STATE OF ARIZONA
OFFICE OF THE
AUDITOR GENERAL

A PERFORMANCE AUDIT
OF THE

ARIZONA DEPARTMENT OF TRANSPORTATION EQUIPMENT SERVICES SECTION

FEBRUARY 1983

A REPORT TO THE
ARIZONA STATE LEGISLATURE

REPORT 83-2

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STATE OF ARIZONA
OFFICE OF THE
AUDITOR GENERAL

February 23, 1983

Members of the Arizona Legislature
The Honorable Bruce Babbitt, Governor
Mr. William A. Ordway, Director
Arizona Department of Transportation

Transmitted herewith is a report of the Auditor General, A Performance Audit of the Arizona Department of Transportation, Equipment Services Section. This report is the fifth of a series of reports to be issued on the Arizona Department of Transportation and is in response to Senate Bill 1001 enacted by the Thirty-fifth Legislature, Second Special Session in 1981.

The blue pages present a summary of the report; a response from the Arizona Department of Transportation is found on the yellow pages preceding the appendices.

My staff and I will be pleased to discuss or clarify items in the report.

Respectfully submitted,

Douglas R. Norton

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Auditor General

Enclosure

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SUMMARY

The Office of the Auditor General has completed a performance audit of the Arizona Department of Transportation (ADOT), Equipment Services Section (Equipment Section). This audit was conducted in response to Senate Bill 1001, enacted by the Thirty-fifth Legislature, Second Special Session requiring a performance audit of the Arizona Department of Transportation and is one of a series of audits to be completed on the Department.

The Equipment Section is responsible for purchasing, maintaining and disposing of ADOT's equipment fleet. To carry out this charge, the Section operates 8 main shops (1 central and 7 district shops) and 11 smaller shops scattered throughout the State.

Our review included evaluating shop operations, equipment utilization and control over parts and fuel. We found that ADOT has not established appropriate standards and controls over its resources throughout several areas in the Equipment Section. Deficient shop operations, underutilized equipment and inadequate control over parts and fuel are causing unnecessary State expenditures.

ADOT needs to improve the performance of its equipment repair shops. Mechanics do not spend a sufficient percentage of their time on repair-related activities. Reasonable increases in productivity at two repair shops may allow staffing to be reduced by about 12 percent, resulting in an annual savings of $120,000. Shop operations may also be deficient in that

- Compared to industry standards, mechanics may be working too slowly when repairing equipment; and
- The quality of repairs may need improvement.

To improve shop operations, ADOT needs to 1) establish a system of time standards and quality control procedures for equipment repairs and 2) monitor these systems closely (see page 5).

Many ADOT vehicles are underutilized. Our review shows ADOT can save at least $238,000 and very possibly more than $718,000 by transferring or not replacing equipment which is unnecessary or of questionable need. Further, because this was a limited review, substantially larger savings may be feasible. Improved management may result in replacement savings even greater than those identified within our audit scope. To achieve these savings, ADOT needs to improve its equipment management by establishing clear standards for utilization, monitoring equipment use regularly and establishing a rate structure for automobiles and light trucks which charges all users the full cost of these vehicles (see page 27).

ADOT has inadequate control over its parts inventory and fuel usage. Although ADOT has previously developed information and control systems for these areas, it failed to adequately monitor input and control recording procedures for the systems. As a result, needed data is unavailable, incomplete or inaccurate, and the Equipment Section does not have sufficient control over the parts inventory or fuel usage (see page 39).

ADOT management is aware of the need to improve the agency's equipment operations. As a result, ADOT is now developing a $400,000 Equipment Management System to replace the previous management information systems. However, unless ADOT improves substantially its data monitoring and control procedures, the new system will not prove to be any more usable than the previous systems (see page 42).

We identified potential areas for further audit work that we could not pursue due to time constraints. For a list of these areas, see page 45.

INTRODUCTION AND BACKGROUND

The Office of the Auditor General has conducted a performance audit of the Arizona Department of Transportation (ADOT), Equipment Services Section in response to Senate Bill 1001 enacted by the Thirty-fifth Legislature, Second Special Session in 1981. This report is one of a series to be completed on the Department of Transportation.

The Equipment Services Section (Equipment Section) of the Arizona Department of Transportation (ADOT) is responsible for purchasing, maintaining and disposing of ADOT's equipment fleet. As of January 1982, the Equipment Section maintained approximately 3,400 pieces of equipment with an estimated replacement cost of $50 million. The statewide operation consists of 8 main repair shops (1 for each district and 1 central shop) and 11 smaller shops scattered throughout the State.

Since 1970, the Equipment Section has operated with a revolving fund established by law.* Revenues are generated from equipment user fees and fleet disposals. Funds are used for equipment acquisitions, repairs and operating expenses. ADOT's Maintenance Section, the largest equipment user, provides 70 to 75 percent of the Equipment Section's revenues.

According to the ADOT Organization Manual, the Equipment Section's primary goals and objectives are:

> "a. Provide the Department of Transportation with an efficient, effective and well managed equipment fleet
> b. Provide the State of Arizona with all data input related to equipment and equipment cost
> c. Maintain, at an appropriate level, all equipment within the fleet
> d. Constantly monitor, modify, up-date, and improve operating methods and maintenance records."

* The revolving fund is currently governed by A.R.S. §28-1831.B.

The Equipment Section operates with an annual budget of about $15.5 million and employs about 180 people. Table 1 presents the Section's operating budget and full-time equivalent personnel for fiscal years 1980-81 through 1982-83.

TABLE 1

ADOT EQUIPMENT SERVICES SECTION
OPERATING BUDGET AND FTEs,
FISCAL YEARS 1980-81 THROUGH 1982-83

Expenditure Classification	1980-81 Actual	1981-82 Actual	1982-83 Estimate
FTE positions	189	181	180
Personal services	$ 3,223,400	$ 3,523,800	$ 3,704,600
Employee-related expenditures	708,800	716,900	843,900
Professional and outside services	149,000	48,900	62,900
Travel:			
In-State	41,800	45,500	55,000
Out-of-State	1,700	1,000	1,700
Other operating expenditures	6,395,000	7,232,700	7,190,400
Equipment	1,533,300	4,021,100	5,052,100
Total appropriated	$12,053,000	$15,589,900	$16,910,600

Audit Scope and Purpose

The purpose of our audit work was to

1. Evaluate the effectiveness and productivity of shop operations and vehicle maintenance procedures,
2. Evaluate vehicle utilization, and
3. Evaluate parts and fuel inventory management and the extent to which ADOT management has addressed deficiencies in Equipment Services identified in numerous studies over the past 13 years.

Because some data are unavailable, incomplete or inaccurate, we were unable to address several areas of concern. These issues are the appropriateness of

1. Staffing levels at specific shops,
2. Equipment replacement or repair decisions, and
3. The rental rates charged to equipment users.

Due to time constraints, we were unable to address several other issues. Potential future audit issues are listed on page 45.

FINDING I

ADOT NEEDS TO IMPROVE REPAIR SHOP OPERATIONS.

ADOT Equipment Section management needs to improve the performance of its equipment repair shops. Shop operations are deficient in that

- Mechanics do not spend a sufficient percentage of their time on productive activities,
- Mechanics may be working too slowly when repairing equipment, and
- Quality of repairs may need improvement.

As a result, the State has incurred a minimum of $120,000 annually in excessive costs at two repair shops.

The primary cause underlying all of these problems appears to be ADOT's inability to adequately evaluate and monitor the performance of its repair staff.

Mechanics Do Not Spend a Sufficient Percentage of Their Time on Productive Activities

Productivity* at two ADOT equipment repair shops can be improved substantially. The Central Equipment Shop (located in Phoenix) could increase productivity by up to 15 percent of available time, while the Tucson Shop could increase by up to 10 percent. Management could accomplish these increases by controlling the time mechanics spend on other activities.

Work Sampling Study - As part of our audit we conducted a work sampling study of the Central and Tucson equipment repair shops.** The purpose of this study was to determine the percentage of time repair staff were involved in productive versus non-productive activities.

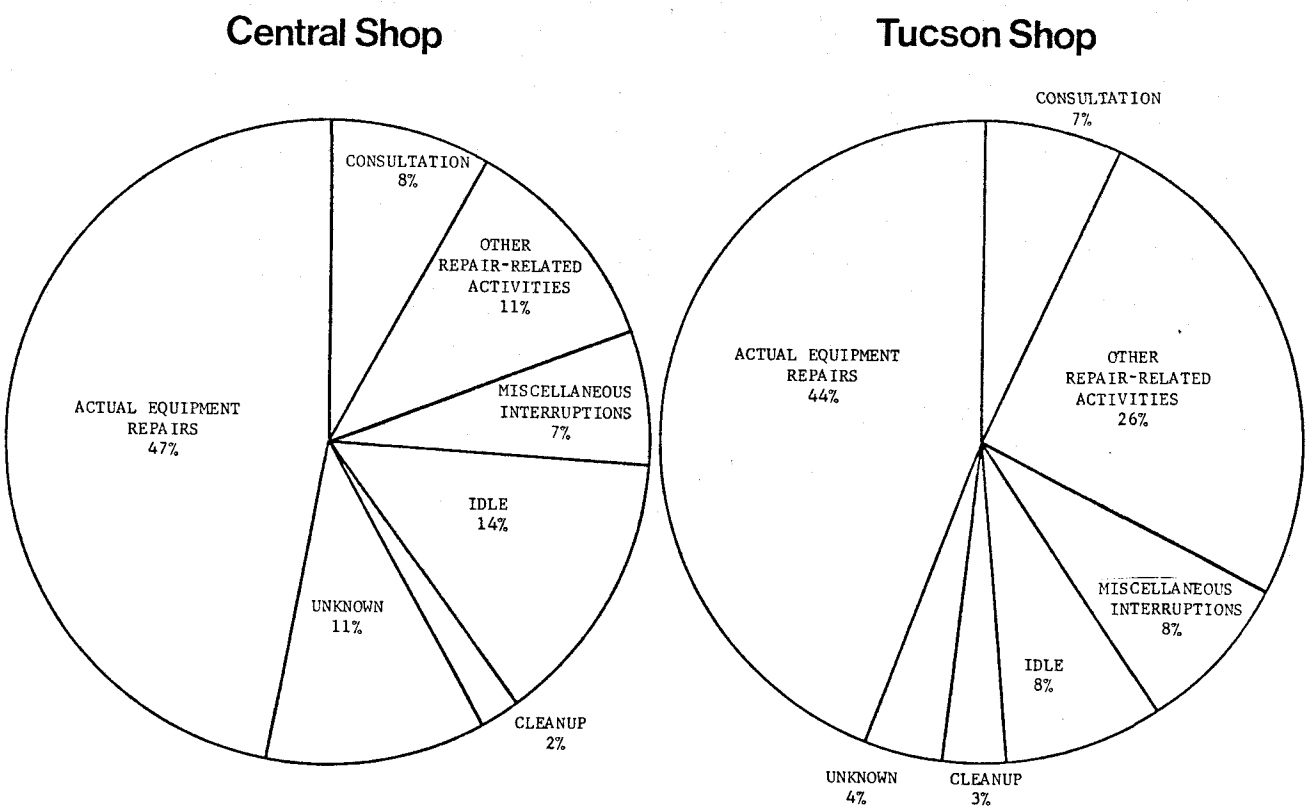
Figure 1 compares, for the Central and Tucson shops, the percentage of time we saw repair staff involved in various activities.

* As used in this finding, "productivity" is defined as including all necessary activities associated with equipment repairs.

** See Appendix I for a description of this study.

FIGURE 1

COMPARISON OF OBSERVED ACTIVITIES
BETWEEN THE PHOENIX CENTRAL AND TUCSON EQUIPMENT REPAIR SHOPS
(PERCENTAGE OF TOTAL OBSERVATIONS FOR EACH SHOP)



As demonstrated in Figure 1, the Central and Tucson equipment shops apparently differ as to the amount of time spent on various activities. Table 2 (see page 8) further details the differences we observed at the two shops.

Time Spent on Non-Productive Activities Should Decrease - As shown in Table 2, the Central and Tucson shops could increase the time spent on productive work by 1) reducing excessive idle/personal time and 2) reviewing and reducing the time mechanics are absent from their work stations.

Idle/personal time for the Central Shop totaled 14 percent of our observations, compared to 8 percent for Tucson. These factors appear to have attributed to this excessive idle time:

1. 30 percent idle time by heavy equipment mechanics - Mechanics at the heavy equipment shop in the Central shop complex spent more than 30 percent of observed time idle. ADOT Equipment Services management stated that this problem was due to lack of sufficient shop space and difficulty in obtaining heavy equipment parts. We were unable to determine the extent to which these conditions existed. However, during our study, apparently neither the shop foreman nor management made any effort to schedule these mechanics to work temporarily on other assignments where they might have been more productive. (It should be noted that these heavy equipment mechanics are qualified to do all other types of mechanic work, including gasoline engine and other routine automotive repairs.)

2. Excessive coffee breaks in general - Central repair staff spent 10 percent of observed time on coffee breaks, while only 6 percent is authorized. This, in effect, amounts to approximately one extra coffee break per day per person or almost 8 extra hours daily for the 31 mechanics observed.

TABLE 2
COMPARISON BETWEEN CENTRAL AND TUCSON SHOPS:
PERCENTAGE OF TOTAL OBSERVATIONS FOR EACH SHOP IN SPECIFIC
ACTIVITY CATEGORIES

	Central (Percentage of Total Observations)		Tucson (Percentage of Total Observations)	
Actual Equipment Repairs		47%		44%
Consultation:				
With foreman	2		2	
With other mechanic	5		5	
Reading instruction manual	1		*	
Total - consultation		8		7
Other repair-related activities:				
Obtaining parts**	3		12***	
Handling parts or tools	3		9	
Moving vehicle (in/out of bay, etc.)	1		2	
Test drive/service call	1		2	
Paperwork	3		1	
Total - other repair-related activities		11		26
Miscellaneous interruptions		7		8
Idle/Personal:				
Coffee breaks	10***		5	
Other observed idle time	4		3	
Total idle/personal		14		8
Cleanup (excludes authorized cleanup at end of day)		2		3
Unknown (unable to locate mechanic or unknown purpose of activity)		11***		4
TOTAL: ALL ACTIVITIES		100%		100%

* Less than 1 percent

** Includes obtaining parts by 1) requesting them from ADOT parts personnel or 2) driving to a parts store to purchase them.

*** This time is significantly higher than might be expected and is discussed further, beginning page 7.

3. Inconsistent prelunch policy - Nearly eight hours of repair time are lost each day at the Central complex* due to an inconsistent prelunch policy. Management has authorized Central complex repair personnel to take ten minutes to clean up before lunch, while neither the Tucson shop nor other shops are allowed this privilege.** This policy in effect gives the 45-person Central complex repair staff an unnecessary authorized idle period amounting to 7.5 hours daily.

Finally, ADOT needs to review the amount of time repair personnel are absent from their work stations. This problem appeared in two different forms at the two shops:

1. Excessive time that Central staff could not be located or their activities identified - Table 2 shows that we were unable to locate Central repair staff or determine what they were doing 11 percent of observed time as compared to 4 percent for the Tucson shop. While this does not necessarily indicate an abuse, it amounts to three times as much unknown time as in Tucson; thus, the potential is present that this time could be spent inappropriately.

2. Too much time spent "chasing parts" - The Tucson shop could increase the time spent repairing vehicles by reducing "parts chasing" by mechanics. Tucson repair personnel spent up to 12 percent of observed time driving to and from parts stores to purchase parts. We noted that this parts chasing often occurred for common parts--items which should be stocked at the shop (see Finding III for a discussion of problems with the parts inventory). In addition, the parts chasing which is necessary may be more appropriately performed by persons other than mechanics. According to authoritative sources, it may be

* Includes the Central and District I shops.

** We observed that this "cleanup" time was actually used by repair staff as extra lunch time. Thus, it is reflected as "idle" or "unknown" in Table 2.

more cost efficient to assign parts chasing to a lower-paid staff member. ADOT parts personnel receive an average annual salary of approximately $17,000, while a mechanic's average salary is over $21,000.

Productive Time Should Increase - The repair personnel at the Central and Tucson shops apparently can increase the amount of available time spent on productive activities by up to 15 and 10 percent, respectively. Currently it appears the two shops are operating below the productivity level reported by the City of Phoenix for its equipment shops.*

Using the City of Phoenix as a model, it appears the Central Shop could increase its productivity by 6 to 15 percent of available time,** and the Tucson shop apparently could increase productivity by about 10 percent. The City of Phoenix reports its shop personnel achieved 88.5 percent productivity last fiscal year.*** Using the City's definition of which activities constitute productive work, the Central Shop currently appears to achieve a productivity level of 74 to 83 percent.** The Tucson shop's productivity level is apparently about 78 percent.

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* The City of Phoenix equipment repair operation is considered a nationwide model.

** The range for the Central shop exists due to differing treatment of the large number of "unknown" observations (see Table 2, page 8). Authoritative sources recommend removing the unknown observations from the percentage base when analyzing work sampling observation study results. However, we felt that the number of unknown observations at the Central shop (11 percent) was rather high in comparison to Tucson's four percent, and should be examined by ADOT. Thus, we provided a range in productivity figures for the Central shop, including and excluding the unknown observations in the percentage base (see page 9 for further discussion of unknown observations at the Central shop). Tucson's unknown observations were excluded from the analysis as recommended.

*** After adjusting for sick leave, vacation, etc.

Mechanics May Be Working Too Slowly When Repairing Equipment

ADOT mechanics appear to charge excessive time for many individual vehicle repairs. While part of the time charged may be explained by the inappropriate manner of charging time (see page 24) and activities such as parts chasing, such reasons do not appear to explain all the time charged. This means that mechanics may take longer than they should to repair vehicles.

The Auditor General hired a mechanic/consultant to review a sample of work orders (ADOT's service repair documents) covering 13 vehicle classes and most of the repair shops in the State for the period April 1, 1981, to March 31, 1982.* The consultant was requested to analyze these work orders and

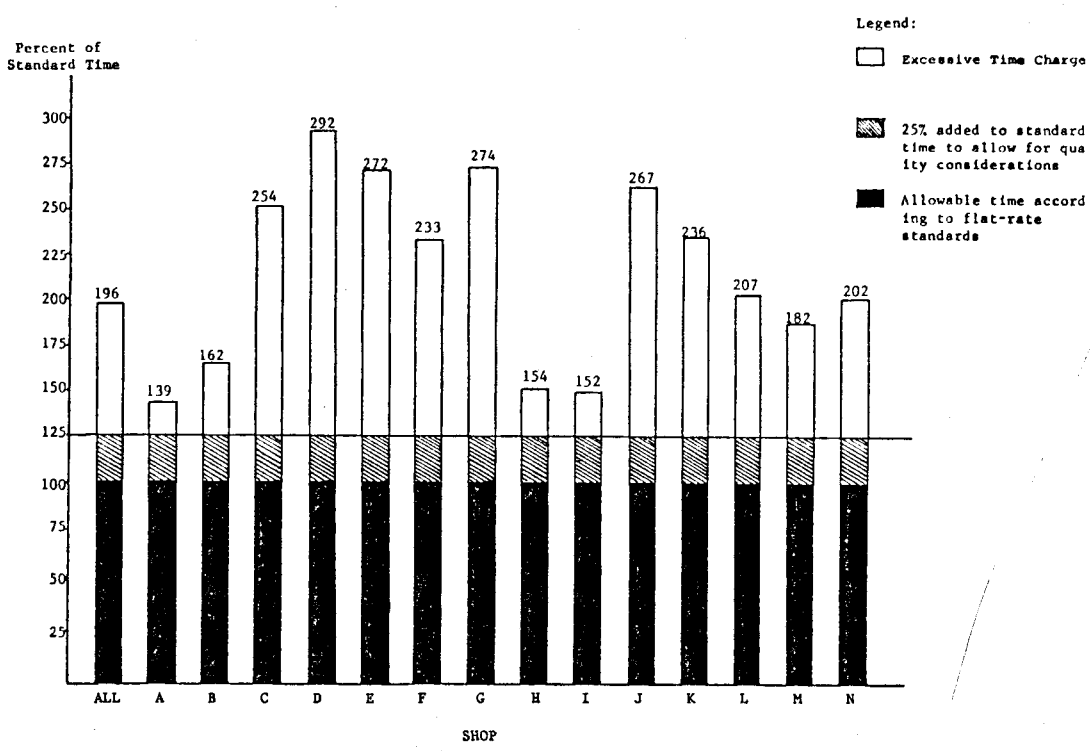
- Compare reported repair times on work orders to published standard repair times,
- Analyze "comebacks" (repairs that had to be repeated) and breakdowns,
- Evaluate the format of the ADOT work order,
- Analyze parts usage, and
- Note any other trends he observed.

* See Appendix III for the consultant's report, including the consultant's qualifications. Appendix II explains how the sample of work orders was selected by audit staff.

When our consultant compared the time charged on the sample work orders to the standard time for the repairs, he found that in most instances excessive time had been charged by the mechanics. Of the sample work orders reviewed for which sufficient information was available, 65 percent indicated that the mechanics had charged excessive time.* All 14 shops charged excessive time for the work orders in our sample, as illustrated in Figure 2. Although we cannot make a statistical inference to all work orders on the basis of this sample, we believe it indicates that charging excessive time is a serious problem.

FIGURE 2

SUMMARY BY SHOP OF EXTENT TO WHICH TIME CHARGED FOR SAMPLE REPAIRS EXCEEDED STANDARD TIMES



Source: An analysis of 274 work orders in our sample for which sufficient information was available to make a comparison.

* Of 471 work orders reviewed, 274 contained sufficient information for our consultant to compare times charged against standard time. Of those 274 work orders, 178 (65 percent) showed excessive time had been charged. ADOT estimates it processes about 20,000 work orders annually.

As shown in Figure 2, on the average, nearly double the standard times were charged for the sample repairs. Our consultant suggested that in the governmental environment it would not be inappropriate for mechanics to take more time than that allowed by flat-rate standards.* However, even if 125 percent is considered acceptable, ADOT mechanics still overcharged time to repairs. On the average, for our sample the excess amounted to 70 percent of standard time, even after allowing this additional 25 percent.

The consultant identified many work orders on which excessive time had been charged. The following cases are a few examples:

CASE I (Tucson)
1972 Dump Truck (Class 270)

Excessive time was charged for repairs on this dump truck. On September 11, 1981, the engine was removed and replaced with another engine. According to standard time, a maximum of 19 hours should have been charged. However, 62 hours were charged, amounting to over three times the standard time. Subsequent to this repair a battery was removed and replaced, a standard operation which should take no more than one hour. Four hours were charged--three hours more than the standard time.

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* This is because 1) ADOT wants to emphasize the quality of work performed and 2) the mechanic, under the merit system, is paid a salary, not by a flat rate or the quantity of work he performs. Under a flat-rate system, a mechanic is paid by the quantity of work performed but is <u>not</u> paid for work which must be repeated.

CASE II (Flagstaff)
1977 Dump Truck (Class 273)

Excessive time was also charged in repairing this dump truck. One work order had 45 hours charged to "R & R engine"* and "check all lights." Our consultant reported that 45 hours was too much for this job. It should have taken between 18 and 20 hours. Thus, at least 25 additional labor hours were charged to this vehicle without documentation on the repair order to justify these additional hours.

CASE III (Central)
1977 Pickup Truck (Class 142)

This truck reflects both excessive time charged and comebacks.** A work order dated June 25, 1981, shows extensive repairs, including replacement of the transmission and a 15,000-mile preventive maintenance service. A total of 53 hours were charged for those repairs, or 22 hours more than standard times would justify. On July 23, 1981--only 559 miles later--the vehicle was back in the shop because of a problem with the passing gear. According to our consultant, the passing gear should have been checked when the transmission was replaced in June. The transmission was pulled twice during the July repairs and 19 hours were charged. Even allowing for pulling the transmission twice, this was 11 hours more than standard times would justify. On September 3, 1981--2,800 miles later--the vehicle was again in the shop for a transmission problem, this time to repair transmission leaks.

* R&R = Remove and Replace
** Repeat repairs

ADOT management claimed one reason for the excessive time may be that mechanics do not record on the work order all the repair work they perform. While this may be true, our mechanic consultant was careful to check all available evidence associated with a repair in order to give mechanics full credit for work performed. In addition to the work orders, our consultant analyzed related parts lists from which he attempted to further pinpoint repairs made. He only evaluated the repairs for which there was sufficient information to compare to standard times.

Management stated that another reason for excessive time charged may be ADOT's emphasis on the quality of work rather than on speed of repairs. However, we also found evidence of poor quality work among some of the work orders reviewed, as explained in the following section.

Quality of Repairs May Need Improvement

Symptoms of poor quality work were evident in some of the work orders reviewed by our consultant. This was seen in the frequency of repairs, including comebacks.

As mentioned earlier, on the basis of our work order sample, we cannot make a statistical inference regarding the quality of all ADOT repairs. However, our consultant found a number of significant cases which may be indicative of a problem regarding repair quality.

Repairs Made Too Frequently - Some vehicles were down for repairs too frequently according to our consultant. One class of dump trucks in our sample averaged over 13 work orders per vehicle in the 12-month period, and 3 of these vehicles had 20 or more work orders. Another truck was down for repairs on the average every 304 miles and had 11 work orders in 5 months' time.

Too Many Comebacks - Comebacks appeared to be a problem for some shops and some vehicles. It was difficult in many cases to determine from the work order whether the comebacks were justified because the repair narrative was inadequate or vague.* For example, one vehicle had 10 work orders in a 12-month period which mentioned "check lights" or "repair lights." The narrative on the work order did not explain the problem with the lights; thus it was ". . . impossible to determine the legitimacy of the repeat repair."** A number of vehicles in the sample came back three or four times for the same problems. One vehicle was in the shop nine times with the same problem in a period of only seven months.

Following are a few examples of vehicles with a record of frequent repairs, including comebacks. These examples are intended to be illustrative and not representative of all ADOT repairs.

CASE IV (Globe)
1969 Dump Truck (Class 270)

This truck illustrates the problems of comebacks and frequent repairs. Thirteen out of the twenty-one work orders from April 1, 1981, to March 31, 1982, illustrate a problem with comebacks. They are summarized below.

* See page 24 for a discussion of vague work orders.
** See Appendix III, page III-2.

PROBLEM IDENTIFIED ON WORK ORDER

Date of Work Order	Back-up Warning System	Exhaust System	Hydraulic Pump
4/1/81		X	
5/11/81			
6/2/81		X	
7/6/81		X	X
7/28/81			X
8/4/81		X	X
9/28/81		X	X
10/20/81			X
11/16/81			X
12/10/81	X		X
12/21/81	X	X	X
1/27/82			X
3/30/82		X	
Totals	2	7	9

Repairs occurred on the average every 304 miles. Nine of these repairs related to the hydraulic pump.* A total of $760 on parts alone was spent to replace the hydraulic pump four times.

* Each time this vehicle came back for a hydraulic pump problem, it was usually assigned to a different mechanic. In all, six out of seven equipment mechanic IIs worked on this problem at one time or another.

CASE V (Tucson)

1970 Dump Truck (Class 260)

This dump truck is another example of comebacks and frequent repairs. Work orders related to comebacks are described below.

PROBLEM IDENTIFIED ON WORK ORDER

Date of Work Order	Starter	Ignition	Carburetor	Condenser and Points	Steering	Wiper
7/6/81	X					
7/13/81		X				
7/17/81		X	X	X		
8/10/81			X			
8/21/81					X	
8/24/81			X		X	
8/31/81					X	
9/8/81			X			X
10/15/81						X
11/16/81			X	X*		
11/27/81	X			X**		
12/3/81		X				
1/5/82			X			
3/15/82			X			
3/31/81						X
Totals	2	3	7	3	3	3

* These parts were replaced after approximately 3,000 miles.
** These parts were again replaced after 18 miles.

Where mileage could be determined, this vehicle incurred repairs on the average every 302 miles.

CASE VI (Globe)
1969 Dump Truck (Class 260)

This truck illustrates problems with comebacks and frequent repairs. The comebacks are summarized below.

PROBLEM IDENTIFIED ON WORK ORDER

Date of Work Order	Carburetor	Hydraulic Pump	Starter	Alternator
8/21/81	X			
9/14/81	X*			
11/24/81	X	X		
12/11/81		X		
12/22/81		X		
1/7/82		X		
1/18/82		X		
1/20/82		X		
2/25/82				X**
3/8/82			X	
3/9/82			X	X
Totals	3	6	2	2

* 25 to 30 hours of excessive time were charged on this work order.
** 3.4 hours travel time listed on a shop repair

The alternator was replaced on February 25, 1982. The truck was checked on March 8, 1982, for a starter problem. On March 9, 1982, the starter was checked again, and the alternator installed on February 25 was replaced by the same mechanic who had installed it.

This dump truck had 19 repair orders in 12 months' time, or an average of one for every 351 miles traveled.

Consultant Questions Quality of Preventive Maintenance Program - Our consultant suggested that the quality or frequency of preventive maintenance (PM)* on some vehicles and some vehicle classes may be poor in that some repairs may be related to the absence of preventive maintenance. According to him, "there appears to be significant violation of PM schedules in certain shops and on certain vehicles. There is strong evidence to suggest that certain failures and problems may be directly related to poor periodic maintenance."

In five of the six cases discussed above, despite repeated repairs and breakdowns, we could find no evidence that preventive maintenance inspections were done in the 12-month period between April 1, 1981, and March 31, 1982. However, on the other hand we were able to document for at least a few vehicles too short an interval between preventive maintenance inspections. In one case only 17 days and 947 miles separated two 15,000-mile inspections.

Although our consultant suggested that preventive maintenance may be deficient for some vehicles and some vehicle classes, a full evaluation of the program would require further audit work.

State Has Incurred Excessive Costs

Because of low productivity the Central and Tucson shops may be overstaffed. In addition, excessive repair time and poor quality work may also be causing unnecessary expense.

* Preventive maintenance is routine, periodic, scheduled maintenance of a vehicle. Work orders generally do not record lubrication and oil changes.

Increased Productivity Will Reduce Costs - If the Central and Tucson shops were to increase their productivity (time spent on repair-related activities) by 13 percent,* they would be able to

1. Handle the current workload with 12 percent fewer mechanics (or 4 to 5 fewer mechanics),
2. Increase the amount of work handled (thus decreasing potential backlogs and downtime), or
3. A combination of the above.

The dollar value of the hours that could be freed is 12 percent of the current payroll for those mechanics, or approximately $120,000 annually. If productivity increases similar to those projected for the Central and Tucson shops could be achieved statewide, ADOT could achieve even greater savings. Audit staff estimates such an increase would save over $300,000 a year.

Other Costs May Be Unnecessary - In addition to the costs resulting from low productivity, the State may also be incurring unnecessary expense due to excessive repair time and poor quality repairs. While the costs cannot be quantified, due to insufficient data, these costs may be reflected in such things as

1. Overstaffing,
2. Unnecessary parts expense,
3. Unnecessary and costly travel time for breakdowns, and
4. The amount of time the vehicles are unavailable for use.

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* This 13 percent increase in productivity is an estimate based on the following assumptions:

1) The City of Phoenix definition of productive activities is used.

2) For the two shops, the percent of mechanics' time spent on productive activities averages about 78 percent.

3) The shops can achieve 88.5 percent productive time (same as City of Phoenix repair shops).

This 10-point increase (from 78 to 88) translates into a 13 percent increase in productivity ($\frac{10}{78} \times 100 = 12.8$ or approximately 13 percent).

ADOT Does Not Adequately Evaluate Mechanic Performance

Problems with low productivity, excessive time to complete repairs and poor quality work appear to exist because the ADOT Equipment Section does not evaluate and monitor mechanics' performance adequately. However, ADOT cannot currently evaluate mechanic performance because

- ADOT lacks a system of work standards,
- The work order form (ADOT's service repair document) does not provide for sufficient detail,
- Mechanics do not adequately complete the work orders,
- Mechanics improperly charge time, and
- Until recently there has been no system for monitoring quality of repairs.

Equipment Shops Should Use Recognized Standards - Work standards, commonly used in the automotive and truck repair industry, are not used in the ADOT equipment repair shops. Although ADOT has been aware of the importance of using work standards in evaluating performance, it has failed to implement a standards system.

Work standards are used not only in private industry but also by governmental entities. Common practice in private industry is to use the flat-rate system, whereby each repair task has an estimated time to complete given in hours and fractions of an hour. The City of Phoenix started out with time standards specific to its operation and further modified them as the city gathered data on the actual repair times. There are also several other sources of established standards. In our opinion, ADOT would not have to develop its own unique standards at the outset. Our consultant stated that flat-rate standards could be used at least as a guideline in establishing standards for many ADOT repairs.*

* As explained on page 13, our consultant suggested that in the governmental environment it would not be inappropriate for mechanics to charge above actual flat-rate standard times. However, he felt that the flat-rate manual could be used as a beginning point in developing standards for many ADOT repairs.

At least three prior management studies conducted for ADOT in the last 13 years have recommended the implementation of time standards for repair activities. According to a 1981 management report,

> "Mechanics' performance must be known in order to establish an accurate measure of the overall quality and effectiveness of the workshop. One way to measure this performance is to compare man-hour requirements for a shop to recognized time standards for the same task." (Emphasis added)

Work Order Format Needs Improvement - Even if ADOT had work standards, management could not evaluate the time it takes to complete each repair because the work order format is inadequate. The work order form commonly in use needs improvement because time for different repairs cannot be identified on the form, there is not enough room for narrative and there is no space to specify fractions of an hour.*

Time for individual repairs cannot be identified on the work orders. For example, one mechanic reported a total of three hours to 1) "replace P.S. belt" and 2) "repair tire." ADOT cannot evaluate the time it took to perform either task individually.

The ADOT work order does not allow sufficient space for the mechanic's narrative. As a result, the work order frequently is vague and the exact nature of the repairs cannot be determined. The narrative is important to identify which work standard is appropriate and also to justify any excess time over standard. It should be noted that only 58 percent of the sample work orders could be analyzed by our consultant because of vague narrative (see Footnote *, page 12).

* The Equipment Section is experimenting with a pilot work order which is an improvement over the current form; however, further revisions may be needed.

The ADOT work order does not specifically provide for recording to the tenth of an hour, and ADOT management does not encourage reporting to the tenth of an hour. However, published work standards specify to this detail so as to make the most efficient use of repair time.

Work Orders Are Not Properly Completed - Although the work order form needs improvement, the mechanics currently fail to complete much of the data that can be recorded on the present form. Without this data it is impossible for ADOT to fully justify either the time or the staff used to repair equipment. According to our consultant,

> "From an auditing standpoint, the majority of work order write-ups were woefully inadequate. Very few work orders had:
> 1. Adequate repair instructions
> 2. Adequate repair narrative
> 3. Adequate parts descriptions or attached invoice."

Examples of other data not being completed include whether the repair is a "comeback," the dates in and out of the repair shop and vehicle mileage.

Practice of Charging Time Needs to be Changed - Time spent on repairs tends to be overstated on the work orders because it is standard practice for the mechanic to charge the full eight hours per day to vehicle repairs. Overhead costs such as the mechanic's coffee breaks, time spent chasing parts and even unassigned time are reported on the work order as time charged to vehicle repairs. This practice makes it difficult for management to evaluate a mechanic's performance from the work orders.

No Systematic Quality Control in the Past - Until May 1982, management had not established a systematic quality control operation at the shop level. Prior to this, one individual had been assigned to inspect the quality of a small number of repairs statewide. In May, ADOT adopted a policy whereby shop foremen would be required to systematically inspect and verify repair quality for a designated percentage of equipment repairs.

New Information System May Help Improve Shop Operations

ADOT claims that the proposed Equipment Management System (EMS) should provide the data needed for more efficient shop operations.

In 1980 the Equipment Section received approval and funding to contract with outside consultants to develop a management information system. The project is scheduled for completion in October 1983 and will cost approximately $400,000. EMS will capture information about several aspects of the Equipment Section's operations, including the use of repair time by mechanics. However, as discussed in Finding III, unless ADOT improves the control and monitoring over this system as compared to that exercised over previous systems, little benefit will be derived from EMS. In addition, even though EMS may enable ADOT to monitor and evaluate the use of repair time, attention must still be given to the quality of repairs.

CONCLUSION

The State has incurred excessive costs due to deficient shop operations. As a result of low productivity, two ADOT equipment shops may be overstaffed at an annual cost of approximately $120,000. Moreover, ADOT's failure to evaluate mechanic performance may be further costing the State in that 1) mechanics may be working too slowly and 2) some repairs may be of poor quality, thus causing work to be repeated.

RECOMMENDATIONS

1. Time standards should be implemented for repairs and preventive maintenance. We suggest that ADOT begin with published standards and revise them as necessary.

2. The work order format should be changed to include
   - More room for mechanic's narrative,
   - Allowance for reporting time to a fraction of an hour,* and
   - Reporting the time of each repair individually.*

3. Management should ensure that the quality control procedures adopted in May 1982 are carried out consistently.

4. Foremen should improve supervision of
   A. Mechanics' uses of time. Attention should be given to
      - Parts chasing,
      - Appropriate/useful mechanic assignments,
      - Idle time,
      - Coffee breaks, and
      - Cleanup.

   B. Work order documentation. Attention should be given to
      - Meeting time standards,
      - Adequate descriptions of repairs (including repair codes),
      - Parts usage,
      - Completeness, and
      - Sign-off by foreman.

   C. Quality of work. Attention should be given to
      - Vehicle repair histories and
      - Comebacks in particular.

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* These items are on the pilot work order form and should be retained in any later revisions.

FINDING II

THE DEPARTMENT HAS NOT EFFECTIVELY CONTROLLED THE SIZE OF ITS EQUIPMENT FLEET. THE DEPARTMENT COULD SAVE AT LEAST $238,000 BY NOT REPLACING UNNECESSARY EQUIPMENT. IN ADDITION, THE NEED FOR AT LEAST ANOTHER $480,700 IN EQUIPMENT IS QUESTIONABLE AND SHOULD BE CAREFULLY REVIEWED.

ADOT has not adequately reviewed the utilization of its rolling stock equipment to identify and eliminate unnecessary equipment. Although ADOT reduced the size of its equipment fleet by almost 9 percent between 1980 and 1982, our review shows that the Department could still save at least $238,000 and very possibly more than $718,000 by transferring or not replacing equipment which is unnecessary or of questionable need. To ensure efficient utilization of ADOT equipment in the future, ADOT needs to strengthen its equipment management procedures.

ADOT Can Eliminate Unnecessary Equipment

Up to 5 percent of the automobiles, trucks and heavy equipment assigned within ADOT in May 1982 were either not needed or of questionable need. ADOT's informal standards and other states' standards show that a large number of additional pieces of equipment are underutilized. Although underutilized equipment may be justified by special needs or assignments, a limited follow-up on only the least utilized equipment revealed that many pieces of low-use equipment cannot be justified by special needs.

Underutilized Cars and Trucks - Half of ADOT's automobiles and light trucks were driven less than Equipment Section informal standards during the 12-month period ended in May 1982. Further, 44 percent of the cars and 43 percent of the light trucks were underutilized when compared to other states' standards.

The Equipment Section applies an informal mileage standard based on average usage to two classes of automobiles and two classes of pickups. These standards represent the annual, or break-even, mileage that vehicles

in these classes must travel to earn sufficient revenue to meet their fixed costs.

Break-even mileages range from 11,900 to 18,300 miles. Approximately 51 percent of the vehicles covered by these four classes have utilization below the breakeven mileage (Table 3).

Historical utilization is a second informal standard that the Equipment Section uses to measure heavy equipment use. This criterion indicates low use if a piece of equipment is used less than half of the past year's average for that class of equipment. Using this standard approximately 11 percent of ADOT's heavy trucks and equipment are underutilized.

ADOT automobiles and light trucks are also underutilized when compared to standards used by other states. Three states surveyed--California, Utah and Idaho--reported having specific utilization standards based on annual mileage. These criteria are 12,000 miles, 14,400 and 11,000 miles, respectively. Using the 12,000-mile criterion, as many as 43 percent of ADOT's cars and light trucks are underutilized. Table 3 shows the percentage of cars and light trucks which are underutilized when compared to the Equipment Section's and California's standards.

TABLE 3

ADOT AUTOMOBILE AND LIGHT TRUCK UTILIZATION,
12 MONTHS ENDING MAY 31, 1982

	Less than Equipment Section Standards			Less than 12,000 miles		
	Number Below Standards	Total Vehicles in Applicable Classes*	Percent of Total	Number Below 12,000 mi	Total Vehicles in Applicable Classes**	Percent of Total
Automobiles	123	280	39%	138	315	44%
Light Trucks	327	608	54	337	790	43
Totals	450	888	51%	475	1,105	43%

* Standards cover four classes only.
** Standards cover ten classes only.

Equipment Not Justified by Special Need - Although some equipment with low utilization may be justified by special needs, our review of the least used equipment shows 50 pieces of ADOT equipment to be unneeded. Further, the need for another 30 pieces of equipment is questionable. Because we did not review all underutilized equipment, however, these estimates are conservative.

Some underutilized equipment may be justified by special needs. For example, some highway crews require equipment to carry out assigned tasks even though they do not make extensive use of that equipment throughout the entire year. In particular, the Department uses heavy trucks and other equipment for snow removal during winter months, but has only limited need for them during the remainder of the year. To determine which underutilized equipment was justified by special needs, we reviewed additional records and contacted equipment users.

Because of time constraints, our review of special needs focused on a sample of the least used equipment. This sample consisted of vehicles which had less than 50 percent of the average historical utilization for that class. For example, the average utilization of an ADOT compact sedan was 15,216 miles per year for the period we analyzed. Thus, a car in this class would not meet our standard if it was driven less than 7,608 miles per year--or 50 percent of the historical average. Using this standard, we still identified 13 percent of the equipment in ADOT's major classes of rolling stock for further review.*

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* We anlayzed the period July 1979 through December 1981 to determine historical averages for each major class of fleet equipment. These major classes included 86 percent of ADOT rolling stock--automobiles, pickup trucks, one-ton utility trucks, heavy trucks and general purpose heavy equipment such as motorgraders, front-end loaders and tractor mowers. The analysis excluded classes with small numbers of vehicles such as compact trucks and special purpose equipment such as oil distributor trucks. In addition, we also excluded equipment which was in service for less than a full year. Thus, the 13 percent is based on 1748 pieces of equipment.

According to our analysis, ADOT had at least 50 pieces of equipment assigned in May 1982 which were underutilized and not justified by special requirements. We identified another 30 pieces of underutilized equipment which were of questionable need. However, available data did not permit a final determination on this equipment. Therefore, in Table 4 we show both a low and high estimate of unneeded equipment.

TABLE 4

ESTIMATES OF UNNEEDED ADOT EQUIPMENT

	Low Estimate		High Estimate	
Category	Number	Percentage of Total*	Number	Percentage of Total*
Automobiles	21	9%	29	13%
Light trucks	27	6	34	8
Heavy trucks	2	**	12	3
Heavy equipment	0	0	5	2
Totals	50	3%	80	5%

* The total figure is the total number of pieces of fleet equipment in the major classes we reviewed or 86 percent of ADOT rolling stock.
** Less than one percent

Examples of this unnecessary or questionable equipment include the following vehicles:

- Equipment Section managers use two sedans for statewide travel. One vehicle traveled 4,410 miles in 12 months. The second sedan was also available for this purpose and traveled 9,575 miles during that period. One sedan should be sufficient for management travel. Motor pool transportation is readily available in Phoenix for the occasions when there may be competing demand for the one automobile.

- The Tucson District Materials Lab had two pickup trucks assigned for general purpose transportation. Employees drove one truck 2,839 miles during 12 months. The second truck traveled 5,911 miles. The combined annual mileage was 8,750 and would justify only one truck.

- The ADOT Building and Grounds Section in Phoenix has two one-ton trucks. One truck traveled 122 miles in 12 months. The second truck traveled 716 miles during the year. Because of the extremely low use for both trucks, it would appear that the Section could carry out its duties with one truck.

Although our analysis identified up to 5 percent of ADOT's fleet equipment as unnecessary or questionable, this figure probably does not represent the full extent of unneeded equipment. First, the standards we used to select vehicles for follow-up were more conservative than the standards used by other states to identify underutilized vehicles. As a result, we did not follow up on the majority of the equipment identified as underutilized in Table 3.

Second, we reviewed the justification for low-use cars and pickup trucks assigned only to the Central office, District One and portions of Districts Two, Five and Six. Follow-up in the remaining parts of these districts and Districts Three, Four and Seven may also identify unnecessary equipment.

Third, in most cases where field personnel indicated that they required equipment to meet a special need, we did not verify that response. It is likely, upon further analysis, that some of this equipment may also be unnecessary.

Much of the equipment we reviewed in detail did appear to be unnecessary or questionable, however. Of the 125 cars and light trucks we reviewed in detail, 48 were unneeded and another 15 were questionable. While this distribution may not apply to all of the underutilized cars and trucks identified in Table 3, these figures and the limited scope of our analysis strongly suggest that the 3 to 5 percent estimate of unneeded equipment is at best a minimum estimate.

Underutilization and Unnecessary Equipment Result from a Lack of Effective Management Procedures

Although ADOT is beginning to emphasize more efficient equipment utilization, its ability to do so is limited by inadequate management procedures. In particular, 1) the Equipment Section does not have clearly defined utilization standards; 2) Equipment Section managers have not systematically monitored and followed up on low-use equipment; and 3) the rate structure for renting cars and pickup trucks does not encourage efficient utilization.

Utilization Standards - Although ADOT previously had utilization standards for some equipment classes, no utilization standards are currently in force. The ADOT Equipment Section Manual does not provide specific guidance or standards on equipment utilization. Section 8.02 of the manual states only that

> "All vehicle assignments are subject to a continuing review to assure that a prudent and economical usage of the department vehicle fleet is being realized. Vehicle assignments are reviewed by the director or his designee."

The manual establishes general criteria for assigning vehicles to organizational units, individuals and motor pools. Nowhere, however, does the manual specify the utilization criteria the Director will use in reviewing vehicle assignments nor does the manual address heavy equipment utilization.

In place of formally established standards, the Equipment Section uses two informal utilization criteria: break-even mileage and historical usage. Break-even mileage standards apply to two of four automobile classes and two pickup truck classes. The breakeven mileage is the distance which a vehicle must travel in a year to generate sufficient revenue to pay its fixed costs. The historical usage standard applies to only heavy trucks and equipment; the Equipment Section uses 50 percent of the last 12 months' utilization as its standard. However, these are informal standards and do not clearly indicate departmental policy. Consequently,

ADOT equipment users lack specific guidance on how the Equipment Section will evaluate their equipment needs.

Because there are no formal utilization standards, field managers do not consider the utilization rate as a major factor in determining their needs for equipment, particularly in making replacement decisions. Maintenance field personnel use the maintenance management system (PeCOS) standards to assess some of their equipment needs. These standards specify what equipment is needed to perform specific maintenance tasks. However, PeCOS addresses only maintenance tasks and does not cover automobiles or all the uses of pickup trucks.

Monitoring Utilization - The Equipment Section has not systematically monitored equipment utilization in recent years. Equipment Section managers have not viewed this function as part of their responsibility. Moreover, any efforts to monitor use are limited by the lack of reports which readily identify low-use equipment and the lack of clear authority for Equipment Section to review all ADOT equipment.

Equipment Section managers have viewed their role as supplying equipment to ADOT users rather than controlling the size of the fleet. For example, one manager stated that the Section "does not wear the black hat" of forcing users to relinquish underutilized equipment.

Although Equipment Section personnel assert that they are assuming a stronger management role, they lack a means for readily identifying underutilized equipment. The only source for identifying this equipment is the monthly report on use and cost for all equipment in each class. This report simply lists information for each of the approximately 2,000 pieces of rolling stock. Therefore, identifying underutilized equipment is a tedious, manual process that Section personnel do not regularly perform. Once the Department establishes utilization standards for the various equipment classes, it should be able to program the existing equipment information system to identify underutilized equipment without much difficulty. Equipment Section and other managers could then follow up on low-use equipment to more carefully assess needs.

The extent of Equipment Section managers' authority to monitor utilization is not clear. The Assistant State Engineer for Equipment does not have full authority to question the need for all ADOT Equipment. In early 1982, the Section identified 81 underutilized vehicles and notified the users--through the State Engineer--of this condition. However, only Highway Division users--52 vehicles--were asked to justify their needs for this equipment. Notices sent to users in other divisions simply provided the information for their use and did not request any specific action.

Rental Rates - Rental rates for ADOT passenger cars and pickup trucks provide no incentive for improved utilization. Vehicle users pay the same rate per mile whether their vehicle travels 200 miles or 20,000 miles per year. High mileage users subsidize low mileage users who have no economic incentive to improve vehicle utilization.

Economic incentives are an important complement to periodic review of utilization. Such incentives provide field managers with a reason to carefully balance the cost of having a piece of equipment against its intended use. For the heavy truck and equipment classes, Equipment Section charges a flat rate per month to recapture the fixed overhead and depreciation costs incurred by having a piece of equipment available. For example, the flat rate for a one-ton utility truck was $121 per month in 1981-82, the rate for a three-axle diesel truck was $703 monthly. These charges are in addition to the hourly or mileage charges for actually operating the equipment and force the user to pay the true cost of having the vehicle. If the vehicle is underutilized, the user must still pay for the privilege of having the vehicle available but idle.

Rates for automobiles and pickup trucks lack any such flat charge. Instead, the mileage charge includes fixed as well as operating costs. Under such a system, high-mileage users subsidize vehicle users who do not produce sufficient revenue through their own use to cover fixed costs. As a result, users lack any economic incentive to utilize their vehicles more efficiently.

For example, if a pickup truck costs $7,200 and has an expected useful life of six years, the annual depreciation cost is $1,200. Currently, this cost is included, along with other fixed costs, in the 27 cents per mile usage charge. However, at an annual utilization rate of 2,200 miles per year, the user will only pay $594--$600 less than the depreciation cost. Moreover, the user's payment does not meet any other fixed costs or any operating costs for the vehicle. Because the user does not bear the full costs, he has no incentive to turn in the vehicle. If a flat rate plus usage charge were used, the cost of the underutilized vehicle would more than double, providing an economic incentive not to retain the vehicle.

ADOT Can Save Future Replacement Costs by Transferring or Not Replacing Unnecessary Equipment

ADOT has begun to improve management of its equipment by transferring or retiring unnecessary equipment, but additional savings can still be achieved. Since May 1982, 6 cars and 13 trucks identified as unnecessary in the Auditor General's analysis have been transferred or scheduled for transfer. However, ADOT could transfer the remaining 31 pieces of unnecessary equipment for replacement savings of approximately $238,000 (Table 5). If the Department transfers or decides not to replace the additional 30 pieces of questionable equipment, anticipated replacement savings would be about $718,700.

TABLE 5

ESTIMATED SAVINGS IN FUTURE REPLACEMENT COSTS

	Low Estimate		High Estimate	
	Number	Replacement Cost	Number	Replacement Cost
Automobiles	15	$108,000	23	$165,600
Light trucks	14	112,000	21	168,000
Heavy trucks:				
One-ton utility	2	18,000	6	54,000
Dump trucks	0	0	6	130,800
Heavy equipment	0	0	5	200,300
	31	$238,000	61	$718,700

Improved utilization of existing equipment, particularly cars and pickup trucks, can eliminate the need to purchase replacements. At the beginning of fiscal year 1982-83 ADOT estimated that it would need to purchase 30 automobiles and 90 pickup trucks during the year. At least 15 to 23 of the estimated automobile purchases appear to be unnecessary. Similarly, the purchase of between 14 and 21 pickup trucks may also be unnecessary.

CONCLUSION

Our review shows ADOT can save at least $238,000 by not replacing unnecessary equipment and possibly another $480,700 or more by not replacing equipment with questionable need. Additional replacement savings may result from a comprehensive review of equipment in all districts. To achieve these savings, ADOT needs to improve its equipment management by establishing clear standards for utilization, regularly monitoring use and establishing a rate structure for automobiles and light trucks which charges all users the full costs of these vehicles.

RECOMMENDATIONS

1. ADOT should develop standards which realistically define the need for each class of equipment in terms of expected utilization and special needs. The Department should publish the standards in its policy manual and disseminate them to all equipment users.

2. The Equipment Section should regularly review and evaluate the needs for all equipment assigned within ADOT. The Director of ADOT should authorize the Assistant State Engineer, Equipment Section to recall or transfer any equipment which is underutilized and not justified under the new utilization standards. As a first step, the Equipment Section should carefully review the need and justification for underutilized equipment that Auditor General staff did not review further. Specifically this review should encompass all passenger vehicles assigned to Districts Three, Four and Seven and vehicles in portions of Districts Two, Five and Six.

3. To facilitate timely equipment review, the Equipment Section should develop a monthly report which identifies equipment not meeting the utilization standard.

4. The Equipment Section should change the rate structure for automobiles and pickup trucks to charge each user full fixed costs of each vehicle in addition to operating costs.

5. The Equipment Section should reduce the amount of its rolling stock by transferring or eliminating unnecessary equipment. Planned purchases of vehicles should be reduced by transferring underutilized vehicles to replace vehicles scheduled for disposal.

FINDING III

THE DEPARTMENT HAS INADEQUATE CONTROL OVER PARTS AND FUEL.

ADOT does not have adequate control over its parts inventory and fuel usage in the Equipment Section. Although ADOT has previously developed information and control systems for these areas, it failed to adequately monitor input and control recording procedures for the systems. As a result, needed data is unavailable, incomplete or inaccurate. ADOT is now developing a $400,000 Equipment Management System (EMS) to replace the previous systems. However, if ADOT does not improve its monitoring and control procedures, this system will not prove to be any more usable than the previous systems.

Parts Inventory

Despite recommendations made in at least four studies between 1975 and 1981, ADOT has not developed adequate control over the $1.5 million parts inventory. Although ADOT has revised the inventory system, it does not collect sufficient data nor does ADOT adequately monitor inventory procedures to ensure that data is correct. As a result, data available through the inventory system is inaccurate and commonly used items may be understocked.

Inaccurate Data - Parts inventory data is unreliable and does not agree with physical inventory counts. A review of three outlying shops found records are incorrect because parts withdrawals and receipts are not always recorded. We found significant differences between the physical inventory count and inventory records. One shop had differences for 22 percent of its inventory items, resulting in a $1,900 net shortage. Three months prior to year-end physical inventory, another shop could not account for 44 tires valued at $3,800. At a third shop, receipts are not always recorded. As a result, discrepancies cannot be identified because parts personnel cannot determine the amounts which should be on hand.

Understocking - The State may incur excessive costs if mechanics are underutilized when parts are not available. Stockouts occur for commonly used items which are understocked. For example, at one shop mechanics must "chase" common parts which are not available when needed (see Finding I, page 9).

This may be caused in part by the fact that neither the automated system used in Phoenix nor the manual system used in outlying shops is designed to capture all necessary data regarding parts demand. Demand must be known or estimated with reasonable certainty to determine which items to carry as well as the appropriate amounts to stock. The present inventory systems do not capture some usage data needed to estimate demand, such as purchases of nonstock items or lengths of stockouts.

Monitoring Inventory Procedures - ADOT has not controlled the quality of available data through supervision and training. The relative newness of the systems, infrequent inventory counts and staff turnover create unfamiliarity with prescribed procedures. Since the manual system was implemented more than one year ago, spot checks have not been conducted. According to the parts department manager, he has been unable to conduct periodic inventory counts due to time constraints. Furthermore, the area supervisors have not conducted spot checks on the parts inventories at outlying shops although they visit these shops on a regular basis.

Fuel Usage

The fuel usage monitoring system ADOT attempted to implement contains misleading or inaccurate data because input was not adequately monitored. As a result, management cannot adequately control fuel usage.

Organizations with large fleets monitor fuel usage, measured by miles per gallon (mpg), to control fuel consumption and identify problem areas including theft. Maricopa County, most transportation agencies in other states surveyed and a large construction company contacted by our Office monitor mpg for all vehicles regularly and investigate significant variances from vehicle class averages.

ADOT's "Fuel Economy Report" generated by the fuel inventory system is useless for monitoring fuel usage. Data input into the system is either untimely or unedited, resulting in misleading or erroneous reports. The following conditions illustrate data input problems:

- Six-digit odometer readings are input into a five-digit field, resulting in truncation, or cutting off, of one digit and a distortion of such readings.

- The system lacks computer edit procedures to identify fuel tickets input more than once. Audit staff found duplicate inputs, resulting in overstated fuel consumption.

- The fuel consumption report uses input data from two sources. Because these sources are independent and the reporting periods do not necessarily coincide, fuel consumption can be misstated.

Miles per gallon figures reported in the "Fuel Economy Report" for some vehicles are markedly different from three-month averages for identical-model vehicles. Comparisons of some reported and average mpgs are shown in Table 6.

TABLE 6

ANALYSIS OF FUEL CONSUMPTION FOR SELECTED VEHICLES

Vehicle Description	Fuel Economy Report	Average for Identical Model Vehicles
Pickup Truck - '74 Chev.	.3 mpg.	9.9 mpg.
Pickup Truck - '74 Chev.	6.5 mpg.	9.9 mpg.
Pickup Truck - '75 Dodge	7.1 mpg.	10.9 mpg.
Pickup Truck - '76 Chev.	N/A *	12.9 mpg.
Pickup Truck - '76 Chev.	N/A	12.9 mpg.
Pickup Truck - '77 Chev.	N/A	13.0 mpg.

* Unreasonable mpg figures, based on miles driven and gallons consumed, are suppressed or edited with "N/A."

Normally such variances would be investigated to determine the cause. However, because Equipment Section management knows that the "Fuel Economy Report" is unreliable, they do not investigate variances.

Need for Monitoring New EMS System

The proposed Equipment Management System (EMS) should provide the data needed to control ADOT resources, including parts and fuel. However, failure to control the quality of information will render the system useless.

As evidenced by ADOT's past experiences with information systems, inadequate control over data recording procedures and data input results in unreliable data which is essentially useless. For example, in 1975 the Equipment Section implemented an automated manpower planning system designed to capture workload information such as number of labor hours per vehicle, specific repair activity and shop performing the repair. Management failed to ensure that shop personnel provided correct and complete information. Therefore, the data input clerk, unfamiliar with repair activities, was required to complete the coding and verify the accuracy of documents, creating a backlog. Because the reports were inaccurate and untimely, management discontinued the system. As discussed above, the current parts inventory and fuel usage monitoring systems also contain inaccurate information. Unless ADOT implements and uses controls over EMS, the new system will prove to be only a more expensive version of the existing systems.

EMS will capture information which can be used in making decisions in inventory management, staffing and work measurement and control. EMS should assist ADOT in the following areas:

- Determining the number of mechanics needed at each shop,
- Identifying which items should be carried in the parts inventory and determining the appropriate amount of each item to stock,
- Establishing the most economical point to replace equipment, and
- Evaluating mechanic performance against established standards.

All of these capabilities, however, depend upon accurate, controlled data input and data recording procedures. Data must be "cleaned" and data entries must be monitored for the system to be a meaningful management tool.

CONCLUSION

ADOT does not have adequate control over its parts inventory and fuel usage because of past failures to monitor and control information systems for these areas. Improvements in monitoring and control procedures must be made if the EMS under development is to be of value.

RECOMMENDATIONS

1. ADOT should implement and use procedures to control the quality of data produced by EMS, including
   - Continual foreman review of source documents used in performance evaluations and manpower planning to ensure completeness and correctness;
   - Periodic area supervisor review of outlying shops' parts inventory procedures and records;
   - More frequent inventory counts at outlying shops, supervised by area supervisors or Phoenix parts department personnel.

2. ADOT should correct deficiencies in the fuel usage monitoring system, including developing edit procedures and coordinating the timing of input from various sources.

AREAS FOR FURTHER AUDIT WORK

During the course of the audit, we identified several potential areas for further audit work. These areas, which were outside the scope of our audit or were not completed due to time constraints (see page 3), include as follows:

- To what extent do statutory bidding requirements affect ADOT's ability to repair equipment in a timely manner by delaying the purchase of parts?

- Is the tools inventory adequately controlled?

- Is the preventive maintenance program effective in maintaining ADOT's equipment fleet?

- Are the equipment maintenance and related activities performed by personnel in ADOT's Maintenance Section adequately managed and effective? (This work is in addition to work performed by the Equipment Services Section.)

ARIZONA DEPARTMENT OF TRANSPORTATION

206 South Seventeenth Avenue Phoenix, Arizona 85007

BRUCE BABBITT
Governor

WILLIAM A. ORDWAY
Director

February 22, 1983

FEB 23 AUDITOR GENERAL

Mr. Douglas Norton
Auditor General
Auditor General's Office
111 West Monroe, Suite 600
Phoenix, AZ 85003

Dear Doug:

Thank you for the opportunity to review the revised preliminary report draft of the performance audit of the Arizona Department of Transportation, Equipment Section. Our comments concerning the three findings are attached.

Again, thanks for this opportunity to comment and for the cooperation extended by you and your staff.

Cordially,

W. A. Ordway
Director

WAO:dl

Enclosure

ADOT'S COMMENTS ON AUDITOR GENERAL'S PERFORMANCE AUDIT
OF THE ARIZONA DEPARTMENT OF TRANSPORTATION'S EQUIPMENT SERVICES SECTION

The Arizona Department of Transportation believes the report prepared by the Auditor General's staff on the Equipment Services Section contains valuable recommendations. Substantially all of the recommendations have been previously identified by agency management and are being implemented through the Equipment Management System under development. In this sense, the audit is a "snapshot" of an organizational unit in mid-transition after intensive management review with nationally recognized consultant support.

Although the recommendations are considered valid and useful, we cannot agree with some of the conclusions and statements within the body of the report. Many are unsupported by fact, and simply represent opinions.

Comments on individual findings follow:

FINDING I - ADOT NEEDS TO IMPROVE REPAIR SHOP OPERATIONS

ADOT POSITION: CONCUR

ADOT is addressing and will continue to emphasize more effective and productive use of mechanics' time. Idle time by heavy equipment mechanics, excessive coffee breaks and inconsistent pre-lunch policies have been addressed and corrected.

The need to develop work standards and monitor repair staff performance is recognized. The Equipment Management System under development will

1. Identify in excess of 275 repair tasks for each of 760 equipment classes. Each of these combinations of task and class will have its own work (labor) standard.
2. Provide an "employee task labor versus standards" report.
3. Develop repair cost standards for all classes of vehicles.
4. Track "comebacks" which will indicate the quality and permanency of repair work.
5. Generate work delay reports and identify cause of same.

6. Facilitate further development of the on-going preventative maintenance program. Comprehensive PM schedules will be established by equipment class. The EMS will automatically generate PM work orders when a vehicle is due for service. The PM work order includes a complete list of tasks to be performed.
7. Utilize a revised work order form which will include labor reporting to the tenth of an hour, work repair reasons and work delay reasons. There will be ample room for mechanics comments.
8. Track open work orders (both PM and repair). Any work order not completed and closed properly will be flagged as still open.
9. Develop staffing requirements.

Exception must be taken to the sampling of work conducted, and the cases cited as examples of excessive repair time and frequent repairs, pages 11 to 24. The consultant stated that the work orders provided for his analysis were woefully inadequate as to repair instructions, repair narratives and parts descriptions. Additionally, the sample was in no way random. Minor repair work orders and vehicles with less than three work orders per year were eliminated. Vehicles reflecting high parts usage and/or frequent repairs were deliberately included.

Based on the foregoing, the analysis cannot be considered a true measure of mechanics performance, but may merely be an indication that all activities were not recorded, thereby distorting the repair times.

Following is a description of the three vehicles cited as examples of frequent repairs:

Case IV - E34-162, Roosevelt based 1969 IHC dump truck averaging 7,400 miles/year on the unpaved road section out of Parker Creek, 45 miles from the nearest shop.

Case V - E34-210, Tucson based 1970 IHC plow service truck averaging 11,000 miles/year in general dump truck and occasional plow service (current mileage 127,000).

Case VI - E34-185, Roosevelt based 1969 IHC plow service truck averaging 11,000 miles/year on the unpaved road sections

out of Parker Creek, 45 miles from the nearest shop (current mileage 135,000).

The deliberate inclusion of "problem" equipment naturally results in such examples.

FINDING II - THE DEPARTMENT HAS NOT EFFECTIVELY CONTROLLED THE SIZE OF ITS EQUIPMENT FLEET. THE DEPARTMENT COULD SAVE AT LEAST $238,000 BY NOT REPLACING UNNECESSARY EQUIPMENT. IN ADDITION, THE NEED FOR AT LEAST ANOTHER $480,700 IN EQUIPMENT IS QUESTIONABLE AND SHOULD BE CAREFULLY REVIEWED.

ADOT POSITION: PARTIALLY CONCUR

ADOT does not totally agree with the statement that fleet size has not been effectively controlled. For the past several years, ADOT has significantly reduced fleet size - approximately 9% since 1980 - and is making a concentrated effort to identify unnecessary equipment. A recently completed report, prepared by a committee established for this purpose, has identified more than 100 additional vehicles which will be removed from the fleet.

Although budgeted, the 120 cars and pickups referenced in the report will not be purchased this fiscal year. Budgets are developed well in advance of expenditures, but a detailed <u>second</u> analysis is made prior to the actual purchase of any equipment. Should need not be apparent, purchase is not made.

The Equipment Management System under development will further assist in control of fleet size by

1. Tracking equipment utilization,
2. Providing utilization analysis reports,
3. Providing fleet size analysis reports,
4. Setting utilization standards,
5. Providing utilization exception reports of below - standard usage,
6. Providing downtime reports,

7. Providing availability reports,
8. Tracking equipment usage by operator.

Equipment usage will be reported on a daily, rather than monthly basis. In addition to miles/hours, the number of trips and shifts per day will be reported. Equipment rates will be calculated and charged based on usage, as well as a monthly rate, which will encourage more effective utilization.

FINDING III - THE DEPARTMENT HAS INADEQUATE CONTROL OVER PARTS AND FUEL.

ADOT POSITION - PARTIALLY CONCUR

While there is a need to improve control, positive steps have been taken in this direction. In 1980, the new Parts Manager initiated a standardized manual parts inventory and filing system. Concurrently, parts storage facilities were redesigned and security improved.

The Equipment Management System under development will provide an on-line statewide parts inventory system. All parts inventory locations, including highway maintenance camps and service trucks, will be tracked individually. All major equipment shops will be equipped with CRT terminals and printers. Parts transactions will be entered on-line and the files will be updated immediately. Parts inventory will be verified cyclically and the parts to be inventoried each cycle will be provided automatically for spot checking purposes. Inventory listings by location or part number may be requested at any time. EMS will calculate economic order points and quantities for each part and provide this information automatically. EMS will track IMU (immediate use items) and provide information to indicate if these items should be stocked. Parts disbursement will be entered on a two part form. One part will be used by the Parts Specialist to update the inventory file. The other part will accompany the repair or PM order and be entered into the computer when the repair/PM order is closed. This will charge the parts usage to the equipment being serviced. The "Security Detail Print" report will identify any discrepancies between the two forms.

ADOT maintains an accurate inventory of fuel stock on hand via receipts and disbursement records.

EMS will thoroughly track fuel usage. Mileage exception reports will be automatically generated. Fuel pump totalizer readings will be entered into the system and tracked. Tank dip stick readings will continue to be entered and will be tracked. EMS will provide reports showing both excessive fuel (more than vehicle tank capacity) and wrong fuel type reporting.

ADOT, at all levels of management, is committed to the implementation and success of the Equipment Management System. A reorganization of the Equipment Section is planned to provide the necessary support personnel to monitor and control the System. Information Systems Group has committed the necessary resources to assure EDP programming support and hardware availability.

APPENDIX I

DESCRIPTION OF WORK SAMPLING STUDY

Auditor General staff conducted a work sampling study of the Central and Tucson (District Two) equipment shops. The purpose of the study was to gain an understanding of the amount of time the repair staff at each shop spends on various activities (such as actual equipment repairs, parts obtainment and paperwork). The results were to help us identify the improvements, if any, which could be made in shop operations.

Work sampling is a generally accepted means of determining productivity. We chose to study the Central and Tucson equipment shops because their work loads did not exhibit substantial seasonal fluctuations as do many northern shops. As a result, a comparison between the two would be meaningful.

Our work sampling study involved making a number of "snapshot" observations of individual staff persons at predetermined times during the workday. Each observation was recorded and then grouped with all other observations made at that shop. Please note that our study should not be confused with "time-and-motion" studies or other types of productivity analyses; it was not our purpose to evaluate the performance of individual mechanics.

Sources Consulted

We designed our study according to guidelines set by two widely accepted texts on the subject* and two experts in the industrial engineering field. Dr. M. E. Mundell advised us on some specific study parameters. Dr. William Moor, from the Arizona State University Industrial Engineering Department, reviewed and approved our research design.

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* Ralph M. Barnes, Work Sampling, New York: John Wiley & Sons, Inc. 1961; and
R. E. Heiland and W. J. Richardson, Work Sampling, New York: McGraw-Hill Book Company, Inc., 1957.

Sample Selection

For the purpose of determining sample size, we defined actual equipment repairs as "productive" and all other activities as "nonproductive." We used the generally accepted confidence level of 95 percent and accuracy rate of plus or minus 5 percent. Based upon the tables for sample selection,* 1,420 and 1,260 observations were required for the Central and Tucson shops, respectively. Our final observation tally was 1,478 for Central and 1,455 for the Tucson shop.

Our staff completed the Central shop observations in May and June and the Tucson observations in July 1982. Prior to the Central shop study, Dr. M. E. Mundell, consultant to the Auditor General, recommended that the Central shop observations occur over a 30-day period to reduce the potential of bias resulting from cyclical work loads. Therefore, we completed an average of 70 observations over each of 21 consecutive working days to arrive at our total of 1,478 observations. However, after a statement by Equipment Section management that the Tucson shop work load did not fluctuate significantly over a 30-day period, we made an average of 162 observations over each of 9 consecutive working days at Tucson to total 1,455 observations.**

* Barnes, Work Sampling, page 31.

** To allow for invalid observations due to employee absence, we actually selected 90 and 170 observations per day for the Central and Tucson shops, respectively. Thus, the daily averages mentioned above of 70 and 162 observations excluded an average of 20 and 8 observations due to employee absence.

Immediately prior to commencement of the observations at each shop, we conducted a trial study. This was to allow for observation times which may not be valid due to bias resulting from altered employee behavior at the beginning of the actual observations. The trial study amounted to 392 test observations over 6 days at the Central shop and 312 observations over 2 days at Tucson. We did not include these test observations in our analysis.

The sample for each shop was selected using a random number generator computer program. Random hours and minutes of the work shift were selected for each day, excluding the first 5 minutes at the beginning of the day, the lunch period and the 10 minute clean-up period at the day's end. Repair personnel were also selected randomly from the

a) Mechanic Level Is and IIs, welders, painters, machinists and auto body specialists assigned to the Central shop (total observed--31 persons) and

b) Mechanic Level IIs and Automotive Service Attendant Level Is assigned to the Tucson shop (total observed--8 persons).*

Definitions

In recording the observations, our staff used the following activity categories:

I. Actual Equipment Repairs

II. Other Activities

1. Consulting/Instruction:
   - with other mechanic
   - with foreman
   - with other person
   - reading manual
2. Break
3. Other idle/personal

* "Traveling" mechanics were not selected in our sample.

4. Obtaining parts
5. Paperwork
6. Moving vehicle
7. Handling tools or parts
8. Road test
9. Miscellaneous Interruptions
10. Clean up:
    - shop area
    - personal
    - other
11. Unknown:
    - unable to locate
    - unidentifiable activity

We defined these categories very conservatively in all cases. As a general rule, we gave the observed individual the benefit of the doubt if there was any question as to his activity at the time of observation. For example, if the mechanic was standing over a vehicle but not actively repairing the vehicle, we still recorded the observation as an actual equipment repair. Similarly, we recorded an observation as "Idle/Personal" only if it was clearly idle time. As a result, we classed all telephone calls as "Miscellaneous Interruptions" rather than idle time, and all conversations held by the repair staff as "Consultation." Finally, we made every effort possible to locate an individual before we categorized an observation as "Unknown."

Intended Use of Study Results

According to authoritative sources, the sample at each shop is scientifically valid at a 95 percent confidence level and plus or minus 5 percent accuracy. As a result, the overall findings of our study can be generalized--i.e., taken as a normal state of occurrence for that shop--for the major activity categories "Actual Equipment Repairs" and "Other Activities." All other detailed activity categories are meant for descriptive purposes and are not to be generalized.

APPENDIX II

WORK ORDER DATA

The Equipment Section does not have a management information system for evaluating the effectiveness and efficiency of its repair services. Therefore, Auditor General staff analyzed a sample of work orders (repair orders) to evaluate several aspects of shop operations.

Selection of Sample

The vehicles included in the work order sample were selected in the following manner:

The 20 largest classes of vehicles were identified, excluding classes 8,000-9,999 which represent lost and stolen, rental and disposed equipment. We then excluded vehicles which are primarily attachments to other vehicles such as trailers and snow plows, arriving at 13 vehicle classes.

Once the 13 classes had been identified for inclusion in the sample, the actual vehicles were selected randomly by computer. The sample size for each class was determined as follows:

- 20 percent of the class if number of vehicles in class was less than 100 and
- 10 percent of the class if number of vehicles in class exceeded 100.

The computer selected 212 vehicles for the sample. However, we found that some had been sold at auction, and there were others for which we could find no work orders. Thus the final sample included 187 vehicles.

We obtained all available work orders for these 187 vehicles for the period April 1, 1981, to March 31, 1982--a total of 1,275 work orders. Of

those 1,275 work orders

- 36 represented work done outside of ADOT, such as windshield repair, and
- 104 represented parts only, where parts were installed by user.

Of the remaining 1,135, 92 percent were complete with labor hours and days of labor. (See Table A for a breakdown of the sample vehicles and work orders by vehicle class.)

TABLE A

ADOT-EQUIPMENT
WORK ORDER SAMPLE,
SUMMARY BY VEHICLE CLASS

Vehicle Type	Vehicle Class Code	Number of Vehicles in Sample	Number of Work Orders	Average Number of Work Orders Per Vehicle
Compact Sedan	103	21	91	4.3
1/2-ton Pickup	120	48	209	4.4
1/2-ton Pickup w/air	121	13	82	6.3
3/4-ton Pickup	130	9	73	8.1
3/4-ton Pickup	142	10	48	4.8
Crew Cabs, 3/4 ton	143	7	35	5.0
1-ton Flatbed Dump Truck	223	14	79	5.6
Plow Service Trucks	260	12	132	11.0
Dump Truck, 2 axle, gas	270	13	111	8.5
Dump Truck, 2 axle, diesel	271	9	100	11.1
Truck, 2 axle, Dodge	273	10	133	13.3
Grader	711	10	118	11.8
Front-end Loader	806	11	64	5.8
Totals		187	1,275	6.8

Analysis of Work Order Sample

We attempted to analyze the work orders for frequency of repairs, downtime, repair time charged, parts usage, delays caused by unavailable parts and evidence of preventive maintenance. However, due to inadequate data on the work orders--such as dates, repair narrative and parts information--we were not able to make conclusions from some phases of the analysis. Nor could we generalize by shop as our sample was of vehicles which had been randomly selected by equipment number, not shop location.

The Auditor General hired a consultant to perform a technical analysis of a portion of the work order sample described above. The larger sample of 1,275 was reduced to approximately 500 for the consultant's review. To accomplish this, we excluded work orders that involved parts only, outside labor, minor repairs and vehicles with less than three work orders in a year. To reduce further, we randomly eliminated vehicle numbers.

Certain vehicles were included in this sample of 500 because our initial analysis suggested that a potential problem might exist with regard to

- parts usage or
- frequency of repairs.

These 500 work orders covered 66 vehicles in 13 classes and serviced at 14 shops. The work orders for each vehicle in the consultant's sample included all relevant work orders from files for the period April 1, 1981, to March 31, 1982. The consultant was requested to analyze these work orders and

- Compare repair times on work orders to published standard repair times,
- Analyze "comebacks" (repairs that had to be repeated) and breakdowns,
- Evaluate the format of the ADOT work order,
- Analyze parts usage, and
- Note any other trends he observed.

The consultant's report describing the results of his analysis is contained in Appendix III.

APPENDIX III

MECHANIC/CONSULTANT'S REPORT

FINDINGS

REPAIR TIMES-FLAT RATE: In the majority of repairs, the repair times exceeded suggested labor times. In comparing reported times (from work orders) to standard times, allowance was made for the highest permissible time. For example, if extra time was allowed because of special accessories or equipment, that time was figured in, even though the work order gave no evidence of these extras. The larger the equipment, the more liberal the time allowance. Some equipment, such as loaders, graders and plow trucks may require extensive cleaning and equipment removal before repairs can begin.

Some overcharges were small enough to be dismissed as diagnostic or cleanup time. There were, however, many gross overcharges (labor) that in no way could be qualified. These findings do not universally suggest or insinuate deliberate fraud. The mechanics/technicians may in fact have worked the entire time. Without supporting evidence or narrative, the comparisons can only be to standard time.

STRAIGHT TIME: Certain operations (rewiring, welding, painting, etc.) are not amenable to flat-rate schedules. These are considered straight or clock time. Questions on suspected excessive straight time can only be raised...answering involves on-site inspection, interview and evaluation.

DIAGNOSTIC TIME: Many work orders included instructions to "check battery," "check charging system," etc. The flat-rate manual gives definite times for most of these operations. In almost all cases, these times were exceeded with no explanation.

ROAD CALL TIME: As with straight time, in lieu of adequate description or narrative, these times are impossible to call.

PARTS OBTAINMENT: In essentially all cases, the method of purchasing parts was expedient and reasonable. Some shops use the mechanics to "chase parts." Serious consideration needs to be given this matter.

PARTS PRICING: ADOT garages appear to be paying competitive prices for parts and supplies. Although there were some price questions on one or two work orders, they were minor and not indicative of any trends.

PARTS APPLICATION: Very few work orders had any discrepancies on parts application. There were some questions on certain popular, universal supplies like anti-freeze, but again, there were no trends or gross violations.

COMEBACKS: From a statistical standpoint, comebacks may appear to be excessive. However, comebacks can be categorically defined as justified or unjustified. For example, a series of work orders documenting reports (multiple) to the top lights may be justified (breakage, vibration, etc.) or unjustified (poor workmanship on the initial repair). If the work order repair narrative is inadequate or vague, i.e. "fix lights," "check lights," "repair lights," then it becomes impossible to determine the legitimacy of the repeat repair.

Comeback evaluation must also be tempered with vehicle types and usage. Some classes of vehicles (heavy trucks, plow trucks, dump trucks, etc.) can be subjected to more severe use and abuse than other vehicles. Such things as clutch, driveline and suspension abuses are common in these vehicles. Evaluation of comebacks that do not fit in the aforementioned categories (such as fuel, ignition and charging systems) reveals a comeback rate that, while certainly not horrible, definitely needs some attention for improvement.

PERIODIC MAINTENANCE (PM): There appears to be significant violation of PM schedules in certain shops and on certain vehicles. There is strong evidence to suggest that certain failures and problems may be directly related to poor periodic maintenance.

WORK ORDERS: From an auditing standpoint, the majority of work order write-ups were woefully inadequate. Very few work orders had:

1. Adequate repair instructions,
2. Adequate repair narrative, or
3. Adequate parts descriptions or attached invoices.

STANDARD SERVICES: A wide range of time was charged in different shops for PM on similar vehicles. A 10,000-mile check ranged from 5 or 6 hours in one shop to 20 or 30 in another. Almost universally, when performing inspections and repairs, the mechanics failed to consider combinations and overlapping times. The most frequent violation/examples consisted of charging full time for tune-up and brake work when in fact, engine and chassis parts had to be disassembled to facilitate a PM service and inspection.

SUGGESTIONS

LABOR TIMES-FLAT RATE: Managers need to implement a standard time awareness procedure. This should include flat-rate manual application and usage at all shops. Meeting flat-rate time exactly is unrealistic and should not be a goal...rather, it should be used as a general guideline for productivity and efficiency evaluation. If a "total" flat-rate system is implemented, then one would expect mechanics also to be rewarded for "beating" the flat rate. I feel that quality, rather than volume, should be an ADOT goal and a reasonable compromise is in order.

LABOR TIMES-STRAIGHT TIME: Managers need to implement procedures to provide more accountability and control in straight time operations. I would suggest that all straight time operations be accompanied with detailed narratives (work descriptions) on or attached to the work orders.

LABOR TIMES-ROAD CALL: It is expected that field repairs would take longer than shop repairs; however, sufficient details on time and distance are necessary to evaluate and separate repairs and travel time.

TRAVEL TIME-"PARTS CHASING": Philosophical and administrative questions need to be raised on the practice of having mechanics "chase" parts.

WORK ORDER FORMAT AND STYLE: Significant space is dedicated to the middle right side of the work order (W/O) for work generator codes or checkoff. In almost all cases, this part of the W/O was unused and therefore wasted. Work generator codes could be printed on other forms and posted or made available to the managers and mechanics (if codes are necessary). The right side of the page should have repair instructions at the top and adequate space for the mechanic's write-up (work/repair description or narrative). It is interesting to observe that on forms which do not have a 1/10th-hour column, almost all labor charges were made in even hours. On forms with 1/10th-hour columns, most labor charges were figured to the tenth of an hour.

Some forms with spaces for checkoff of miscellaneous time (cleanup, parts chasing, clerical, etc.) seem to have a high amount of time charged to these categories. I encourage mechanics to allow for and charge for this time, but a checkoff system seems to be abused.

The parts side of the page is generally adequate and seemed to be well used in most shops. It could be divided into categories:

1. Internal Shop Supplies
2. Internal Parts
3. External Parts/Supplies

<u>3,000; 5,000; 10,000 and 15,000 MILE SERVICES</u>: Managers, mechanics and consultants need to develop time guidelines for these services for particular vehicle categories. Supervisors and mechanics need to be aware of overlapping labor combinations.

DEFINITIONS

LABOR TIMES: The Mitchell "Estimated Labor Times," given in hours and tenths of an hour, generally reflect the needs of an average, trained auto mechanic working in an average, independent repair shop. Times listed are to be used as a guide only and therefore may need to be adjusted to meet individual repair shop and vehicle conditions.[1]

The estimated times generally include appropriate time for standard test procedures or normal services which accompany individual operations. They do not include allowances for diagnosis, booking the job, billing, wash-up time or any special courtesy services that may be performed, such as cleaning windows. The times also do not allow for the fact that a job may be delayed due to lack of parts availability.[1]

ADDITIONAL TIME: "Additional Time," that extra time needed to gain access to a part, is signified in Mitchell by * or a tariff (1). The * indicates that the additional time has general application (e.g. that any vehicle equipped with power steering needs the specific extra time); the tariff is a note for a specific model or option.

Further additional time should be used to cover conditions such as these:

Broken studs or bolts,
Siezed bolts,
Rusted or corroded parts,
Undercoating removal,
Steam cleaning,
Check and clean used parts, and
Accessory items not covered by text.[1]

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1 Mitchell Manuals: Mechanical Parts/Labor Estimating Guide, Domestic Trucks, 1979 Edition.

COMBINATIONS: "Combinations," denoted in the Mitchell text by a ★, are additional labor times to be used to perform additional tasks which are directly related to the original operation and are conveniently done along with it.

For example: a voltage regulator being replaced in combination with an alternator overhaul.[1]

OVERLAPPING LABOR TIMES: When two or more operations are performed on a vehicle and have overlapping labor times, a reasonable deduction should be made from the total times given. It is impossible to give specific recommendations for all these specific situations. For example, if one is doing a carburetor overhaul and finds that the water pump also needs repair, 0.2 hours should be deducted from the total of the individual times.[1]

D&A: Disassemble and Assemble.[1]

O/H, O/HAUL, OVERHAUL: Disassemble, clean, adjust and repair or replace parts as necessary to restore a part or assembly to its original order or working condition.[1]

R&I, REMOVE AND INSTALL: Removal of a part or assembly from vehicle to facilitate overhaul or other work and reinstall the same part on vehicle. Includes any alignment necessary to reposition removed part or assembly.[1]

R&R, REMOVE AND REPLACE: Removal of part or assembly from vehicle, transfer of any attached parts to new part or assembly, reinstall new part or assembly on vehicle. Includes any alignment necessary to reposition removed part or assembly. Add time as necessary if welded parts are transferred.[1]

DIAGNOSTIC TIME: Repair shops are entitled to charge for time spent in diagnosing vehicle malfunctions and discrepancies and in preparing an estimate to effect necessary repairs.

Many vehicle operators are unable to describe technically the complaint to a service technician; the technician must sometimes make a road test to determine the exact discrepancy. Such diagnosis and estimation requires time, experience and, in many cases, the use of expensive testing equipment.[1]

STRAIGHT TIME: Labor time for operations not listed in the flat-rate manual. These include custom work/repair and operations such as welding and painting.

REFERENCES

GENERAL CONSULTANT: PHIL D. RANDOLPH

Professor of Automotive Technology and Program Director at Glendale Community College, Glendale, Arizona. Member of The Society of Automotive Engineers (SAE) and certified NIASE (National Institute for Automotive Service Excellence) General Mechanic in all areas.

PARTS CONSULTANT: JOHN SPENCER

Owner of Metro Auto Parts, Spence's Arco and Spence's Towing and Instructor in Automotive Parts Merchandising at Glendale Community College.

FLAT-RATE MANUALS

The latest editions of Mitchell Mechanical Parts/Labor Estimating Guide were used. Various editions cover passenger cars and trucks.

HEAVY EQUIPMENT RESOURCE

Personnel and flat-rate books at John Deere and Case were used. Resource people include Warren Brower, Service Manager at Arizona Industrial Machinery (John Deere) and Mike Urban at Case Power and Equipment.