TECHNICAL ASSISTANCE
REPORT

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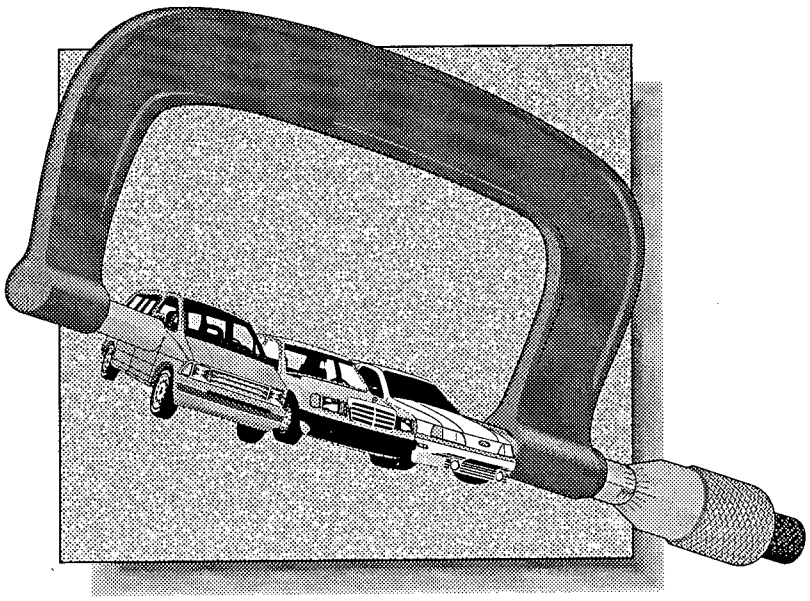
RIGHTSIZING THE DIVISION OF FLEET MANAGEMENT'S TRIP POOL



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Abstract

The Virginia Department of Transportation's Division of Fleet Management (DFM) maintains a fleet of vehicles for short-term rental to state employees traveling on official state business. This fleet, known as the trip pool, is a subset of the state-owned centralized fleet. Until May 1996, vehicles in the trip pool were not assigned in the most efficient manner, thereby limiting their maximum potential utilization. In May 1996, a vehicle rental contract with a private-sector company enabled the DFM to change its vehicle assignment practices to better utilize the vehicles in the trip pool.

The private-sector vehicle rental contract enabled the DFM to reduce the size of the trip pool, since excess demand could be met with private-sector vehicles. This study is a continuation of the author's unpublished 1995-96 study of the DFM. It incorporates updated data into a revised inventory model. The results included in the study show that the vehicle rental contract with a private-sector company has resulted in approximate quantifiable savings of $20,000 per year. The full amount of the savings to the Commonwealth resulting from the rental contract cannot be quantified due to lack of available data. Other results included in the study indicate that the overall cost of state employee travel can be reduced by an estimated additional $20,000 per year if the DFM resizes the trip pool as indicated in the study.

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Virginia Transportation Research Council
(A Cooperative Organization Sponsored by the
Virginia Department of Transportation and
The University of Virginia)

Charlottesville, Virginia

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ABSTRACT

The Virginia Department of Transportation's Division of Fleet Management (DFM) maintains a fleet of vehicles for short-term rental to state employees traveling on official state business. This fleet, known as the trip pool, is a subset of the state-owned centralized fleet. Until May 1996, vehicles in the trip pool were not assigned in the most efficient manner, thereby limiting their maximum potential utilization. In May 1996, a vehicle rental contract with a private-sector company enabled the DFM to change its vehicle assignment practices to better utilize the vehicles in the trip pool.

The private-sector vehicle rental contract enabled the DFM to reduce the size of the trip pool, since excess demand could be met with private-sector vehicles. This study is a continuation of the author's unpublished 1995-96 study of the DFM. It incorporates updated data into a revised inventory model. The results included in the study show that the vehicle rental contract with a private-sector company has resulted in approximate quantifiable savings of $20,000 per year. The full amount of the savings to the Commonwealth resulting from the rental contract cannot be quantified due to lack of available data. Other results included in the study indicate that the overall cost of state employee travel can be reduced by an estimated additional $20,000 per year if the DFM resizes the trip pool as indicated in the study.

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INTRODUCTION

Section 33.1-402 of the Code of Virginia states: "*The Commissioner shall establish an appropriate administrative unit within the Department to manage the centralized fleet. The Commissioner's responsibilities for the centralized fleet shall include, but not be limited to, the following:*

1. *Administering the assignment of vehicles to officers and employees of the Commonwealth;*
2. *Managing a pool of vehicles for short-term use;*
3. *Purchasing vehicles necessary to the operation of the centralized fleet;*
4. *Repairing and maintaining vehicles;*
5. *Monitoring the use of vehicles and enforcing regulations regarding their proper use; and*
6. *Maintaining records related to the operation and maintenance of vehicles, and the administration of the centralized fleet."*

The Division of Fleet Management (DFM) is the administrative unit within the Virginia Department of Transportation (VDOT) that manages the centralized fleet according to §33.1-402 of the Code of Virginia. It employs 11 people to administer the fleet, plus one liaison within each state agency. The mission of the DFM is to provide safe, efficient and reliable passenger transportation for state employees.[1]

As of June 30, 1997, the centralized fleet consisted of 2,973 vehicles, of which 198 vehicles were assigned to the trip pool. The centralized fleet is comprised of compact sedans (approximately 75 percent), intermediate sedans (approximately 7 percent), full-size sedans (approximately 8 percent), minivans (approximately 8 percent) and full-size vans (approximately 2 percent). Fleet vehicle maintenance is provided through a central garage, various VDOT equipment-repair shops located throughout the state, and commercial vendors.

A 1988 study of fleet operations by the Joint Legislative Audit and Review Commission (JLARC) established vehicle replacement criteria.[2] All vehicles, except full-size vans, are scheduled to be replaced when they have been driven 95,000 miles or when the life-to-date maintenance expenditure (parts and labor) reaches $3,200, whichever comes first. Full-size vans are scheduled to be replaced when they have been driven 132,000 miles or when the life-to-date maintenance expenditure reaches $12,500.

Since the 1988 JLARC study, various branches of state government have expressed continued interest in DFM operations. For example, in January 1994, Governor Allen signed

Executive Order 1 (94), which established a commission, known as the Governor's Commission on Government Reform (GCGR). Additionally, Governor Allen signed Executive Order 17 (94) in June 1994 that included a one-year moratorium on the purchase or lease of passenger vehicles.

In the fall of 1994, the GCGR investigated and recommended further study of fleet operations. In addition to other recommendations, the GCGR recommended that, "VDOT should determine and periodically re-evaluate the optimal trip pool size based on demand, and cost of meeting all legitimate automobile travel needs. A formula should be developed which could use statistically significant historical data to predict future demand."[3]

The DFM had previously recognized that the trip pool contained too many vehicles and had requested that VDOT's Management Services Division study the issue. The Management Services Division's subsequent unpublished report indicated that the DFM should decrease the size of the trip pool if an alternate means of travel could be provided to state employees. Two alternative means of travel were identified in the report: 1) personal vehicle use by state employees; and 2) establishment of a contract with a private-sector company to provide rental vehicles on an as-needed basis. Because it deemed the first alternative not feasible, DFM has been contracting with private-sector companies to provide passenger vehicles on an as-needed basis since May 1996. The Division of Fleet Management requested that the author perform a follow-up analysis on the optimal size of the trip pool.

PURPOSE AND SCOPE

The purpose of this study was to assist the Division of Fleet Management in improving its efficiency and effectiveness by rightsizing the trip pool, thereby helping reduce the total cost of state-employee travel. The study focused on the size of the trip pool operation and identified estimated savings from its rightsizing. The study did not include evaluating vehicle replacement criteria or establishing new rental rates.

METHODOLOGY

Literature review

In July 1979, JLARC published its "Management and Use of State-Owned Motor Vehicles" study. Although the 1979 JLARC study primarily focused on the management and use of state-owned passenger vehicles, the study contained a section on economic utilization.[4]

The 1979 JLARC report included an equation (Equation [1], below) to determine the minimum annual mileage a state-owned vehicle needs to be driven in order for it to cost less than reimbursing an individual for traveling in a personal vehicle.

$$\frac{\$900 + \$0.08x}{x} = \$0.15 \qquad [1]$$

where: x = annual breakeven mileage
$900 = minimum annual capital/replacement charge (18,000 miles at $0.05 per mile)
$0.08 = rate per mile for state-owned vehicle operating costs
$0.15 = rate per mile for private vehicle (personal reimbursement rate)

Based on the rates in effect in 1979, it was less expensive for a state employee to use a state-owned vehicle if the vehicle was driven 12,857 or more miles per year. If fewer than 12,857 miles per year were driven, it would have cost less to reimburse individuals for using their personal vehicles.

In April 1987, a study team consisting of staff from the Management Services and Internal Audit Divisions completed the "Organization and Administration of the Central Garage" study. The two goals of the 1987 study were to "review and evaluate the implementation of prior recommendations concerning Central Garage" and to "review the current operations of the Central Garage in order to examine and report on:

(1) effective and efficient utilization and replacement of passenger vehicles;
(2) appropriate monitoring of the user rate;
(3) increased productivity and more relevant information through enhanced data processing support; and
(4) organizational structure and management of the Central Garage and its relationship with the Car Pool Committee."[5]

The study team recommended that DFM develop and document a vehicle replacement methodology, and that the formula (Equation [1]) should be reviewed to determine a new annual mileage requirement for permanently assigned vehicles.

In August 1988, JLARC followed up its 1979 study of the Central Garage with its "Management and Use of State-Owned Passenger Vehicles" study. The 1988 study included reviews of vehicle assignment and utilization, fleet operations, financial management and management authority.

In the 1988 study, JLARC recalculated the annual breakeven mileage using Equation [1]. Using 1989 rates, JLARC determined that the breakeven point occurred at 11,649 miles per year. JLARC also determined the appropriate size of the trip pool for the month of September 1987 using 16 days of data during the same month—the analysis determined that 188 vehicles were needed for that month, instead of the actual inventory of 230.[6]

Using differential calculus and estimated salvage values from the National Automobile Dealers Association (NADA), JLARC estimated the average capital, the average operating expense and the average total expense functions of each class of vehicle (compact sedans, full-size sedans and vans). The analyses yielded estimated optimal replacement points of 95,000 miles for compact sedans, 85,000 miles for full-size sedans, and 132,000 miles for vans.

Additionally, the 1988 JLARC study proposed new simplified rate structures for the following biennium. The rate structures for passenger sedans were as follows (the other rates can be found in the 1988 JLARC study[7]):

	Operating Charge	Average Daily Mileage	Capital Charge
FY 1989	$0.0942 per mile	over 65.75 miles	$0.0694 per mile
		under 65.75 miles	$6.35 per business day
FY 1990	$0.0948 per mile	over 66.45 miles	$0.0717 per mile
		under 66.45 miles	$6.63 per business day

The JLARC study proposed less than a 1 percent increase in the operating charge per mile from FY 1989 to FY 1990 and a 3.2 percent increase in the capital charge if the minimum mileage criterion was met. If the minimum mileage criterion was not met, the JLARC study proposed a 4.2 percent increase in the capital charge from FY 1989 to FY 1990.

In December 1993, the Auditor of Public Accounts completed its "Privatization Guidelines," instructional guidelines to assist in considering and evaluating state functions for privatization. The guidelines included a completed work program using VDOT's trip pool. The analysis identified a $0.159 per mile cost to operate vehicles in the trip pool.

In the fall of 1996, the Virginia Department of Transportation's Management Services Division completed a preliminary study of DFM. The study:

- determined the optimal replacement criteria for each class of vehicle in the fleet
- reconfigured the rental rate structure to make it more accurately reflect the true cost of operating the different vehicle types
- identified the appropriate size of the trip pool

Due to the limitations of available data, the study concentrated on compact and full-size sedans, and minivans—these vehicles comprised approximately 98 percent of the centralized fleet when the study was initiated.

In the fall of 1997, the Virginia Transportation Research Council and the Management Services Division completed a benchmark study[8] for the DFM. The benchmark study replicated aspects of the 1994 Minnesota benchmark study.[9] The authors found that DFM continued to meet or exceed the marketplace practices identified in the Minnesota study that were applicable to it. These practices included: average annual vehicle utilization, vehicle rental rates, new vehicle purchase prices, personal reimbursement rates, and vehicle replacement criteria.

Daily vehicle inventories

The DFM tracks daily the number of vehicle requests, the number of vehicles issued and returned, and the number of unfilled rental requests. Although these are important statistics, the daily number of vehicles needed cannot be found without estimating the number of vehicles on the road each day.

DFM's current computer system cannot directly provide its users with the number of trip pool vehicles rented out each day. Therefore, a DFM employee takes a daily inventory of the number of vehicles on the lot by type (compact sedan, full-size sedan, minivan, 15-passenger van, and small and large cargo vans). DFM started collecting vehicle issuance and return data on February 1, 1995, to determine the number of filled and unfilled vehicle requests. The author used these data to determine the distribution of rental-vehicle demand. When combined with the trip pool composition (which is periodically updated), this information enabled the author to calculate the number of vehicles in use each day starting from February 1, 1995.

Analyses

The newsboy inventory model[10] (newsboy model) was used to determine how many compact sedans and minivans should be included in the trip pool. The newsboy model is a single-period stochastic inventory model that incorporates the cost of lost revenue from not meeting a unit of demand and the holding cost of keeping a unit of excess inventory for one time period to determine the optimal inventory level.

The newsboy model dictates that on-hand inventory should be set at such a level that it suffices to cover all demand with probability $F(Q^*)$. $F(Q^*)$ is determined by:

$$F(Q^*) = \frac{c_u}{c_o + c_u} \qquad [2]$$

where: $F(Q^*)$ = probability of satisfying all demand during a period if Q^* units are on hand
c_u = cost of one unit of negative inventory (unmet need) per day
c_o = cost of one unit of positive inventory (excess inventory) per day

Solving Equation [2] based on the costs c_u and c_o yields the probability that the DFM will meet all vehicle rental demand on a given day using trip pool vehicles. Strictly speaking, determining the optimal trip pool size is a multi-period stochastic inventory problem: DFM can change the size of the trip pool at various points in time and vehicle demand is a random variable (demand is not explicitly known).

However, based on information and examples in Nahmias,[10] a single-period stochastic inventory model (the newsboy inventory model) should efficiently and effectively determine the numbers of vehicles needed. For the DFM's trip pool operation:

c_u = daily cost difference between a private-sector rental vehicle and a DFM vehicle
c_o = daily cost of an idle DFM vehicle

To determine the optimal size of the trip pool, the following data were collected or determined:

- historical vehicle rental data beginning on February 1, 1995, to develop a forecasting model to predict future vehicle rental demand
- average daily rental charge for a DFM vehicle
- daily rental charge for a private-sector rental vehicle
- daily cost of an idle DFM vehicle

Cost determination

The costs of leased vehicles were obtained from the current DFM contract with Richmond Car and Truck. The daily rental contract costs do not include fuel or insurance:

Compact sedan	$18.95
Minivan	$35.00

DFM vehicle costs were determined using 1995 Equipment Management System (EMS) data, DFM new vehicle purchase prices for 1998 model-year vehicles, and estimates of the salvage values for seven-year old vehicles. The unpublished Management Services Division study determined that the optimal vehicle replacement point, assuming approximately 15,000 miles per year, was seven years for both compact sedans and minivans. Additionally, the unpublished study estimated that the salvage values of seven-year old vehicles were approximately 15 percent of the purchase price of new compact sedans and approximately 25 percent of the purchase price of new minivans. The costs used in the study analyses are presented in Table 1.

Table 1: Relevant costs

Vehicle type	Purchase price	Estimated salvage value	Annualized capital recovery cost	Operating & maintenance cost per mile	Fuel cost per mile
Compact sedan	$12,487	$1,873	$1,928	$0.039	$0.023
Minivan	$18,741	$4,685	$2,663	$0.052	$0.030

The annualized capital recovery cost incorporates the depreciation cost along with the cost of capital. The cost of capital (the opportunity cost of money invested in vehicles) used in the analyses was five percent per year.

Rental demand forecasts

The newsboy model uses the unit costs of inventory overage and underage to determine the amount of inventory that should be maintained. Specifically, the inventory level should be set such that the demand is satisfied the percentage of the time identified by the model.

The DFM has collected daily vehicle issuance and return data for each type of vehicle since February 1995. The number of trip pool vehicles in use each day was calculated using this information with trip pool inventory data. The monthly and annual average number of vehicles rented each day and the standard deviation of vehicle rentals were determined for February 1995 through February 1998 (except for October 1997—unfortunately, no data was collected in this month).

The monthly average numbers of vehicles rented each day were used to calculate monthly rental trends. Twelve monthly rental factors were calculated by averaging the ratios generated by dividing the monthly average daily number of vehicles rented each year by the annual average daily number of vehicle rentals. The July monthly rental factor for compact sedans is presented in Table 2 as an example.

Table 2: A compact sedan monthly rental factor calculation

Year	July average daily compact sedan rentals	Annual average daily compact sedan rentals	July average divided by annual average
1995	89.05	82.55	1.0787
1996	94.76	98.71	0.9600
1997	110.09	104.99	1.0486
July factor			1.0291

In addition, regression analyses using the annual average number of daily vehicle rentals were performed to determine if any overall trend in rentals over time existed. The average number of daily compact sedan rentals has increased each of the past three years, but the rate of increase has been decreasing. The average number of daily minivan rentals increased significantly (approximately 60 percent) from 1995 to 1996, but has since remained relatively constant. The two best regression models and the corresponding estimated annual average number of daily vehicle rentals for 1998 and 1999 are presented in Table 3.

Table 3: Estimated 1998 and 1999 average number of daily vehicle rentals

Vehicle type and regression model	Goodness of fit (R-square)	1998 estimated average number of daily rentals	1999 estimated average number of daily rentals
Compact sedan:			
Inverse model	0.999	107.46	109.13
Logarithmic model	0.990	111.78	116.41
Minivan:			
Inverse model	0.905	17.67	18.15
Logarithmic model	0.815	18.70	19.98

The inverse and logarithmic models are logically appealing in that they both assume a decreasing rate of increase in the average number of rentals.

The inverse regression model is defined by Equation [3]. The logarithmic regression model is defined by Equation [4]:

$$y = b_0 + \frac{b_1}{t} \quad [3]$$

$$y = b_0 + b_1 \times \ln(t) \quad [4]$$

where: y = predicted value (dependent variable);
t = time (independent variable); and
b_0 and b_1 = regression coefficients (data dependent).

Regression models fitted to the average daily vehicle rental demand each year, in conjunction with the monthly rental factors, were used to estimate the average daily compact sedan and minivan rental demand for each of the next twelve months.

RESULTS

Newsboy inventory model

The amount of demand to be satisfied by on-hand inventory according to the newsboy model is given by:

$$F(Q^*) = \frac{c_u}{c_o + c_u} \quad [2]$$

Where the terms c_u and c_o are defined as:

c_u = cost of leased vehicle less Fleet's cost (sum of: depreciation plus cost of capital; operating and maintenance costs less cost of fuel)
c_o = cost of depreciation plus cost of capital.

The calculations to determine $F(Q^*)$ for compact sedans and minivans are based on the current Richmond Car and Truck rental rates (which have been extended through June 1999) and the following assumptions:

- Seventy miles are traveled on average per rental day (based on DFM rental data)
- There are 250 rental days/year (to determine the daily cost of capital and depreciation)
- Vehicle costs and estimated salvage values are accurate

Compact sedan

c_u = \$18.95 - (\$1,928/250 + \$0.039*70 - \$0.023*70)
= \$10.12

c_o = \$1,928/250
= \$7.71

$$F(Q^*) = \frac{c_u}{c_o + c_u}$$

$$= \frac{\$10.12}{\$7.71 + \$10.12}$$

$$= 0.57$$

Minivan

c_u = \$35.00 - (\$2,663/250 + \$0.052*70 - \$0.030*70)
= \$22.81

c_o = \$2,663/250
= \$10.65

$$F(Q^*) = \frac{c_u}{c_o + c_u}$$

$$= \frac{\$22.81}{\$10.65 + \$22.81}$$

$$= 0.68$$

The results of the newsboy model indicated that DFM should keep sufficient vehicles in the trip pool to meet all compact sedan daily requests 57 percent of the time and all minivan daily requests 68 percent of the time. That is, private-sector compact sedans should only be needed to supplement the trip pool on 43 percent of the days that the DFM is open. Private sector minivans should only be needed to supplement the trip pool on 32 percent of the days that the DFM is open.

Trip pool size

To determine the approximate number of compact sedans and minivans to be kept in the trip pool, the estimated average number of daily rentals for 1998 and 1999 obtained from the inverse regression models were used along with the monthly rental factors and the pooled daily vehicle rental standard deviations from the monthly means. The inverse regression models were selected because their goodness-of-fit values were better. Trip pool size results for compact sedans are presented in Table 4. The results for minivans are presented in Table 5.

Table 4: Newsboy inventory model results for compact sedans

Month	Daily average	Standard deviation	Newsboy inventory level[1]
April 1998	110.42	14.68	113.00
May 1998	116.23	14.68	118.81
June 1998	107.93	14.68	110.51
July 1998	110.02	14.68	112.60
August 1998	109.97	14.68	112.55
September 1998	113.53	14.68	116.11
October 1998	121.96	14.68	124.54
November 1998	114.37	14.68	116.95
December 1998	91.89	14.68	94.47
January 1999	95.00	14.68	97.58
February 1999	103.28	14.68	105.86
March 1999	106.70	14.68	109.28

[1] Newsboy inventory level $= x + s \times z_{F(Q^*)}$

where x = daily average;
s = sample standard deviation; and
$z_{F(Q^*)}$ = standard normal value ($z_{0.57} = 0.176$)

Table 5: Newsboy inventory model results for minivans

Month	Daily average	Standard deviation	Newsboy inventory level[1]
April 1998	14.84	3.44	16.45
May 1998	16.47	3.44	18.08
June 1998	20.42	3.44	22.03
July 1998	19.28	3.44	20.89
August 1998	17.69	3.44	19.30
September 1998	17.96	3.44	19.57
October 1998	18.28	3.44	19.89
November 1998	18.02	3.44	19.63
December 1998	15.21	3.44	16.82
January 1999	15.47	3.44	17.08
February 1999	17.35	3.44	18.96
March 1999	22.51	3.44	24.12

[1] Newsboy inventory level $= x + s \times z_{F(Q^*)}$

where x = daily average;
s = sample standard deviation; and
$z_{F(Q^*)}$ = standard normal value ($z_{0.68} = 0.468$)

DFM generally orders new vehicles for the fleet direct from manufacturers from October through March each year. Usually, new vehicles are delivered to the DFM from January through May. As a result, DFM can only increase the size of the trip pool from January through May each year. Additionally, DFM removes vehicles from the trip pool as needed from May through December each year to use as replacements and new assignments for the rest of the centralized fleet.

The suggested trip pool sizes presented in Table 6 are based on the newsboy inventory levels identified in Tables 4 and 5 and on preliminary estimated private-sector vehicle demand calculations. The trip pool sizes take into account DFM's window of opportunity to increase the size of the trip pool, and that DFM periodically removes vehicles from the trip pool to serve as replacements.

Table 6: Suggested trip pool sizes

Time period	Number of compact sedans	Number of minivans
April 1998 – May 1998	120 – 125	18 – 20
June 1998 – November 1998	120 – 125	23 – 25
December 1998 – January 1999	100 – 105	18 – 20
February 1999 – March 1999	110 – 115	22 – 24

Decreasing the size of the trip pool will increase the number of private-sector rental vehicles used. The estimated impact on the number of rental vehicles to be provided by the private sector based on the trip pool sizes identified in Table 6 are presented in Table 7 and Table 8. The analyses assumed that the next twelve months of vehicle demand are exactly the same as the demand from the previous twelve months and, therefore, do not reflect any change in the daily vehicle rental demand. The anticipated rental demand is only an estimate and is solely meant to provide DFM management with a rough estimate of what DFM may have to rent from the private sector. Table 7 presents the estimated number of vehicle rental days that DFM would contract from a private-sector company and the largest number of vehicles at any one time each month based on the low end of the ranges presented in Table 6. Table 8 presents the same analysis using the high end of the ranges presented in Table 6.

Table 7: Estimated private-sector vehicle demand based on low-end trip pool size

Month	Number of private-sector compact sedan rental days	Most private-sector compact sedans needed on any given day	Number of private-sector minivan rental days	Most private-sector minivans needed on any given day
April 1998	9	9	9	2
May 1998	178	24	17	4
June 1998	63	13	0	0
July 1998	50	14	1	1
August 1998	2	1	0	0
September 1998	6	6	0	0
October 1998[1]	0[1]	0[1]	15[1]	3[1]
November 1998	182	25	0	0
December 1998	273	41	19	3
January 1999	179	30	12	3
February 1999	22	7	0	0
March 1999	0	0	0	0
TOTALS	964	41[2]	73	4[2]

[1] No data for October 1997 were available. October 1996 daily rental data were used instead.

[2] These are the highest number of vehicles needed on any given day and are not totals.

Table 8: Estimated private-sector vehicle demand based on high-end trip pool size

Month	Number of private-sector compact sedan rental days	Most private-sector compact sedans needed on any given day	Number of private-sector minivan rental days	Most private-sector minivans needed on any given day
April 1998	4	4	0	0
May 1998	121	19	3	2
June 1998	22	8	0	0
July 1998	17	9	0	0
August 1998	0	0	0	0
September 1998	1	1	0	0
October 1998[1]	0[1]	0[1]	1[1]	1[1]
November 1998	125	20	0	0
December 1998	218	36	6	1
January 1999	127	25	2	1
February 1999	2	2	0	0
March 1999	0	0	0	0
TOTALS	637	36[2]	12	2[2]

[1] No data for October 1997 were available. October 1996 daily rental data were used instead.

[2] These are the highest number of vehicles needed on any given day and are not totals.

DISCUSSION

Cost to the Division of Fleet Management

In order to estimate the cost to the DFM of renting private-sector vehicles, future day-to-day vehicle demand was estimated. Unfortunately, lower and upper confidence intervals and point estimates could not be made because daily rental demand is not an independent variable. The number of vehicles in use on a given day is not completely independent since vehicles may be rented for up to three weeks at a time. Therefore, the cost estimates assume that the next twelve months of vehicle rentals will be identical to the previous twelve months. This was obviously not a realistic assumption since daily vehicle rental demand is not constant. However, there was no reason to believe that the daily rental distribution and day-to-day variation over the past twelve months were unusual. It is also reasonable to assume that the above cost estimates are close to a lower limit on the cost to the DFM since the average daily rental demand for compact sedans has increased each year since 1995.

Reducing the size of the trip pool will result in an increase in the number of private-sector vehicles rented by the DFM, which will increase the cost of the rental contract. Based on the current contract rental rates, the DFM could expect to pay approximately $21,000 for private-sector vehicle rentals during a twelve-month period if the trip pool size were set at the low-end values indicated in Table 6. Alternatively, it could expect to pay approximately $12,500 for private-sector vehicle rentals during a twelve-month period if the trip pool size were set at the high-end values indicated in Table 6.

Savings to the Commonwealth

Although decreasing the size of the trip pool will increase DFM costs, resizing the trip pool will result in overall savings to the Commonwealth. Four assumptions were made in order to estimate these savings. The administrator of the DFM reviewed the four assumptions and stated that all four of them were realistic. The assumptions were:

(1) Vehicles removed from the trip pool will be used to fill a new assignment.
(2) Mileage traveled in a newly-assigned vehicle is travel that would have otherwise been reimbursed on a per mile basis.
(3) Newly-assigned vehicles on average travel the same mileage each year as other centralized fleet vehicles.
(4) Increased use of trip pool vehicles results in a comparable decrease in the amount of personally reimbursed travel in the Richmond area.

The DFM on average collects approximately $0.225 per mile for sedans and minivans. The actual rate collected is higher than the normally-quoted $0.19 per mile rental rate because some vehicles do not travel the minimum 1,315 miles per month required for the $0.19 per mile rate. If a permanently assigned vehicle travels less than 1,315 miles per month, the user is charged $127 for capital (the minimum monthly charge) plus $0.12 per mile.

For example, if a vehicle traveled 1,000 miles in a month, the user would be charged:

$$\begin{aligned} \text{charge} &= \$127 + (1{,}000 \text{ miles} \times \$0.12 \text{ per mile}) \\ &= \$127 + \$120 \\ &= \$247 \end{aligned}$$

$$\begin{aligned} \text{rate per mile} &= \$247 \div 1{,}000 \text{ miles} \\ &= \$0.247 \text{ per mile} \end{aligned}$$

Based on the four assumptions above and the $0.225 per mile DFM average rental rate, the estimated average annual savings resulting from removing a vehicle from the trip pool and using it as a new assignment are:

$$\begin{aligned} \text{savings} &= \text{average annual mileage} \times (\text{personal reimbursement rate} - \text{average DFM rental rate}) \\ &= 15{,}000 \text{ miles per year} \times (\$0.27 \text{ per mile} - \$0.225 \text{ per mile}) \\ &= \$675 \text{ per year for each vehicle reassigned} \end{aligned}$$

Assuming that the DFM reduced the size of the trip pool to the high-end numbers in Table 6, the trip pool on average would include 120 compact sedans and 23 minivans for an average total of 143 of these types of vehicles. As of June 30, 1997, the trip pool included 152 compact sedans and 21 minivans for a total of 173 vehicles. Therefore, approximately 30 vehicles could be removed from the trip pool for use as new assignments. The estimated savings over the next 12 months to the Commonwealth would be:

$$\begin{aligned} \text{savings} &= 30 \text{ vehicles} \times \$675 \text{ per year for each vehicle reassigned} \\ &= \$20{,}250 \text{ per year} \end{aligned}$$

In order for the Commonwealth to realize these savings, the DFM would pay an estimated $12,500 to a private-sector company for vehicle rentals. The DFM does not receive funds from the state general fund (DFM funds come from vehicle rental rates). Therefore, the Commonwealth would save an estimated $20,250 over the next 12 months at an estimated expense of $12,500 to the DFM.

If the DFM reduced the size of the trip pool to the low-end values in Table 6, the trip pool on average would include 115 compact sedans and 21 minivans for a total of 136 of these types of vehicles. The removal of another seven trip pool vehicles for use as permanent assignments would result in additional savings to the Commonwealth of:

$$\begin{aligned} \text{additional savings} &= 7 \text{ vehicles} \times \$675 \text{ per year for each vehicle reassigned} \\ &= \$4{,}725 \text{ per year} \end{aligned}$$

The additional cost of private-sector rental vehicles to the DFM is:

$$\begin{aligned} \text{additional cost} &= \$21{,}000 \text{ per year} - \$12{,}500 \text{ per year} \\ &= \$8{,}500 \text{ per year} \end{aligned}$$

There are also additional savings to the Commonwealth resulting from more efficient use of the trip pool and the private-sector vehicle rental contract. Before the first private-sector vehicle rental contract went into effect in May 1996, it was very common for requests for trip pool vehicles to be turned down or for state employees to be put on waiting lists. These two effects resulted in state employees using personal vehicles and receiving reimbursement at the "state vehicle not available" reimbursement rate. (If a state employee is unable to travel in a state vehicle due to lack of state vehicle availability, the state employee is eligible to be reimbursed for travel in a personal vehicle at $0.27 per mile. However, if a state employee travels in a personal vehicle when a state vehicle is available, the employee is only reimbursed at $0.19 per mile.)

Since May 1996, when the first private-sector vehicle rental contract went into effect, the DFM has greatly improved customer service—it has neither turned down nor wait-listed any request for a passenger sedan or minivan. As a result of these two factors, state employees in the Richmond area should not normally be reimbursed for travel in a personal vehicle at the higher "state vehicle not available" rate. The savings to the Commonwealth from the reduction in personal reimbursement cannot be fully quantified since the total cost of reimbursing state employees for travel in the Richmond area is not known. These non-quantifiable savings to the Commonwealth are probably substantial. However, a portion of these savings can be quantified.

The total distance traveled in trip pool and permanently assigned vehicles is tracked by fiscal year and not by calendar year. The number of miles traveled in trip pool vehicles, the size of the trip pool and the average number of miles traveled per vehicle each fiscal year are presented in Table 9.

Table 9: Trip pool statistics

Fiscal year	Number of miles traveled in trip pool vehicles	Number of vehicles in trip pool at the beginning of each fiscal year	Average miles traveled per vehicle
1995	3,194,270	230	13,888
1996	2,728,786	168	16,243
1997	2,882,678	198	14,559

The average number of trip pool compact sedans and minivans in use each day in calendar years 1995, 1996 and 1997 are presented in Table 10. The average number of compact sedans and minivans in use each day in 1996 and 1997 was 118.05, while the average in 1995 was 92.64.

Table 10: Average daily use of trip pool vehicles

Calendar year	Daily average number of compact sedans in use	Daily average number of minivans in use
1995[1]	82.55	10.09
1996	98.71	16.45
1997[2]	104.99	15.95

[1] No data was available for January 1995.
[2] No data was available for October 1997.

Assuming that the increase in the average number of trip pool vehicles in use each day is due to improved vehicle scheduling by the DFM, the quantifiable portion of the savings to the Commonwealth from the corresponding reduction in reimbursement for travel in personal vehicles are:

$$\begin{aligned} \text{savings} &= 25.4 \text{ rentals per day} \times 250 \text{ days per year} \times 70 \text{ miles per day} \times (\$0.27 - \$0.225) \text{ per mile} \\ &= \$20{,}002.50 \text{ per year} \\ &\approx \$20{,}000 \text{ per year} \end{aligned}$$

The approximate $20,000 of quantifiable savings per year probably started to occur shortly after the DFM's private-sector rental contract went into effect. As stated before, these are probably only a fraction of the total savings to the Commonwealth. As there is no practical approach to quantify the amount of personally-reimbursed travel originating in the greater-Richmond area, there is no way to quantify the savings to the Commonwealth resulting from a reduction from $0.27 per mile to $0.19 per mile of personally-reimbursed travel.

CONCLUSIONS

1. DFM's contract with a private-sector company to provide rental vehicles as needed has improved the efficiency of the trip pool.

2. The amount of travel in personal vehicles in the Richmond area reimbursed at the higher rate of $0.27 per mile should have decreased since the rental contract went into effect in May 1996, thereby reducing the overall cost of state employee travel to the Commonwealth by approximately $20,000 per year. There are also additional savings to the Commonwealth resulting from a reduction in the cost of personally reimbursed travel that cannot be readily quantified.

3. Removing vehicles from the trip pool for use as permanent assignments reduces the amount of personal reimbursement at $0.27 per mile, thereby reducing the overall cost of state employee travel to the Commonwealth.

RECOMMENDATIONS

1. The DFM should reduce the number of compact sedans and minivans in the trip pool to the high-end numbers presented in Table 6.

2. The DFM should continue to collect daily vehicle rental data and regularly monitor the number of private-sector daily vehicle rentals used.

3. The DFM should continue to periodically re-evaluate the number of vehicles in the trip pool.

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