 mpg during the study period. The Chevrolet averaged 9.96 mpg. Mean mpg for the department was 7.695.

Mean cpm for the department was \$0.082. CPM for the Peterbilt was \$0.11 and cpm for the Chevrolet was \$0.053.

Sheriff's Department

Three Sheriff's Department vehicles were included in this study. Average age of the three vehicles was 2.67 years. The newest car is one-year-old and the oldest is five-years-old.

Mean fuel consumption for the study period was 281.667 gallons per month. The mean number of miles traveled was 3,750.33. The lowest number of miles was 2,141 and the highest number of miles was 5,837.

Mean mpg was 13.057. The highest mpg was 14.08 and the lowest mpg was 12.27. Mean cpm for the period was \$0.044.

Recommendations

1. Consideration should be given to the appointment of a fleet management board for Sequatchie County. The initial responsibility of the board would be to recommend a written fleet management policy to the Sequatchie County Commission. The fleet management policy could combine rules and regulations for the operation of county owned vehicles, including reimbursement procedures for the use of personal vehicles. The policy could also establish a reimbursement procedure for repair work performed by the Highway Department or Department of Education garage for other departments or agencies within the county.

Sequatchie County has sophisticated engine analysis equipment located at the Department of Education bus shop. Other departments could provide a higher level of preventative maintenance for their vehicles if they had periodic access to this equipment and trained personnel.

The fleet management board should also be responsible for the regular review of all vehicles owned by Sequatchie County to determine which vehicles could be removed from the fleet. The review should include a comparison of the status of each vehicle with the listing of vehicles covered by insurance.

2. A central location should be chosen, possibly the county executive's office, where all vehicle fuel and maintenance information is compiled monthly. Records maintained by the Highway Department are not sufficient to determine vehicle operational costs. Records for the Sheriff's Department and Department of Education have adequate information to make decisions about repair and replacement needs but they are not summarized for management use. The new computer system located in the County

Executive's office could provide the information for all departments if staff time is available to make the monthly entries. Information for the monthly summaries should include labor hours for in-house repair and maintenance.

3. Consideration should be given to the total replacement of the manual records system used by the Sheriff's Department, Department of Education, and Sanitation Department with a computerized fuel management system. The computerized system would use a vehicle card and employee number to replace the current fuel tickets and fuel sheets. The information provided by the system could include total fuel use, by department, as well as separate areas for the entry of repair and maintenance costs. The final result is a system that could provide complete information about each vehicle and which could be used to make management decisions. Several fuel storage tanks are scheduled for replacement due to underground storage tank requirements. The cost of adapting the system to use computerized fuel management may be less now than at any time in the future.

4. Consider replacing gasoline buses operated by the Department of Education with diesel-powered buses. Summary data indicating mpg for other local governments included in this study demonstrate the higher fuel economy which can be achieved by using diesel rather than gasoline for bus fleets. Based on Hawkins County diesel bus mileage, the savings in Polk County could be as much as \$5,000 each school year.

Weakley County

Weakley County is located 53 miles north of Jackson. County population, according to the 1980 census, is 32,896. The county has three departments operating vehicles and equipment. Each department is supervised by an elected official. All three departments share space at the Weakley County central garage facilities constructed in 1972.

The Department of Education operates and maintains 50 school buses and other vehicles. The Sheriff's Department operates and maintains patrol cars and other vehicles in a separate shop. The Highway Department operates and maintains highway maintenance vehicles and pieces of equipment in a third shop. All three repair shops are located in an area known as the central garage. One innovative feature of the Weakley County fleet operation is the computerized fuel pump located at the central garage. The pump serves all departments and provides a print-out of fuel use, by vehicle, for each department.

Weakley County does not have a written fleet management policy. Recommendations which would result in a policy change usually come through a cooperative effort involving the County Executive, Highway Supervisor, and Director of Transportation for the Department of Education. Actual policy changes are made by the County Commission.

Specifications for new vehicles are prepared by the director of finance for Sheriff's Department and Highway Department vehicles. The bus supervisor prepares specifications for school buses. The county provides a 5% bid advantage to firms located in Weakley County. The State of Tennessee bid list has been used for the purchase of patrol cars in the past so there is some standardization in vehicle types. The Department of Education has made efforts to standardize buses in transmission type. School bus frames and bodies are usually accepted as low bid, regardless of manufacturer.

The central garage facility is self-supporting and each department is billed at the end

of each month. All fuel and oil has an amount added to the total cost to assist in supporting the central operation. Each department remains autonomous and there are no pooled vehicles.

Sheriff's Department

The Sheriff's Department in Weakley County operates eight patrol cars used by 15 deputies. There are also two cars driven by investigators, one car driven by the chief deputy, and one car assigned to the sheriff. One unmarked car is used for drug investigations.

Repair work is performed by one full-time employee who also pumps gas and cleans the vehicles. Most preventative maintenance work is performed by trustees from the county jail. There are an average of three trustees working at the central garage at all times.

Shop equipment in the portion of the central garage used by the Sheriff's Department includes a tire changer and cage, air compressor, and floor jacks. Hand tools are not furnished by the department. Repair work performed includes tire changes, oil and filter changes, and light maintenance. Most major work, including engine analysis, transmission repairs, and major mechanical work, is contracted to local shops. The Sheriff's Department does not maintain a parts inventory.

The preventative maintenance program for Sheriff's Department vehicles includes oil and filter changes and general vehicle inspections. These jobs are scheduled each 2,000 miles for each vehicle.

The fuel record system is computerized but all repair work and parts are recorded manually. Records maintained include oil, tires, repairs, and preventative maintenance. The computerized fuel system provides a record of the vehicle, driver, department, miles, and fuel use. This system is used by all departments when they obtain fuel at the central garage.

Figure 14 shows the minor changes which have occurred in the Sheriff's Department vehicle operation budget from 1984 through 1989. Both fuel and maintenance costs have decreased through the period and are now less than 1984 totals.

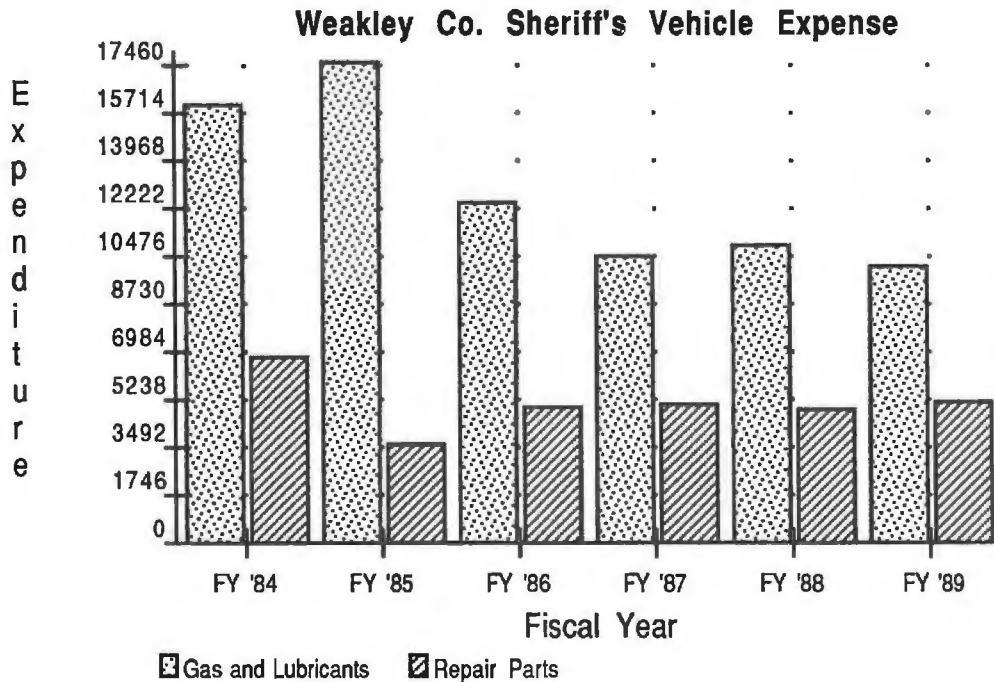


Figure 14. Weakley County Sheriff's Department Vehicle Operating Expense
(1984-1988 Weakley County Audit. 1989 Budget)

Weakley County Department of Education

The Department of Education garage is one of three primary buildings which make up the Weakley County central garage complex. The bus garage is housed in a building constructed in 1972 and staffed with one supervisor and three mechanics.

The garage is equipped with a tire changer, jacks, and some specialized tools. Hand tools are furnished by the Department of Education. Most repair work is performed in-house. Contracted maintenance items include automatic transmission repair, glass

replacement, and some major engine repair. The bus supervisor makes decisions on what items need to be contracted based on the type of repair and work schedule in the garage. A small parts inventory is maintained at the garage.

The record system is both manual and computerized. All work orders are entered on a written ledger with parts and labor identified for each bus. The records are then entered on an Apple IIe computer to provide a monthly consolidated print-out. Fuel records are part of the Weakley County computerized fuel system and are supplied monthly to the bus supervisor. The fuel records are generated from a "dumb" terminal and are not transferable to the bus maintenance computer system.

The Department of Education vehicle expense has decreased from 1984 levels.

Figure 15 shows the level of expenditures from 1984 through 1989.

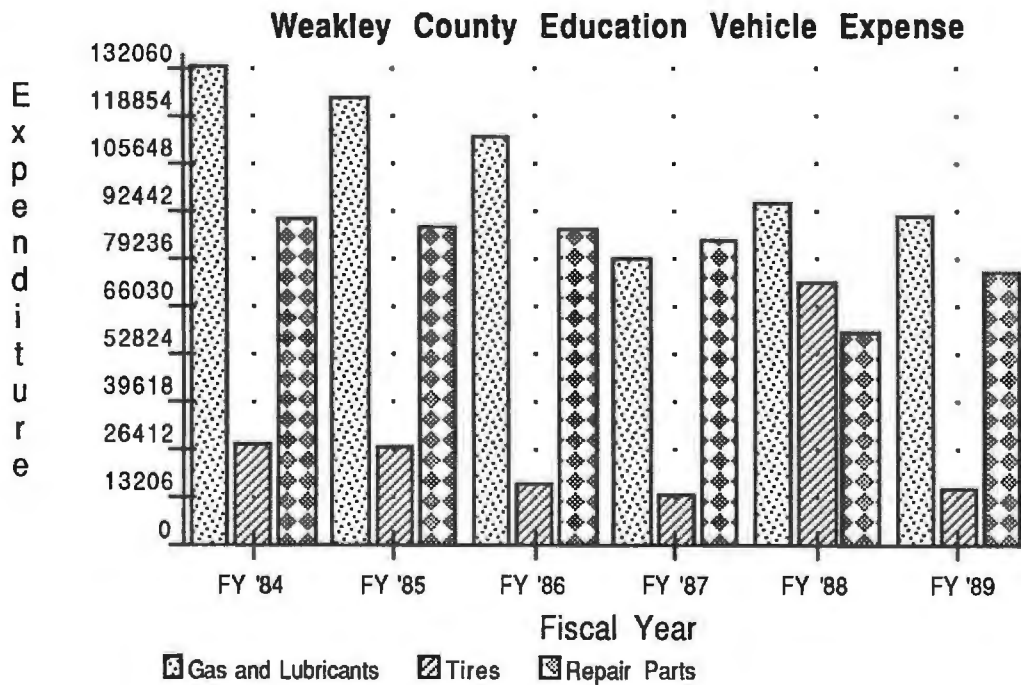


Figure 15. Weakley County Department of Education Vehicle Expense
(1984-1988 Weakley County Audit. 1989 Budget)

Weakley County Highway Department

The Highway Department occupies another of the three major buildings which make up the central garage complex. The Highway Garage was constructed in 1972 and is staffed by one supervisor, one parts room employee, and three mechanics.

All types of repair work are completed in the garage except specialized repairs on heavy equipment. The garage has most major equipment items and hand tools are furnished by the Highway Department. The parts room stocks all routine replacement items and is staffed by one employee who also keeps repair records.

The record system identifies most repair jobs by specific vehicle. Labor hours are not included in total costs. The record system is manual for parts and contracted maintenance but is part of the computerized fuel system for fuel obtained at the central garage. It is not possible to presently identify all cost associated with each vehicle.

Repair parts are the largest vehicle operation expense of the Highway Department. All other budget categories have decreased from 1984 levels. Figure 16 shows the trend in each of the categories which are part of the vehicle and equipment operating budget.

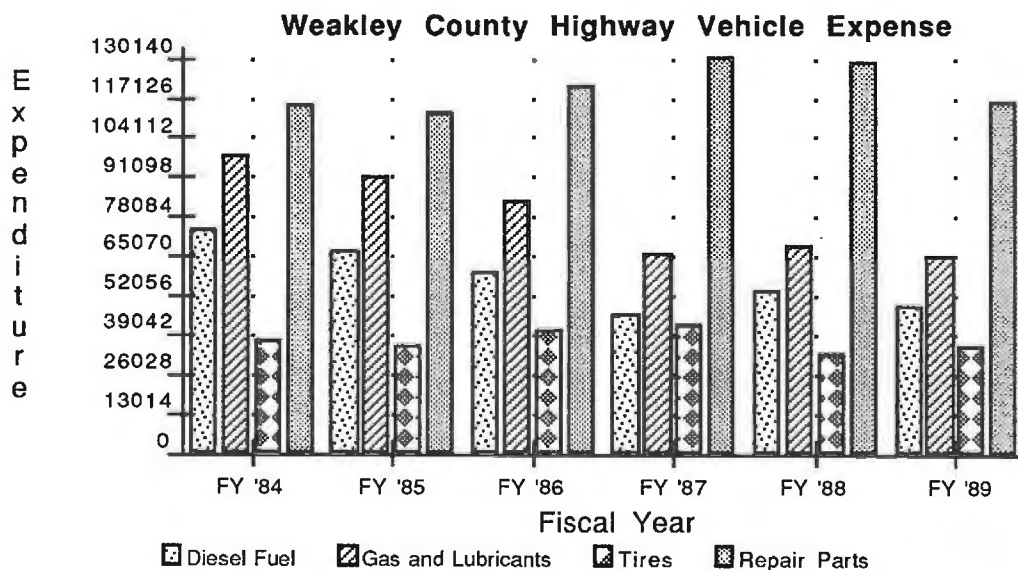


Figure 16. Weakley County Highway Department Vehicle and Equipment Expense
(1984-1988 Weakley County Audit. 1989 Budget)

Weakley County Fuel and Maintenance Data

For comparison with the other participating units of local government, the following fuel and maintenance experience of the Department of Education information is provided. The information was initially compiled by the bus supervisor at the Weakley County Department of Education bus shop.

During the study period there were 49 buses reviewed for operational cost and mileage. These buses traveled a total of 579,095 miles with a mean of 11,818 miles per bus. The highest number of miles by a single bus was 22,724 and the lowest was 6,103 miles. Mean gas consumption for the period was 2,427.84 gallons per bus. The mean mpg for the 49 buses was 4.94. The highest mileage was 6.83 mpg and the lowest was 3.76 mpg. The mean cpm for the 49 buses was \$0.122.

Weakley County Recommendations

1. The Weakley County computerized fuel monitoring system is unique for county governments in Tennessee and was the only automated fuel system used by any of the local governments in this study. The system appears to work well. Consideration should be given to expanding the use of the equipment.

Discussions were held during the course of this study involving representatives of the equipment vendor and staff of the finance department, Department of Education, and sheriff's department. Based on these discussions, it should be possible to expand the computerized fuel system to include the remote fuel pump sites located throughout Weakley County. If an expansion is possible the system should be improved to allow easy access, through the use of a desk-top computer system for the entry of maintenance parts and labor. Desk-top computers located at the main pumps and at the bus shop would allow constant entry of maintenance data from all departments. The result would be an easy to use management document including mpg and cpm for each vehicle.

2. Record keeping for all vehicles and equipment should include documentation of hours worked on each vehicle. Some departments now record labor hours resulting in a more accurate review of actual cost of operation for each vehicle and equipment item.

3. A fleet management board should be appointed and the board should begin the development of a written fleet policy for Weakley County. The board should consist of representatives from the vehicle user departments (Sheriff's, Highway, and Education). The Board should also consider the joint purchase of equipment items that could not be justified by a single department. Equipment, such as electronic engine analyzers, could reduce repair shop time, provide a higher level of vehicle performance, and improved fuel mileage. Vehicles and equipment become more sophisticated each year and Weakley County should anticipate repair shop needs through additional equipment and employee training.

4. Weakley County should review the current vehicle assignment programs in Roane and Hawkins County and consider establishing a similar program in the future. Both Roane and Hawkins Counties assign specific vehicles to each Sheriff's Department officer. The programs are new in each county, but appear to be successful in the effort to provide greater accountability and personal care for each vehicle.

5. The Weakley County Department of Education should review the success of the Hawkins County diesel bus program and consider a similar change for all Weakley County buses. Hawkins County now has 25 diesel buses in a fleet of more than 80 vehicles. During this study, the diesel buses had an average of 7.72 mpg while the gasoline powered buses had an average of 6.37 mpg. If all Weakley County buses could achieve a level of 7.72 mpg, 863 gallons of fuel per bus during the study period (287.66 gallons per month) might have been saved. The potential exists to save as much as \$10,712 each month, or \$96,412 each school year based on an average fuel cost of \$0.76 per gallon. Many variables contribute to improved mileage, but it appears that a change to diesel buses could provide substantial savings.

Data Summary

	Miles Per Gallon	Cost Per Mile
City of Cowan		
Six Vehicles	5.88	\$0.519
Police Vehicles	9.30	\$0.155
Hawkins County		
Sheriff's Department	19.34	\$0.062
Vehicles > 4 years old	15.08	
Vehicles < 4 years old	21.04	
Department of Education		
All buses	6.8	\$0.189
Gasoline powered buses	6.37	\$0.196
Diesel powered buses	7.72	\$0.173
Highway Department	8.44	\$0.164
City of Jackson		
All vehicles	8.64	\$0.11
Police vehicles	9.83	\$0.099
City of Lebanon		
All vehicles	7.67	\$0.174
Police vehicles	9.88	\$0.092
McMinn County	N/A	N/A
Memphis South Precinct		
Police Vehicles	14.38	\$0.04
Polk County		
Sheriff's Department	12.94	\$0.068
Highway Department	5.83	
Roane County		
Department of Education	3.79	\$0.181
Sheriff's Department	13.07	\$0.064
Highway Department	6.77	\$0.219
Sequatchie County		
Department of Education	4.49	\$0.155
Sanitation Department	7.70	\$0.082
Sheriff's Department	13.06	\$0.044
Weakley County		
Department of Education	4.94	\$0.122

Fleet Analysis Summary

Local government fleet operations in Tennessee are a major cost in the delivery of public services. Control and administration of large numbers of vehicles and equipment is often spread among department heads and elected officials. It is difficult to review operating cost of an entire fleet owned by a single unit of local government.

An accurate records system is the first step to cost control and fuel savings. A records system should be uniform throughout a single unit of government and should provide summary information used to make management decisions.

A total fleet management program should begin with the establishment of a fleet management board. The board should consist of representatives of major vehicle user organizations within the local government. The board should recommend written policies governing the use of government vehicles. The board should provide training in proper driving and repair techniques as part of the fleet policy.

Conclusion

All participating local governments do some unique and admirable things with very limited resources. The ability of some Sheriff's Departments to perform all vehicle maintenance using jail trustees resulted in savings to county taxpayers. The skills of individual mechanics exceeds available equipment and facilities.

The cost of operating city and county vehicle fleets is large enough in almost every jurisdiction to warrant greater emphasis and concern by elected officials. The large number of miles accumulated, especially by school buses and police vehicles, provides opportunities for substantial savings through minor increases in average mpg.

BIBLIOGRAPHY

BIBLIOGRAPHY

- American Gas Association. The Natural Gas Vehicle Manual. (Catalog Number 577131). American Gas Association. Arlington, Virginia.
- Automated fuel dispensing offers more than convenience. (1983, March). Public Works, pp. 56-57.
- Bruning, Edward R. (1989, Spring). The relationship between profitability and safety performance in trucking firms. Transportation Journal, pp. 40-49.
- Burnett, Walter. (1985, November). Should your city lease its fleet equipment? Public Works, pp. 61-63.
- Cocchiola, Frank A. (1985, November). County fleet management program started from scratch. Public Works, pp. 46-48.
- Electronic system helps Texas city cut fuel loss. (1983, September). American City and County, pp.56-58.
- Estimating fleet fuel consumption for vans and small trucks (1989, February). Transportation Science, p. 46.
- Georgian, Tony. (1987, November). Preventative maintenance program breaks new ground. Public Works, pp. 46-47.
- Institute for equipment services research foundation. (1975). Equipment Management Manual. (APWA Research Project 70-1). American Public Works Association.
- Klingelhofer, Dennis. (1987, June). How to contract fleet maintenance. American City and County, pp. 50-55.
- Larsen, Lilliam M. (1988, November). Computerized vehicle management for a water district. Public Works, p. 56.
- Magnuson, Michael P. (1988, November). Microcomputer program assists planning for fleet funding. Public Works, pp. 59-62.
- Murry, Richard. (1986, June). Converting to automated fuel dispensing. Public Works, pp. 56-57.
- New York state energy office. Conserving energy in fleet operations. New York State Energy Office. Albany, N.Y.
- Planning for vehicle refurbishment (1986, September). Public Works, pp. 136-137.
- Schmitt, Rodell. (1987, November). Computerized fleet analysis improves budgeting. Public Works. pp. 50-51.

Small automated fueling system benefits small fleet (1986, April). Public Works, pp. 67-69.

Standardized truck fleet improves efficiency and cuts cost (1983, November). Public Works, p. 48.

APPENDICIES

APPENDIX A

APPENDIX A

Sample Employee Recognition Press Release

Mechanic

The (City of _____/_____ County) has named Mr./Ms. _____ (employee name) Service Employee of the Month. (Mayor/County Executive) _____, in announcing the honor, said _____ (employee name) has demonstrated skills and concern for the vehicles we depend on which has made the delivery of public services easier for all employees. The citizens of _____ (city or county name) should be proud to have _____ (name) as an employee." _____ (name) has been an employee of _____ (city or county name) for _____ years. The Employee of the Month program was established to provide recognition for employees who demonstrate special skills or provide cost savings through additional training or recommendations for improvements.

Vehicle or Equipment Operator

_____ (Mayor or County Executive) has announced the selection of _____ (employee name) as Outstanding Vehicle and Equipment Operator for _____ (year or month). _____ (Mayor or County Executive), in announcing the selection said " _____ (name) has been an employee of _____ (city or county name) for _____ years and has shown, through safe driving techniques and concern for our vehicles and equipment, that public funds can be saved through proper driving techniques."

APPENDIX B

RECORDS OF GAS STATION DISBURSEMENTS

PUMP NO. _____

DATE 1/1

SHEET NO.

[illegible]

ATTENDANT

DRIVER DAILY CHECKLIST

VEH. NO. _____

LEGEND FOR MARKING

- ✓ - OK - NO COMPLAINT
 X - ADJUSTMENT REQUIRED
 XX - REPAIRS REQUIRED

DATE: _____

MILEAGE _____

USE SEPARATE FORM FOR TOWED EQUIPMENT

	Before Opera- tion	During Opera- tion	After Opera- tion	Remarks		Before Opera- tion	During Opera- tion	After Opera- tion	Remarks
LEAKS, GENERAL				WALK AROUND AND LOOK	CLUTCH				CHECK BEFORE LEAVING LOT
BATTERIES				CHECK THAT WATER COVERS PLATES	ENGINE OPERATION				REPORT NOISES, MISSING, POWER
BELTS/HOSES				FRAYED, TORN, LEAKING, ETC	HORN				TEST BEFORE LEAVING LOT
ENGINE OIL				CHECK DIP STICK, CAREFULLY	PACKING SYSTEM				TEST BEFORE LEAVING LOT
ENGINE WARM UP				1-3 MIN' WARM 3-5 MIN. COLD	POWER TAKE-OFF				ENGAGING, SHAFT, OPERATION
FUEL				FILL TANK EVERY EVENING	STEERING				JERKS, PULLS, WANDERS, ETC.
GAGES/INSTRUMENTS				CHECK OFTEN MUST FUNCTION	TRANSMISSION OIL				
HYDRAULIC OIL				CHECK DAILY - KEEP CLEAN	WINDSHIELD WIPERS				MOTOR, ARMS, BLADES, CONTROLS
LIGHTS/SIGNALS				CHECK DAILY - MUST FUNCTION	UNUSUAL NOISES				REPORT ANYTHING YOU HEAR
RADIATOR				CHECK THAT WATER COVERS CORE	DRAIN AIR TANKS				ALL TANKS, DRAIN, THEN CLOSE VALVES
TIRE PRESSURE				CHECK DAILY - CUTS, OBSTACLES	TOTE CART				
WHEEL LUGS				LOOSE, BROKEN, MISSING	OTHER				ANY OTHER ITEM NOT SHOWN
BRAKES				TEST BEFORE LEAVING LOT					

REMARKS: CA3, DOORS, FENDERS, HEATER, MIRRORS, WINDOWS, ETC.

SHUT OFF ALL ACCESSORIES PRIOR TO STARTING

PULL, NEVER PUSH VEHICLES WHEN STUCK

OPERATOR'S SIGNATURE: _____

FOREMAN'S SIGNATURE: _____

No. _____

EQUIPMENT SERVICE REQUEST

Dept. or Div. _____ Date _____

Equipment No. _____ Type _____

Operator _____

Description of Trouble:

- | | | | |
|----------------|----------------------|----------------------------|----------------|
| Brakes | Electrical | Transmission System | |
| • Hand | • Battery | • Clutch | |
| • Foot | • Horn | • Transmission | • Changing Oil |
| | • Headlights | • Driveshaft | • Lubricate |
| Motor | • Tail Light | • Universal | • Oil Filter |
| • Knocks | • Stop Light | • Rear end | |
| • Heats | • Starter | • Axle | |
| • Misses | • Generator | | |
| • No Power | • Ignition | Miscellaneous | |
| • Carburetor | | • Radiator | |
| | Miscellaneous | • Hoist | |
| Springs | • Heater | • Cab | |
| • Front | • Defroster | • Body | |
| • Rear | | | |

Description of work wanted
or trouble and cause:

Authorized by _____

Est. Ready

Date ____/____/____

Shop Work Order No.

--	--	--	--	--

A. Detailed Form

EQUIPMENT SERVICE REQUEST

THIS FORM IS TO BE USED ONLY FOR PM RECORDS. ALL REPAIRS RESULTING FROM, OR SCHEDULED WITH THIS INSPECTION FORM WILL BE RECORDED ON A SEPARATE SHOP REPAIR ORDER

EQUIP NO _____
DIVISION _____

LUBE	
PM "A"	
PM "B"	

MILE/HRS.

DATE/TIME RECEIVED IN SHOP

☐ CHECK IF INSPECTION MADE ON DATE SCHEDULED

☐ CHECK IF INSPECTION WAS NOT ON SCHEDULED DATE

✓ CHECK IF ITEM OK		X ADJUSTMENT MADE		0 REPAIRS REQUIRED	
1.	☐	RADIATOR-FILL TO PROPER LEVEL-PRESSURE TEST	16.	☐	DIFFERENTIAL-LEAKS, LUBRICANT LEVELS, VENT
2.	☐	BELTS CONDITION AND PROPER TENSION	17.	☐	DRIVE SHAFT, UNIVERSAL JOINTS, YOKES, SPLINES
3.	☐	FUEL SYSTEM-LEAKS, GOVERNOR, AND PUMP SEALS	18.	☐	TIRES - CONDITION, INFLATION, RIMS, LUGS
4.	☐	BATTERY - ELECTROLYTE, VOLTAGE, MOUNTING	19.	☐	FIFTH WHEEL - MOUNTING, BUSHINGS, LATCHES
5.	☐	EXHAUST SYSTEM LEAKS, CONDITION, MOUNTING	20.	☐	BODY - DAMAGE, PAINT, MARKINGS, FLAPS, BUMPERS
6.	☐	AIR CLEANER-SERVICE, CONDITION, MOUNTING	21.	☐	LICENSE, PERMITS, TAGS, INSPECTIONS, PLACARDS
7.	☐	CRANKCASE - DRAIN AND REFILL	22.	☐	MOUNTED EQUIPMENT - REFRIGERATION SYSTEM, AIR CONDITIONING, WINCHES, ETC
8.	☐	FILTERS - CHANGE OR CLEAN, OIL, FUEL, WATER	23.	☐	AIR SYSTEM - LEAKS, OPERATION, DRAIN AIR TANK
9.	☐	HEATER - DEFROSTER - OPERATION	24.	☐	BRAKES - CHECK AND ADJUST
10.	☐	ALL LIGHTS AND SIGNALS OPERATION & CONDITION	25.	☐	FIFTH WHEEL PLATE-CRACKS, MOUNTING, WEAR, KING PIN
11.	☐	CLUTCH - FREE PEDAL, OPERATION, NOISE	26.	☐	LANDING GEAR-CONDITION, OPERATION, MOUNTING
12.	☐	CAB, INTERNAL - WINDOW GLASS, MIRRORS	27.	☐	TANK - DOME COVERS, VENTS, VALVES
13.	☐	SUSPENSION-AXLES, SPRINGS, EQUALIZERS, "U" BOLTS	28.	☐	UNLOADING EQUIPMENT-MANIFOLD AND PIPING, METERS, AND READINGS
14.	☐	TRANSMISSION LEAKS, MOUNTING, LUBRICANT LEVEL, VENT	29.	☐	SAFETY EQUIPMENT-EMERGENCY VALVES, REMOTE CONTROLS, FIRE EXTINGUISHER
15.	☐	PTO AND CARGO PUMP-MOUNTING, CONTROLS, OPERATION	30.	☐	LUBRICATION - COMPLETE LUBRICATION

☐ COMPLETE THE FOLLOWING SPECIAL PROCEDURES: (1) _____

(2) _____

(3) _____

COMPLETE "A" PM SERVICE

- 1-30. COMPLETE PM "A" SERVICE
36. GOVERNOR - CHECK AND ADJUST
37. IGNITION POINTS, PLUGS, TIMING
38. CARBURETOR - CLEAN, ADJUST
39. THERMOSTAT, SHUTTERSTAT TEST, ADJUST, REPLACE
40. AIR COMPRESSOR - CLEAN AIR FILTER
41. SPRING - TORQUE "U" BOLTS AND ALIGNMENT CLIPS
42. BODY - CHECK CAB AND BODY MOUNTING, CARGO FASTENING DEVICES

- 1-30. COMPLETE PM "A" SERVICE
36-42. COMPLETE PM "B" SERVICE
51. COMPRESSION-CHECK EACH CYLINDER WITH GAUGE
52. FUEL PUMP - MOUNTING, PRESSURE, OPERATION
53. INJECTORS, VALVES - CHECK, ADJUST
54. WHEEL ALIGNMENT - CHECK, ADJUST
55. ENGINE-TORQUE CYLINDER HEADS, ROCKER ARM SHAFT, MANIFOLD
56. WHEEL BEARINGS - CHECK, REPACK
57. BRAKES - CHECK DRUMS, LININGS, AND CYLINDERS

THIS CHECK AND LUBRICATION HAS BEEN COMPLETED AND ALL INDICATED REPAIRS HAVE BEEN SCHEDULED, COMPLETED, OR NOTED FOR REFERENCE.	ENTER EMPLOYEE NO. FOR			DATE COMPLETED:
	LUBE	ENG.	BRAKES	
	ALIGNMENT	BODY	UNDER CARRIAGE	
	SIGNATURE OF SUPERVISOR			

Source: City of Charlotte, North Carolina

Report Only PM INSPECTION REPORT

PM Order No.

Facility

Date

EMF 14

PM INSPECTION REPORT with Cost Information

EQUIPMENT DESCRIPTION

This form is to be used only for PM Record. All repairs resulting from, or scheduled with this inspection form will be recorded on a separate shop repair order.

Equipment No.

Assigned to

MILE/HOUR METER
READING

10THS

LUBE

PM A

PM B

PM C

RECEIVED IN SHOP (DATE/TIME):

☐ CHECK IF STATUTORY INSPECTION MADE☐ CHECK IF THIS INSPECTION WAS NOT ON REGULAR SCHEDULE

LABOR HOURS

Time off	Time on	Hours	Minutes	Employee No.
Off				
On				
Off				
On				
Off				
On				
Off				
On				
Off				
On				

✓ - CHECK IF OK

X - ADJUSTMENT MADE

O - REPAIRS NEEDED

GROUP A SERVICE

- | | |
|---|--|
| 1. ☐ RADIATOR-FILL TO PROPER LEVEL-PRESSURE TEST
2. ☐ BELTS-CONDITION AND PROPER TENSION
3. ☐ FUEL SYSTEM-LEAKS, GOVERNOR, AND PUMP SEALS
4. ☐ BATTERY-ELECTROLYTE, VOLTAGE, MOUNTING
5. ☐ EXHAUST SYSTEM-LEAKS, CONDITION, MOUNTING
6. ☐ AIR CLEANER-SERVICE, CONDITION, MOUNTING
7. ☐ CRANKCASE-DRAIN AND REFILL
8. ☐ FILTERS-CHANGE OR CLEAN, OIL, FUEL, WATER
9. ☐ HEATER-DEFROSTER, OPERATION
10. ☐ ALL LIGHTS AND SIGNALS-OPERATION AND CONDITION
11. ☐ CLUTCH-FREE PEDAL, OPERATION, NOISE
12. ☐ CAB, INTERNAL-WINDOW GLASS, MIRRORS
13. ☐ SUSPENSION-AXLES, SPRINGS, EQUALIZERS, "U" BOLTS
14. ☐ TRANSMISSION-LEAKS, MOUNTING, LUBRICANT LEVEL, VENT
15. ☐ PTO AND CARGO PUMP MOUNTING, CONTROLS, OPERATION
16. | 16. ☐ DIFFERENTIAL-LEAKS, LUBRICANT LEVELS, VENT
17. ☐ DRIVE SHAFT, UNIVERSAL JOINTS, YOKES, SPLINES
18. ☐ TIRES-CONDITION, INFLATION, RIMS, LUGS
19. ☐ FIFTH WHEEL-MOUNTING, BUSHINGS, LATCHES
20. ☐ BODY-DAMAGE, PAINT, MARKINGS, FLAPS, BUMPERS
21. ☐ LICENSE-PERMITS, TAGS, INSPECTIONS, PLACARDS
22. ☐ MOUNTED EQUIPMENT-REFRIGERATION SYSTEM
☐ AIR CONDITIONING, WINCHES, ETC'
23. ☐ AIR SYSTEM-LEAKS, OPERATION, DRAIN AIR TANK
24. ☐ BRAKES-CHECK AND ADJUST
25. ☐ FIFTH WHEEL PLATE-CRACKS, MOUNTING, WEAR, KING PIN
26. ☐ LANDING GEAR-CONDITION, OPERATION, MOUNTING
27. ☐ TANK-DOME COVERS, VENTS, VALVES
28. ☐ UNLOADING EQUIPMENT-MANIFOLD AND PIPING, METERS AND READINGS
29. ☐ SAFETY EQUIPMENT-EMERGENCY VALVES, REMOTE CONTROLS, FIRE EXTINGUISHER
30. ☐ LUBRICATION-COMPLETE LUBRICATION |
|---|--|

☐ COMPLETE THE FOLLOWING SPECIAL PROCEDURES:

(1)

(2)

(3)

GROUP B SERVICE

- 1-30.
- ☐
- COMPLETE PM "A" SERVICE
-
- 36.
- ☐
- GOVERNOR-CHECK AND ADJUST
-
- 37.
- ☐
- IGNITION POINTS, PLUGS, TIMING
-
- 38.
- ☐
- CARBURETOR-CLEAN, ADJUST
-
- 39.
- ☐
- THERMOSTAT, SHUTTERSTAT-TEST, ADJUST, REPLACE
-
- 40.
- ☐
- AIR COMPRESSOR-CLEAN AIR FILTER
-
- 41.
- ☐
- SPRING, TORQUE "U" BOLTS, AND ALIGNMENT CLIPS
-
- 42.
- ☐
- BODY-CHECK CAB AND BODY MOUNTING, CARGO FASTENING DEVICES

GROUP C SERVICE

- 1-30.
- ☐
- COMPLETE PM "A" SERVICE
-
- 36-42.
- ☐
- COMPLETE PM "B" SERVICE
-
- 51.
- ☐
- COMPRESSION-CHECK EACH CYLINDER WITH GAUGE
-
- 52.
- ☐
- FUEL PUMP-MOUNTING, PRESSURE, OPERATION
-
- 53.
- ☐
- INJECTORS, VALVES-CHECK, ADJUST
-
- 54.
- ☐
- WHEEL ALIGNMENT-CHECK, ADJUST
-
- 55.
- ☐
- ENGINE, TORQUE CYLINDER HEADS, ROCKER ARM SHAFT, MANIFOLD
-
- 56.
- ☐
- WHEEL BEARINGS-CHECK, REPACK
-
- 57.
- ☐
- BRAKES-CHECK DRUMS, LININGS, AND CYLINDERS

COMMERCIAL COST

Class	Labor \$	Parts \$	Total \$

This check and lubrication has been completed and all indicated repairs have been scheduled, completed or noted for reference

Supervisor
Signature:

Date

**Suggested Time Standards to Perform Systematic Inspection,
Correction, and Servicing of All "A" Type PMs**

Description of Units	Recommended Time Standards	Remarks
Automobiles, Station Wagons, Vans, Jeeps, Broncos, Air Compressors.	30 – 45 Minutes (0.5 – 0.8 Hours)	High usage, high mileage vehicles are scheduled every month. Average usage vehicles are scheduled every (2) months. Low mileage, low usage vehicles are scheduled every (3) months. Whenever a vehicle registers less mileage than anticipated, only the filter may be changed depending on the type of operating conditions. This accounts for the extra labor time shown in each category. One example is our refuse trucks where we change oil every month, but only change the filter every other month.
1/2 and 3/4 ton pickups, agriculture type tractors, small single axle dump trucks	48 – 60 Minutes (0.8 – 1.0 Hours)	
Large Tandem Axle Trucks, Small busses, small rollers, street flushers	78 – 90 Minutes (1.3 – 1.5 Hours)	
All Street Sweepers, Sewer Jets, Tankers, Large Busses, Distributors, Large Rollers, Rubber Tired Front Loaders, Backhoes, Gas Powered Refuse Trucks, Motor Graders, Excavators, Ditchers	120 – 150 Minutes (2.0 – 2.5 Hours)	
Diesel Powered Refuse Trucks, Paint Spray Trucks, Landfill Compactors, Grade-Alls, Crawler Tractors, Self Loading Pans or Scrapers, Vac-Alls	150 – 180 Minutes (2.5 – 3.0 Hours)	

"A" PM TIME STANDARDS

No. _____

EQUIPMENT SERVICE REQUEST

Dept. or Div. _____ Date _____

Equipment No. _____ Type _____

Operator _____

Description of Trouble:

Brakes	Electrical	Transmission System	
• Hand	• Battery	• Clutch	
• Foot	• Horn	• Transmission	• Changing Oil
	• Headlights	• Driveshaft	• Lubricate
Motor	• Tail Light	• Universal	• Oil Filter
• Knocks	• Stop Light	• Rear end	
• Heats	• Starter	• Axle	
• Misses	• Generator		
• No Power	• Ignition	Miscellaneous	
• Carburetor		• Radiator	
	Miscellaneous	• Hoist	
Springs	• Heater	• Cab	
• Front	• Defroster	• Body	
• Rear			

Description of work wanted
or trouble and cause:

Authorized by _____

Est. Ready

Date / /

Shop Work Order No.

--	--	--	--	--

A. Detailed Form

EQUIPMENT SERVICE REQUEST

FACILITY

EQUIPMENT NO. _____ ASSIGNED TO ACTIVITY _____ DRIVER _____
CODE: _____

AUTHORIZED TO OBTAIN THE FOLLOWING WORK FROM _____
Shop name & address

(DESCRIPTION OF WORK): _____

REPAIR TYPE CODE(S): _____

REASON(S):

☐ SPECIAL EQUIPMENT REQUIRED

☐ STANDING CONTRACT

☐ SHOP OVERLOAD

☐ WARRANTY

☐ RECALL

☐ INSURANCE CLAIM

☐ OTHER (DESCRIBE): _____

DISTRIBUTION:

COPY 1 - ACCOUNTS PAYABLE
COPY 2 - VEHICLE RECORD JACKET
COPY 3 - VENDOR

ESTIMATED TOTAL COST _____ MAXIMUM COST _____

AUTHORIZED SIGNATURE: _____ RECEIVED (WORK COMPLETED) DATE: _____

TITLE: _____ APPROVED FOR PAYMENT: _____
(MAINTENANCE OFFICIAL)

RECORDED ON R. O. NUMBER _____ DATE _____

VOUCHER NUMBER _____ DATE _____

EXHIBIT 10

[illegible]

APPENDIX C

Replacement Analysis

THE ECONOMICS OF EQUIPMENT REPLACEMENT

A given piece of equipment has a number of "lives." It has a *service life* which indicates the amount of time the vehicle is capable of operating and rendering service. This life may be nearly infinite if the unit receives adequate maintenance and if worn-out components are dutifully replaced. For example, if sufficient maintenance commitments are met, many "museum pieces" are capable of rendering some level of service.

A unit also has a *technological life* which represents the relative productivity decline of the unit when compared with newer models on the market. For example, a 15-year old unit may be only 50% as productive as comparable current models. Imagine substituting automobiles from the 1920's for an agency's present police vehicles. Although the older vehicles might still be capable of rendering some service (given an unlimited maintenance budget), they would be incapable of matching the performance requirements of most of the officers. Thus, the technological life of equipment may be quite different from the service life.

This chapter is concerned with another type of equipment life--the *economic life*. The economic life of a unit is of critical importance to equipment managers for it relates to the total stream of costs associated with the unit through time. Therefore, it has a significant impact upon both capital and operating budgets. The economic life of a unit, as used in this manual, refers to the length of time over which the average total vehicle cost is a minimum. Total unit costs would encompass all costs associated with the ownership of the

vehicle and would include costs of:

1. depreciation
2. operations
3. maintenance
4. downtime
5. obsolescence
6. operator training
7. carrying a parts inventory (storage, insurance, etc. --not the actual parts costs)
8. interest
9. alternative capital value
10. inflation

During the life of a piece of equipment these cost elements will fluctuate -- some increasing, some remaining level, and others decreasing through time. Together, they comprise the total life costs of the unit, and it is this total cost stream that is relevant to the determination of the economic life of the vehicle. Diagram 1 graphically depicts a generalized cost stream for a piece of equipment as a means of illustrating the interrelationship of the components of total life costs.

Concentration upon one or the other of these cost elements, without considering the total, will most likely cause the equipment manager to suboptimize, i.e., to choose replacement lives which lead to lower costs in one or more of the elements but result in higher overall costs. This situation is often forced upon equipment managers by the peculiarities of their agencies' budget processes. For instance, they may find that it is more difficult to obtain capital outlay dollars for vehicle replacement

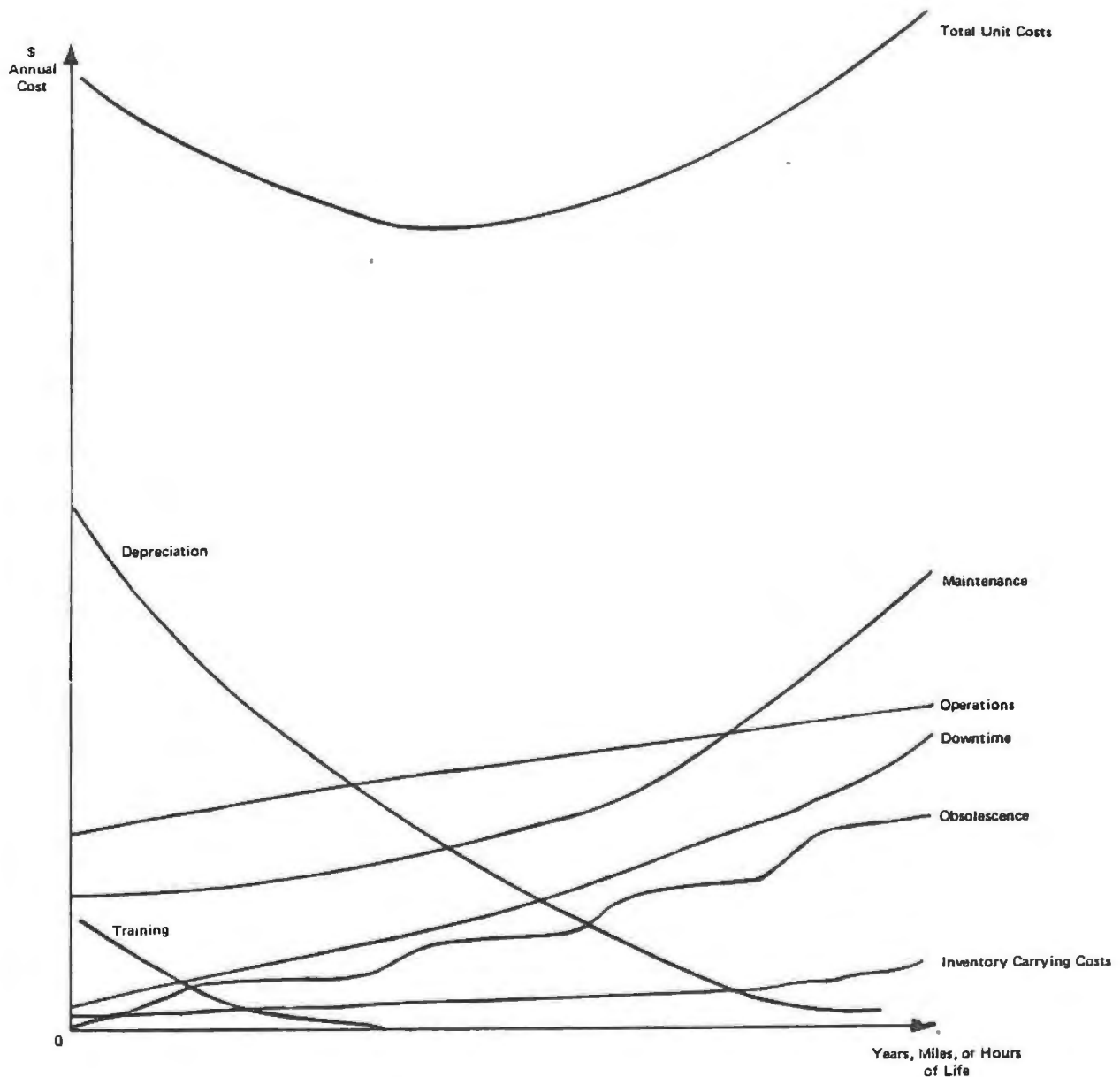


Diagram 1
Generalized Ownership Cost Patterns

than it is to obtain current operating dollars for maintenance. In actuality, the reduction in capital outlays may be far outstripped by the rapidly escalating costs of maintenance, downtime, and obsolescence which result from holding equipment beyond the economically optimum point of replacement. Again, economic decisions cannot normally be made on the basis of a single cost element. Rather, they require the Equipment Manager, Budget and Finance Officer, City Manager, and Council to view the total cost picture.

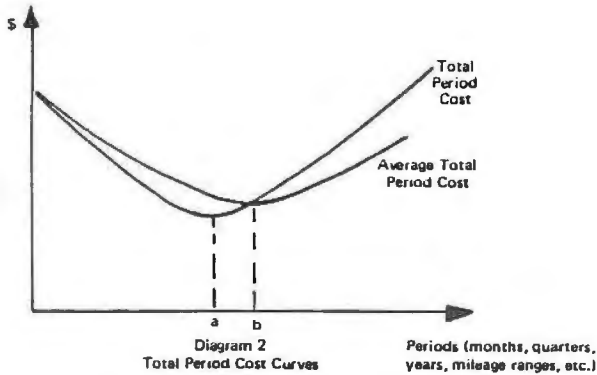
One means of combating this problem is to come to budget hearings armed with good data and sound analytical support for replacement proposals. Political considerations or

local financial conditions may still dictate deviations from an economically optimum replacement program, but these decisions would have to be made light of the analysis. This would seem preferable to the situation of many equipment managers who promote replacement plans based upon intuition rather than hard data. Their intuition may lead them to proper conclusions, but intuition is too easily dismissed during budget or policy reviews.

DETERMINATION OF ECONOMIC LIFETIME

Assume that our goal is to minimize the total costs associated with the ownership of a given piece of equipment. How do we go about de-

termining the economic life for such a unit? Would it be the age at which total period costs begin to increase, such as at "a" in Diagram 2? This might seem the obvious answer, but in actuality it is not always the correct one. The value which we should minimize is instead the *average period cost*. This would suggest that "b" would be the economically appropriate period to trade.



This point is made clearer by the following hypothetical example. Assume the yearly vehicle costs as shown in Table 1 and depicted in Diagram 3 for the Rustmobile. As you will

notice the minimum yearly cost falls in the third year whereas the minimum average yearly cost falls in the fourth year. If we were to trade every three years, we would (ignoring discounting) spend the equivalent of \$2,667 for the vehicle each year. By trading the vehicle every four years, we would spend the equivalent of \$2,625 or \$42 less for the vehicle each year. Again, it is the average yearly cost that we should minimize if we are to minimize total ownership costs.

Year	Total Yearly Costs	Avg. Yearly Costs	Total Life Costs
1	3000	3,000	3,000
2	2600	2,800	5,600
3	2400	2,667	8,000
4	2500	2,625	10,500
5	3100	2,725	13,600
6	3600	2,867	17,200

Table 1
Ownership Costs of the Rustmobile

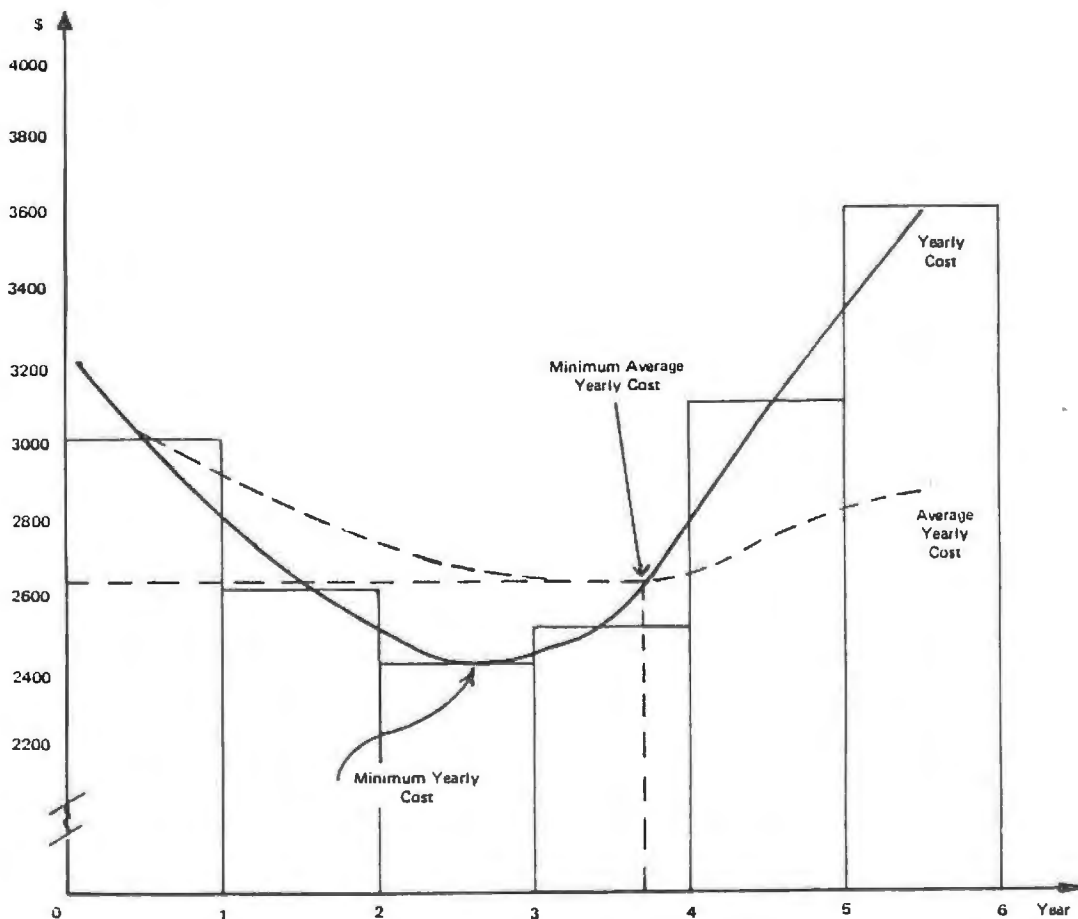


Diagram 3
Ownership Costs of the Rustmobile

A generalized formula for calculating this average or *mean period cost* (MPC) is as follows:

Mean Period
Cost for
replacement
cycle R

$$(MPC_R) = \frac{P - S_R + \sum_{t=1}^R X_t}{R}$$

where: P=purchase price at t=0
t=period (numeral indicator)
S=resale or salvage value
R=period of replacement
X=sum of the period's costs (excluding depreciation, alternative costs of capital, and inflation)

note: The Greek letter, " Σ "

is used to indicate a summation operation.

$\sum_{t=1}^R X_t$ signifies that we are to add the period costs, X_t , from the first period through the Rth period, i.e., $X_1 + X_2 + X_3 + \dots + X_R$.

The analysis could focus upon periods of either time or usage. Years, quarters or months could be used as the designated time periods. Ranges of mileage or accumulated hours could be used as the usage periods. Choice of the "period" measurement would depend upon the character and availability of data for the analysis.

The data for the analysis might come from the agency's equipment management information system, the APWA Equipment Data Bank, estimates of the management staff, local auction experience, *Blue Book* analysis, or other sources. Yet any estimate of the future is subject to some measure of error. It is important to use the best estimates available since the validity of the output of the analysis is largely dependent upon the validity of the input.

For a given type of equipment unit, a series of *mean period cost's* would be calculated for various replacement cycle lengths, e.g., MPC_1 , MPC_2 , MPC_3 , etc. until a minimum MPC is found. This is a tabular approach to the solution. If we can determine formulas for the various cost vectors through time we can determine the solution more directly. This is done by first substituting these formulas into the above expression and then by solving directly for the minimum MPC_R .

Example 1 demonstrates the use of this analytical approach (tabular method).

Example 1

Table 2 presents hypothetical life data for a 15-ton capacity dump truck. It contains information on resale or salvage values, operating costs, maintenance costs, etc. This data is arranged by year in this example. The "period" therefore, has been designated as a year, and the general formula is modified as follows:

Mean Annual
Cost for
replacement
cycle R

$$(MAC_R) = \frac{P - S_R + \sum_{t=1}^R X_t}{R}$$

where: P=purchase price at t=0
t=year (numeral indicator)

S=resale or salvage value

R=year of replacement

X=sum of the year's costs (excluding depreciation, alternative cost of capital, and inflation)

The data in Table 2 has been transferred to the worksheet in Table 3. This worksheet is provided in order to simplify manual computations. The data has been manipulated through the body of the worksheet until in column 9 one finds ten different MAC's-- MAC_1 , MAC_2 , MAC_3 , . . . , MAC_{10} . Thus ten optional replacement cycles have been investigated on the one worksheet.

$$MACE_R = \left[P - \frac{S_R}{(1+i)^R} + \sum_{t=1}^R \frac{X_t}{(1+i)^t} \right] \left[\frac{i(1+i)^R}{(1+i)^R - 1} \right]$$

i = 8%

(1) Year [t]	(2) Original Purchase Price [P]	(3) Resale or Salvage Value [S _t]	(4) Dis- count Factor $\left[\frac{1}{(1+i)^t} \right]$	(5) Dis- counted Resale Value [(3)·(4)] $\left[\frac{S_R}{(1+i)^R} \right]$	(6) Deprecia- tion (Dis- counted) [(2)-(5)] $\left[P - \frac{S_R}{(1+i)^R} \right]$	(7) Total Yearly Costs X _t	(8) Dis- counted Total Yearly Costs [(7) · (4)]	(9) Cumula- tive Sum of Col. 8 $\left[\sum_{t=1}^R \frac{X_t}{(1+i)^t} \right]$	(10) Total Dis- counted Costs [(6) + (9)]	(11) Annual EQUIVA- lency Factor $\left[\frac{i(1+i)^R}{(1+i)^R - 1} \right]$	(12) Mean Annual Cost EQUIVA- lent [(10)·(11)] MACE ^R	(13) Replacement Period [R]
1	16,500	10,627	0.9259	9,840	6,660	4,856	4,496	4,496	11,156	1.0800	12,048	1
2	16,500	6,844	0.8573	5,867	10,633	5,877	5,038	9,534	20,167	0.5607	11,308	2
3	16,500	4,408	0.7938	3,499	13,001	7,299	5,794	15,328	28,329	0.3880	10,992	3
4	16,500	2,839	0.7350	2,087	14,413	8,520	6,262	21,590	36,003	0.3019	10,869*	4
5	16,500	1,828	0.6806	1,244	15,256	9,741	6,630	28,220	43,476	0.2505	10,891	5
6	16,500	1,177	0.6302	742	15,758	10,963	6,909	35,129	50,887	0.2163	11,007	6
7	16,500	758	0.5835	442	16,058	12,184	7,109	42,238	58,296	0.1921	11,199	7
8	16,500	488	0.5403	264	16,236	13,306	7,189	49,427	65,663	0.1740	11,425	8
9	16,500	315	0.5002	158	16,342	14,427	7,216	56,643	72,985	0.1601	11,685	9
10	16,500	203	0.4632	94	16,406	15,448	7,156	63,799	80,205	0.1490	11,951	10
11												

Table 6
Replacement Analysis Worksheet
Example 2

DETERMINATION OF ECONOMIC REPLACEMENT POINT

By utilizing these analytical methods, we can proceed to the question of when vehicles already in the fleet should be replaced.

An economic criteria for vehicle replacement can be stated as follows: replace the current piece of equipment when its period costs equal the minimum average period cost, MPC_{Minimum} (this would include MAC and MACE as in the previous examples), of the chosen replacement unit. There are however, two further conditions which must be met: (1) the period costs of the current vehicle should be rising, i.e., greater than the MPC_{Min} of the replacement vehicle in the periods following the equality, and (2) the average period cost, MPC, from the present period to the period of equality for the current vehicle should be equal to or less than the MPC_{Min} of the replacement vehicle.

Diagram 4 graphically illustrates these criteria. We are attempting to decide when to replace unit A in our fleet. Assume that we can replace

"A" by either unit B, C, or D. Assume also that we have owned "A" for one period as shown on the graph ($t=0$ is the period of purchase and $t=1$ is the current period).

First, it should be noted that the relevant costs to be considered in this decision are future costs. There is no need to consider past costs on unit A; our replacement decision can in no way change them. They are simply history at this point and are relevant only to the extent that they may have assisted us in predicting the future costs being considered.

Assume for a moment that only "B" is being considered as a replacement for "A". There are two points, "b" and "f", where "A's" period costs equal \$1,500, the MPC_{Min} of "B". We would hardly want to trade at "b", however, since we would lose the advantage of the 5½ periods between "b" & "f" where the period costs of Unit A are always below \$1,500. "Condition 1" would have required us to have eliminated "b" as the choice since the costs were declining at that point. Point "f" would be the appropriate point to trade unit A for unit B.

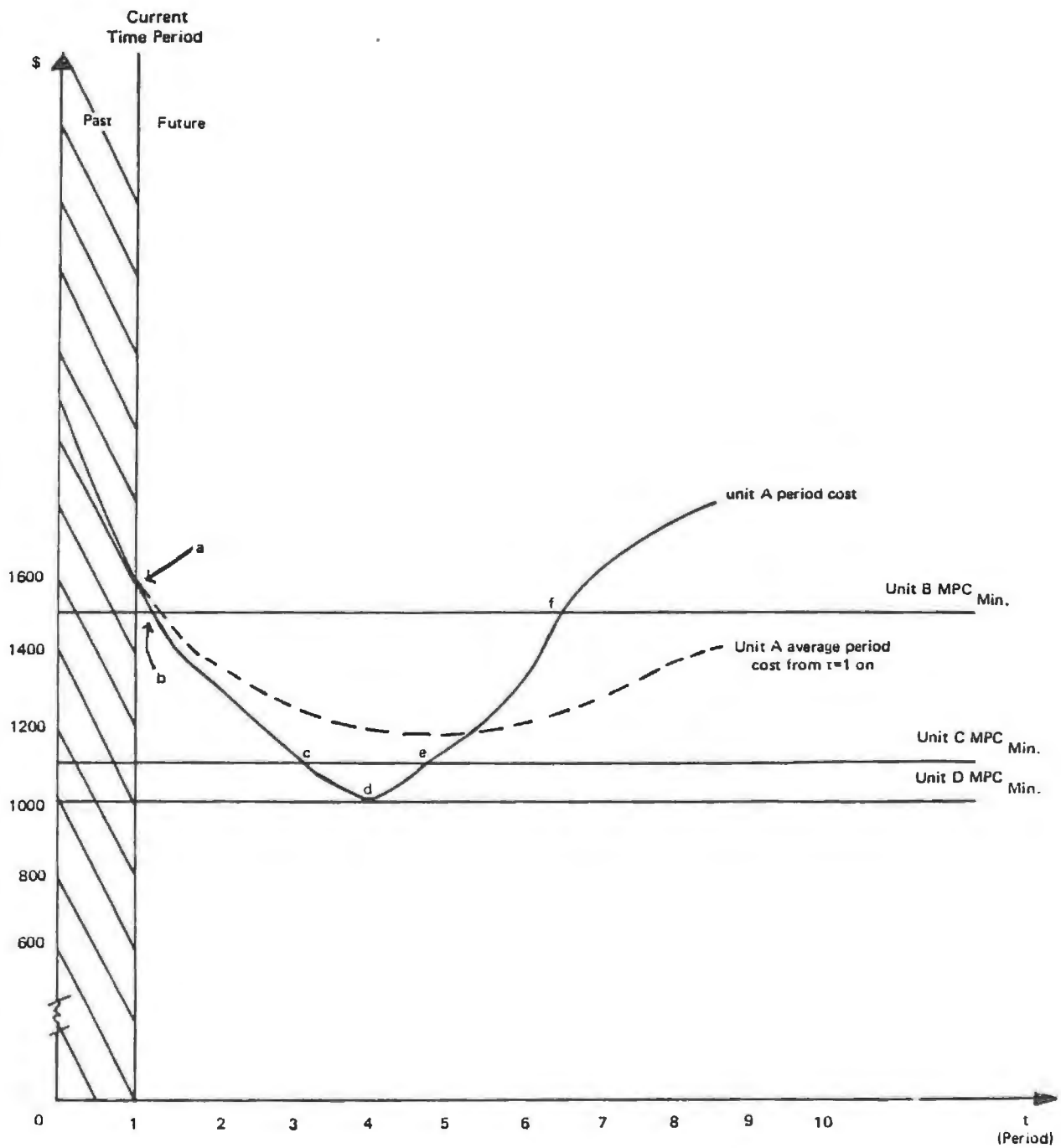


Diagram 4
Determination of Economic Point
of Replacement

if unit C were the only replacement being considered, we should trade immediately. Points "c" and "e" both meet the criteria of equality, but only "e" complies with the first condition--the period costs must be increasing. But the second condition is not met at "e" since the average period costs for "A" (from $t=1$ to $t=5$), \$1,170, is greater than the MPC_{Min} of the replacement unit, \$1,100. This being the case, it is to our cost advantage to trade right now for "C." Otherwise we would be losing \$70 per period for the next 4 periods.

We would also trade immediately if "D" were the only alternative unit being considered. At no point does the projected yearly cost of "A" fall below \$1,000, the MPC_{Min} of "D". The costs are equal at point "d" and the costs begin increasing at that point but the second condition is not met at "d". Again, it is to our cost advantage to trade immediately.

REPLACEMENT POLICIES UNDER BUDGET CONSTRAINTS

Up to this point it has been implicitly assumed that given our cost projections, analytical methods, and replacement criteria, we would have sufficient funds available to trade whenever it was economically feasible. Although some governmental agencies may operate with few budget constraints, the vast majority of equipment managers must live within fund allowances which will not permit them to replace vehicles at the economically optimum time. In other words, most equipment managers are short of cash!

The preceding analysis can be used to demonstrate the financial advantage of trading, even when borrowed funds must be used. Still, realities of the budget process, legal limitations on borrowing, and administrative politics in some organizations often leave equipment managers able to replace only a portion of those units due for replacement.

Priorities must be set to determine which vehicles to replace with the limited funds available. The following method provides one possible approach. If a unit is due for replacement, then the projected total costs of the current unit for the following year should be greater than the projected MAC_{Min} or $MACE_{Min}$ of the proposed replacement. This difference is the estimated loss associated with holding the

current vehicle beyond its economic point of replacement.* Priority should then be given to those vehicles which represent the largest relative loss per dollar of ownership cost (MAC_{Min} or $MACE_{Min}$) of the replacement unit.

This method is illustrated by the example in Table 7. Column 1 indicates the local vehicle number for each unit. Column 2 carries the units' 8-digit APWA codes, and column 3 lists the department assignments associated with each vehicle. The odometer or hourmeter reading, the current age, and the optimum replacement age are included in columns 4, 5, and 6 respectively. Next year's projected ownership costs of the current vehicle are in column 7, and the MAC_{Min} or $MACE_{Min}$ of the replacement unit are in column 8. The difference between these two, the project loss, is entered in column 9. The loss-cost ratio is calculated by dividing the projected loss by the MAC_{Min} or $MACE_{Min}$ and is recorded in column 10.

The vehicles in the table are arranged according to their loss-cost ratio--the highest ratio is first, the lowest ratio is last. This provides a priority ranking for replacement. Because capital funds are the limiting factor in this case, the net capital outlay (the price of the new unit less the salvage value of the current one) is listed in column 11. The cumulative sum of column 11 is then entered in column 12, e.g., the sum of lines one, two, and three is entered on line three; the sum of lines one through eight is recorded on line eight, etc.

The values in column 12 generally represent the capital budget commitment required to replace the vehicles to that point, e.g., replacement of the first ten units would require approximately \$45,020. If the capital budget allocation were \$52,000, replacement of the first twelve units of equipment on the list would be possible.

This approach to priority ranking could be developed for the entire fleet regardless of departmental assignment or alternatively a ranking list could be prepared for each department or fund. For example, if a given amount is appropriated for replacement of police equip-

*This difference does not necessarily indicate the immediate budget impact of the proposed trade since the first year costs of the new vehicle are almost certainly higher than the MAC_{Min} or $MACE_{Min}$. The cost advantage of the trade would be recognized during the life of the new unit and would likely fall in several future budget years.

(1) Vehi- cle No.	(2) APWA Code	(3) Department	(4) Mileage or Accum. Hrs.	(5) Age	(6) Optimum Replace- ment Age	(7) Projected Cost Next Year	(8) Optimum Equivalent Annual Cost	(9) Projected Loss	(10) Loss/Cost (9) ÷ (8)	(11) Capital Outlay Required for Replacement *	(12) Cumulative Sum of Column (11)	(13) Priority Rank
2011	1AL3ED5L	Police	50,649	3.0	3.0	1,218	895	323	.361	3,500	3,500	1
2198	1AL3ED5L	Police	45,736	3.0	3.0	1,218	895	323	.361	3,500	7,000	2
2300	1AL3ED5L	Police	62,428	3.0	3.0	1,218	895	323	.361	3,500	10,500	3
1253	1AA3FC4K	Bldg. Inspl.	56,961	4.0	3.0	1,221	904	317	.350	3,930	14,430	4
0244	3BC6JD4L	Sanitation	30,389	3.0	3.4	3,924	2,915	1,009	.346	13,420	27,850	5
0343	2LA1FC4L	Sanitation	49,400	3.0	3.0	1,125	852	273	.321	3,450	31,300	6
9246	1AA4ED5K	Manager	55,405	4.0	3.0	1,166	883	283	.320	4,500	35,800	7
2306	1AA3FD5L	Police	55,002	3.0	2.4	1,203	928	275	.296	2,560	38,360	8
1499	2KA1FC4L	Bldg. Inspl.	67,067	3.0	3.3	989	768	221	.288	3,460	41,820	9
5451	2LA1FC4L	Parks	48,690	3.0	3.2	1,006	804	203	.251	3,200	45,020	10
6003	1AA3FC4J	Engineering	56,187	5.0	3.6	1,056	849	207	.244	3,960	48,980	11
2562	1KA1BA1L	Police	49,410	3.0	3.2	1,013	843	170	.201	2,900	51,880	12
3112	2PH1FC4H	Water	64,105	6.0	4.2	1,083	905	178	.197	3,150	55,030	13

* Price of new machine less projected salvage value of old machine.

Table 7
Replacement Priority Rating List

ment a "Replacement Priority Rating List" could be constructed to act as a guide for their replacement decisions. The ranking system could just as easily be applied to equipment replacements financed by a general fund, a public health and safety fund, a water fund, etc.

This priority ranking system, and indeed the analysis presented in this entire chapter, is intended to serve as a guide or a tool for decision-making. It should in no way be construed as a substitute for the equipment manager's decision-making process. While financial variables must play a major role in such decisions, there are other considerations which should or will be addressed particularly in the short run. Limitations on the size of the maintenance facilities may encourage a more vigorous replacement policy in the short run since an older fleet will almost certainly require a greater maintenance commitment. A community desire to improve the environ-

mental impact of the fleet may suggest building a newer fleet having more extensive emission controls. It may also require outfitting portions of the fleet with special fuel systems or power plants which reduce pollution. A management desire for a "shiny new fleet," may dictate shorter replacement cycles. Bureaucratic images, expectations, and jealousies will also affect replacement decisions. Finally the economic conditions within the agency's boundaries will influence the manager's decisions--shortages of revenue and constrained borrowing capacity may very well set the limits of the agency's replacement decisions.

These considerations and others will enter into the decision-making process relating to the questions of which units should be traded and when they should be replaced. The preceding economic analysis should serve as a foundation and a guide, but the judgment of the equipment manager is needed to complement this analysis and to make the process relevant.

The University of Tennessee does not discriminate on the basis of race, sex, color, religion, national origin, age, handicap, or veteran status in provision of educational opportunities or employment opportunities and benefits.

The University does not discriminate on the basis of sex or handicap in the education programs and activities which it operates, pursuant to the requirements of Title IX of the Education Amendments of 1972, Pub.L. 92-318; and Section 504 of the Rehabilitation Act of 1973, Pub.L. 93-112; respectively. This policy extends to both employment by and admission to the University.

Inquiries concerning Title IX and Section 504 should be directed to Ms. Mary H. Taylor, Assistant to the Vice President, 109 Student Services and Administration Building, Knoxville, Tennessee 37996-0212, (615) 974-6621. Charges of violation of the above policy should also be directed to Ms. Taylor.

