AFIT/GTM/LAL/99S-5

COST-BENEFIT ANALYSIS OF LEASING VERSUS BUYING AIR FORCE GENERAL PURPOSE VEHICLES IN THE CONTINENTAL UNITED STATES

THESIS

Robert J. Neal Jr., Captain, USAF

AFIT/GTM/LAL/99S-5

Approved for public release; distribution unlimited

The views expressed in this thesis are those of the author and do not reflect the official policy or position of the Department of Defense or the U.S. Government.

AFIT/GTM/LAL/99S-5

COST-BENEFIT ANALYSIS OF LEASING VERSUS BUYING AIR FORCE GENERAL PURPOSE VEHICLES IN THE CONTINENTAL UNITED STATES

THESIS

Presented to the Faculty of the Graduate School of Logistics

and Acquisition Management of the Air Force Institute of Technology

Air University

Air Education and Training Command

In Partial Fulfillment of the Requirements for the

Degree of Master of Science in Transportation Management

Robert J. Neal Jr., B.A.

Captain, USAF

September 1999

Acknowledgements

I want to express my appreciation to my thesis advisors, Dr. William Cunningham and Maj Kevin Moore, for all of their effort and guidance in this research effort. Their expertise and experience greatly aided in the completion of this thesis. I also wish to express my appreciation to my sponsor, Mr. Bob Wiley from the Headquarters Air Force Vehicle Management Branch, for his support and insight provided to me throughout this endeavor.

I would like to thank Mr. Walter Naman from Joe Bullard Automobile Group in Mobile, Alabama and Karen Hampel from GSA in Washington, D.C. for their assistance in explaining procedures unique to their profession and company. Each of them stood fully ready to answer any questions I had regarding my thesis.

Lastly, and most importantly, I want to express my deepest appreciation to my wife, Ashley, and daughter, Elizabeth, for all of their love, devotion, understanding, and patience over the last 15 months of my studying. Without their love and support, I could have not survived this journey.

Robert J. Neal Jr.

Table of Contents

Page

List of Figures

List of Tables

Abstract

Given the increasingly aging vehicle fleet and declining vehicle budget, this research performed a cost-benefit analysis of leasing versus buying various Air Force general purpose vehicles for the entire continental United States (CONUS). In contrast to previous analyses, which have examined the leasing versus buying issue on a base-by-base basis, this analysis studies the issue from an Air Force-wide perspective using a cost-buying model. Costs and benefits are calculated for three purchasing options (Air Force ownership, GSA leasing, and commercial leasing) to determine and recommend the best alternative for the Air Force. Finally, a sensitivity analysis is to test the results of the cost-benefit models.

The research demonstrates that the best alternative available to the Air Force is GSA leasing because of its overall lowest cost and accompanying benefits such as a newer vehicle fleet and a stable budget requirement. The current method of buying vehicles for ownership proves to be the least costly option for the Air Force when considering salvage value. Because the Air Force does not recognize salvage value, this study recommends that the Air Force convert the CONUS general purpose vehicle fleet to GSA leased vehicles.

COST-BENEFIT ANALYSIS OF LEASING VERSUS BUYING AIR FORCE GENERAL PURPOSE VEHICLES IN THE CONTINENTAL UNITED STATES

I. Introduction

Background

According to Bunjer and Van Bemmel (1973), since the late 1940's, the Department of Defense (DOD) has studied whether to lease or purchase general purpose vehicles such as sedans, pick-up trucks, vans, and step-vans. Following World War II, the U.S. military had a large surplus of vehicles, which attracted the attention of the U.S. Congress. The DOD was never able to satisfy Congress' concern with the amount of money needed to continue purchasing more vehicles, especially general purpose vehicles. Heeding to congressional pressure, President Eisenhower placed the General Services Administration (GSA) into the vehicle leasing business in 1952 to provide a consolidated motor pool for the U.S. Federal Government (Bunjer and Van Bemmel, 1973: 1-2). After GSA's entrance into the vehicle leasing business, the United States Air Force conducted various unpublished base level cost analyses over the years regarding leasing and buying. The majority of these studies identified vehicle procurement as the most cost effective option. Consequently, the Air Force's approach to leasing has been on a base-by-base basis; hence, the Air Force has only leased a relatively small portion of vehicles. Most bases continue operations with vehicles purchased by the Air Force.

In 1991, the General Accounting Office (GAO) completed a report for the Chairman of the Subcommittee on Readiness, House Armed Services Committee, regarding the management of military services' vehicles that concluded the military could save millions of dollars by converting military-owned vehicles to GSA leased vehicles. The GAO used the U.S. Army's estimates on vehicle conversion costs as the basis of the report. In 1986, the Army planned to convert all Army-owned vehicles to GSA vehicles by fiscal year 1992, due to increased vehicle age and maintenance along with a lack of vehicle procurement money within the Army (General Accounting Office, 1991: 16).

By 1992, the Army expected to convert approximately 70 percent of its worldwide vehicle fleet. The Army estimated that the annual savings from the vehicle conversions would be between $25 and $52 million dollars. The GAO went back to verify the Army's estimations, discovering the actual leasing cost was higher than the estimated leasing cost; however, this was due to a GSA rate increase after the Army completed the original study and charges for deferred maintenance (costs this analysis identifies as refurbishment costs) (General Accounting Office, 1991: 16).

One pitfall the Army encountered was that GSA could not supply the number of vehicles the Army needed; however, over time, GSA was able to increase the size of its vehicle fleet to meet the Army's needs. If the Air Force converts its vehicle fleet to an all GSA fleet, GSA may have similar trouble filling all of the Air Force vehicle authorizations due to a significant increase in demand on GSA's vehicle fleet requirements. GSA's general replacement policy is to replace 20 percent of the vehicle

fleet in the first 5 years, and then replace the leased vehicles according to GSA life expectancy rules (General Accounting Office, 1991: 17).

The GAO concluded the report by recommending that all other branches of service conduct similar analyses to determine if leasing was the cost effective option (General Accounting Office, 1991: 18).

Air Force Vehicle Situation

Since the mid to late 1980's, the funds allocated for vehicle procurement have shrunk significantly. For example, Air Force vehicle purchasing has declined from $279,739,000 in 1989 to $88,757,000 in fiscal year 1997. This represents a 68 percent drop in vehicle spending using constant fiscal year 1997 dollars. For the last several years, Congress has funded about 5 percent annually of the DOD's budget request for purchasing vehicles. Because of this limited amount of funding, the average age of the vehicle fleet is increasing (currently around 10 years), and this trend is likely to continue with the current system in place (McDaniel, 1997: 7). The Air Force must make one of two choices; either purchase more vehicles and follow a sound vehicle replacement policy, or lease all of the vehicles and let the lessor handle the replacement policy. An Air Force message received by the Air Force Materiel Command's Vehicle Management Branch stated that Congress has already made the choice for the Air Force, placing a provision in the 1999 Defense Appropriation Bill stating that the DOD will lease all vehicles starting that year. There is no money in the 1999 Defense Bill for general purpose vehicle purchases. The only money identified in the 1999 Air Force budget for general purpose vehicles is $5 million for vehicle leasing (HQ USAF/ILS: 1998).

Statement of Problem

Currently, it is unknown whether buying or leasing general purpose vehicles is the most efficient option to take in satisfying Air Force vehicle requirements. The purpose of this research is to perform a cost-benefit analysis of leasing versus buying various Air Force general purpose vehicles for the entire continental United States (CONUS), to determine the most efficient vehicle procurement method for the Air Force. This research will calculate and compare the costs and benefits associated with three courses of action: continued ownership, GSA leasing, and commercial leasing.

The cost analysis part of this research is straightforward, which probably accounts for the lack of written information regarding lease versus buy analyses for vehicle fleets. The approach taken by the Air Force in the past has been a base-by-base analysis, where various bases have performed lease versus buy analyses. During the past year, the Air Force Audit Agency (AFAA) initiated a study on leasing versus buying for the Air Force fleet using a random sampling approach (Henderson, 1998). This research abandons the base-by-base approach previously employed and analyzes different vehicle types of the Air Force general purpose vehicles throughout the CONUS at an aggregate level.

In contrast to the cost analysis, the benefit analysis is more subjective. Benefits are hard to quantify, especially in the military. This study attempts to identify all of the benefits associated with leasing and buying vehicles, although not all benefits are quantifiable. Finally, a cost analysis model was used to compare the costs and benefits of leasing and buying vehicles to determine the best course of action for the Air Force.

Research Questions

The question this research attempts to answer is which one of the three options is the most efficient and effective method of procuring general purpose vehicles for the Air Force, considering all the costs and benefits. Before this analysis can answer the research question, the costs and benefits associated with GSA leasing, commercial leasing, and buying general purpose vehicles must be identified. After identifying these costs and benefits, this analysis will determine how sensitive the models are to various inputs such as inflation, fuel cost, indirect costs, and mileage utilization to determine if the overall procurement decision changes with different input values.

Scope of the Research

Because of data limitations, this research is limited to the general purpose vehicle fleet at Air Force bases within the CONUS. This research examines the three most popular categories of general purpose vehicles: sedans, pick-up trucks, and vans. The costs for each vehicle category are average costs for the various vehicle types that make up the general category as given by HQ USAF/ILTV and WR-ALC due to time and manpower constraints. It must be noted that GSA does not lease large sedans except to law enforcement agencies and the presidential staff. Currently, the Air Force has only two avenues for large sedans, leasing through commercial sources or purchasing through the current process. Because this analysis is unable to include an accurate GSA cost of leasing large sedans, large sedans are omitted from this analysis.

The information in this study will be applicable primarily to all CONUS general purpose vehicles with possible applications to Air Force bases overseas. However, the

basic approach employed by this analysis can be modified for use by military services in performing cost-benefit analyses to determine the most efficient vehicle procurement method for them. Figure 1 highlights the different vehicle types under analysis in this research.

Sedans	**4X2 Trucks**	**4X4 Trucks**
Subcompact	Compact	Compact
Compact	Compact-Elec	3500 GVW
Midsize	3500-4500GVW	4600-5799GVW
Station Wagon	4600-5799GVW	6000 GVW
Vans	Multistop(B180)	7500 GVW
7-Pax	Multistop(F176)	9-Pass Utility
8-Pax	Stake-7000GVW	Dual Wheel
9-Pax	8000 GVW	4-Door
15-Pax	9-Pass Utility	
Panel-6999GVW	4-Door	
Panel-7000GVW		

Figure 1. Vehicle Types under Analysis

Assumptions

The assumptions for this thesis fall into two broad areas: overall and model. One overall such assumption is that there will be no significant changes in vehicle authorizations. Vehicle authorizations change fairly often, but the changes are generally small. Large-scale authorization changes would only occur for large policy decisions such as base closures; therefore, the assumption regarding vehicle authorizations is reasonable for the purposes of this analysis. Another overall assumption for this research is that there will be no significant changes in the general purpose mechanic manning

level. With the current trend of retention in the Air Force, this assumption is plausible, especially with no large force downsizing projected in the future. The Air Force will need some amount of general purpose mechanics for staff-level, overseas, and TDY assignments. This overall assumption is based on the fact that the Air Force will still require general purpose mechanics to fill palace tenure and other contingency taskings around the world. An additional overall assumption is the current vehicle life expectancies will not change. This assumption is necessary to establish the amount of vehicles that will need to be replaced annually. The final two overall assumptions regard vehicle leasing. First, this research assumes that GSA is able to meet Air Force leasing needs and supply the required number of vehicles within the first 5 years and replace the required amount annually throughout the duration of the lease. GSA may stretch this assumption in the short term, but it is believable in the long term. Second, commercial leasing sources will be able to meet the needs of the Air Force and supply the required number of vehicles. Considering the large number of vehicles that commercial sources lease every year, this assumption is credible, especially since a large number of fleet leasing companies are linked directly to a vehicle manufacturer.

There are several assumptions this research must make in the area of the cost models to calculate costs for each vehicle type in the categories under study. The first model assumption is that with each option, the number of vehicles assigned will equal the number of vehicles authorized. By using the authorizations, this research computes each alternative on the same basis. The cost of ownership cost model assumes that the Air Force will send its vehicles to GSA for auctioning to recoup some money from the

residual value of vehicles beyond their life expectancy. Unless the vehicle is totally destroyed, each vehicle will have some amount of residual value. This analysis assumes that GSA will accomplish all repairs on GSA leased vehicles. With very few exceptions, this assumption is sound since the GSA mileage rate includes maintenance on the vehicles. Regarding maintenance on leased vehicles, this analysis assumes that the only scheduled maintenance required on commercially leased vehicles is oil changes. Most new vehicles come with a 3-year, 36,000-mile warranty on them; therefore, the vehicle manufacturers will cover any major repairs on the leased vehicles. Considering the vehicle warranty period and the length of average commercial vehicle leases, this analysis prescribes the commercial leasing replacement time at 3 years.

Key Terms

The following key terms are defined to assist the reader in this analysis:

Consolidated Analysis Reporting System: a single operating system maintained at WR-ALC that provides data on vehicle reliability, maintainability, use, and costs as well as labor hour utilization and cost data (Department of the Air Force, 1994: 5).

Consumer Price Index (CPI): an indicator of the general level of prices. It attempts to compare the cost of purchasing the market basket bought by a typical consumer during a specific period with the cost of purchasing the same market basket during an earlier period (Gwartney and Stroup, 1997: 706).

General Accounting Office: a nonpartisan agency within the legislative branch of government. GAO conducts audits, surveys, investigations, and evaluations of federal programs at the request of congressional committees or members, or to fulfill GAO

specifically mandated or basic legislative requirements (General Accounting Office, 1999).

General purpose vehicle: A vehicle designed for moving personnel or material; a vehicle which will satisfy general automotive transport needs (Bunjer and Van Bemmel, 1973: 15).

General Services Administration: a central management agency in the Federal Government charged with the responsibility of providing travel and transportation services, managing the Federal motor vehicle fleet, overseeing telecommuting centers and Federal child care centers, preserving historic buildings, managing a fine arts program, and developing, advocating, and evaluating government-wide policy to and for Federal Government agencies (General Services Administration, 1999).

Gross Domestic Product (GDP) deflator: a price index that reveals the cost of purchasing the items included in GDP during the period relative to the cost of purchasing these same items during a base year (Gwartney and Stroup, 1997: 708).

Office of Management and Budget: an organization that assists the President in preparing the Federal budget. OMB evaluates the effectiveness of agency programs, policies, and procedures, assesses competing funding demands among agencies, and sets funding priorities. OMB ensures that agency reports, rules, testimony, and proposed legislation is consistent with the President's budget and with Administration policies (Office of Management and Budget, 1999).

Technical Order 36A-1-1301: Air Force document that establishes life expectancy for all vehicles and also establishes annual mileage goals for certain vehicles (Karzon and Underwood, 1994: 10).

Thesis Overview

Chapter 2 of this thesis is a review of the small amount of literature available regarding cost-benefit analyses, especially in vehicle procurement. Chapter 3 discusses the methodology employed by this research to answer the research questions posed in this chapter. Chapter 4 exhibits the data analysis and findings of this research while Chapter 5 presents recommendations and suggested areas for further research.

II. Literature Review

Introduction

This is not the typical literature review due to the lack of published information on previous lease-buy analyses. The other sister services have conducted similar analyses in the past, but did not publish the results of those analyses; however, the Army's analysis was identified as the basis for a 1991 GAO report to Congress on vehicle management. Numerous attempts have been made to contact the agencies involved in previous lease-buy analyses, but it has been to no avail. As identified in Chapter One's background information, the Air Force approach has been primarily on a base-by-base basis. Because of this approach, there is a severe lack of published results for this analysis to review in the course of this chapter; therefore, the focus of this chapter is on the overarching fundamentals of performing a cost-benefit analysis, which costs to consider, and what benefits corporations have realized as a result of different procurement methods.

One basic economic concept that every business course teaches is the need to minimize costs. The ultimate goal of any business venture is to make a profit; otherwise, the venture will eventually cease to operate. The simplest profit equation is total revenue minus total costs equals profit. In a free market economy, businesses must minimize costs to help maximize profit. If businesses fail to minimize costs, inefficiencies occur and may result in possible financial losses.

Although the goal in the United States Air Force, and Department of Defense as well, is not to make a profit, the Air Force must still search for ways to reduce costs. Because the defense budget has been shrinking for approximately the last 10 years, the

Air Force has had to look for ways to minimize its costs to maintain our capability and continue to devise future programs. The need to allocate money efficiently forced the Air Force to take a broad look into all areas to identify where they could find cost savings. Looking at where the Air Force spent most of its money, one author identified that logistics costs were a majority of life cycle costs of weapon systems. Because of this proportion of the total cost of a weapon system, the Air Force targeted logistics for cost reductions, looking for new ways of doing business to drive down the costs (Muczyk, 1997: 90). One part of the logistics area that military leaders have considered for a cost saving has been the general purpose vehicle fleet.

Debates have continued over whether the Air Force should lease or buy general purpose vehicles. When considering leasing, AFI 24-301, paragraph 5.9, states that agencies can lease if, "An economic analysis verifies a cost benefit to the government." (Department of the Air Force, 1997: 36)

Before this research can progress to the analysis, this review needs to identify what costs are associated with a cost-benefit analysis. This review will describe the different levels and types of costs that these cost analyses must consider. This review also needs to identify and describe what benefits a researcher must consider in an analysis, including some examples of observed benefits that corporations have realized in the past with leasing or purchasing. Along with identification of the costs and benefits, this literature review will give an overview of the cost-benefit analysis process. The review discusses current guidance regarding the use of cost-benefit analyses and how to apply this analytical technique.

Defining Costs

When referring to costs, this review is describing life cycle costs. One source describes life cycle costs as, "The total cost of a system (or item) over its full life which includes a research and development phase, an investment phase, an operating phase, and final disposal." (Gill, 1998: 1) Use of life cycle cost models aids planners in estimating costs of purchases to determine the best use of resources. Although there are little, if any, costs in the research and development phase, there are significant costs associated with the investment, operating, and final disposal phases of vehicle procurement. There are various life-cycle cost models available that help an analyst in performing cost computations.

The goal of any cost analysis is to compare the costs between practical alternatives and select the best alternative. Before performing a cost analysis, one must first identify the various costs and determine which costs to use in the analysis. When looking for costs, not all costs need to be in dollars. There are four different levels for defining cost: dollar expenditures, other costs evaluated in dollars, other quantifiable costs, and other non-quantifiable costs (Gill, 1998: 35).

The easiest level of cost to identify is the dollar expenditures. Dollar expenditures are actual payments made by an organization and can be used to measure opportunity costs. Examples of dollar expenditures would be payments made to purchase or lease vehicles. Other costs evaluated in dollars are support costs associated with an alternative. Tools, equipment, and parts are all examples of other costs. Other quantifiable costs are more difficult to quantify in dollars. An example of this type of cost would be

improvements in vehicle fleet efficiency. It would be difficult to express this in dollars, but one could state efficiency in percentage improvements. The final level of cost definition is other non-quantifiable costs, which by definition are impossible to quantify. An example of a non-quantifiable cost is someone having more flexibility in choosing a specific type of vehicle (Gill, 1998: 36).

Once analysts determine what levels of cost to look for, they must decide which costs to use in their review. The Office of Management and Budget (OMB) guidance regarding cost-benefit analysis states that analyses have to recognize both tangible and intangible costs (OMB, 1993: 5). When recognizing costs, there is an underlying question that the analyst must ask, "Is this cost avoidable if the alternative is not selected?" (Gill, 1998: 36) If the cost is avoidable, the analysis should include it; otherwise, the analysis does not include the unavoidable costs. An analysis should study all fixed and variable costs for inclusion in the study. Fixed costs are costs that do not vary with the amount of output produced; variable costs do vary with the amount of output produced. These definitions are time sensitive, in that in the long run, all costs are variable. An analysis should include use joint costs, costs of different activities added together, providing that the joint cost's magnitude is relatively large in the analysis. Analyses should also use external and internal costs. External costs refer to costs imposed upon someone else who does not receive payment for the imposed cost, such as water or air pollution. OMB guidance tells the analyst that all analyses must take into account the social net costs and not just the costs to the Federal Government (OMB, 1993: 5). Internal costs are actual costs that organizations incur. An example of an

internal cost would be depreciation of a vehicle. "Wash" costs are costs associated with each of the alternatives, and analyses generally do not include them. Finally, sunk costs are costs made in the past and not recoverable regardless of any choice of alternatives; therefore, the study should not include sunk costs in the analysis (Gill, 1998: 36-37).

Identification of Benefits

Besides identifying costs, this analysis also has to identify the associated benefits of each alternative. In the broadest sense, a benefit is something that adds value or importance to society, whether tangible or intangible. Benefits are also actions that have future effects and side effects associated with an alternative. Although some benefits are quantifiable, most benefits are often difficult to quantify. If a benefit is not quantifiable, analyses must still identify the benefit and include a narrative describing the benefit, thus providing decision-makers with a complete picture in which to make a decision. By describing the benefits, decision-makers are able to account for all aspects surrounding a decision (qualitative and quantitative), and in the end, permit a more informed decision based on many factors instead of costs alone. This helps ensure the most "bang for the buck" with vital Air Force resources.

An analysis can identify benefits in categories such as productivity, operating efficiency, reliability, maintainability, manageability, service life, ecology, and economic impact, to name a few, demonstrating there are a number of categories that analysts can use to measure benefits (Gill, 1998: 70). This review identifies examples of the different categories of benefits.

One example of the operating efficiency category is the relative young age of a leased vehicle fleet. Through leasing, companies are operating fleets that are no more than 4 or 5 years old. The newer vehicles are more fuel-efficient, safer, more reliable, and generally more environmentally friendly than an older fleet. The sum of these characteristics equals additional savings (Candler, 1997: 55).

The lower operating costs per mile associated with ownership is another example of operating efficiency. Operating costs per mile are often lower if the company owns the vehicles instead of leasing them. Ownership also does not restrict a company with the mileage cap usually specified in a lease. If a company leasing vehicles exceeds a certain mileage in a time period (usually a year), that company pays a per mile penalty (Candler, 1995: 30).

An example of maintainability, ecology, and service life is evident in the fact that leasing vehicles relieves companies from servicing the vehicles and the environmental concerns associated with servicing. By leasing, the lessor is responsible for servicing the leased vehicles and ensuring the vehicles and corresponding servicing adheres to environmental and regulatory guidance (Candler. 1997: 54).

An example of manageability is companies that lease can accurately budget for transportation expenses over the life of the lease (Waterman, 1998: 10). However, vehicle purchasing gives a company more flexibility in choosing what type of vehicles it owns. This is another example of manageability. With leases, a company ends up with the vehicle types the leasing company purchases, but by purchasing, the company can pick the exact kind of vehicle it wants (Candler, 1995: 30).

Finally, an example of economic impact is how leasing releases' companies from large capital investments that vehicle purchasing would require the company to make. Companies are then able to use that capital in other areas of business (Candler, 1997: 54).

Cost-Benefit Analysis Process

With the costs and benefits defined, this review can now give the reader an overview of the cost-benefit analysis process. The OMB Circular A-94 gives guidance, in very broad terms, on how to accomplish a cost-benefit analysis. The guidance states there are four elements of a cost-benefit analysis. First, the analysis should clearly state the rationale for the program being analyzed. Second, with the estimated future benefits and costs, there should be an identification of the underlying assumptions. Third, analyses should consider all practical alternatives. Finally, there should be future studies to determine if the agency actually realized the anticipated costs and benefits (OMB, 1993: 4).

Stated otherwise, a cost-benefit analysis determines all the costs and benefits associated with each alternative throughout its life cycle. An analysis then converts all costs and benefits to dollar figures and determines the net present value of each alternative. To find the net present value, subtract the present value of costs from the present value of benefits. If the present value is positive, it is a project worth considering. The analyst then chooses the project with the highest net present value (Shedden, 1984: 25).

When describing present value, this research is referring to the time value of money, in that, a dollar today is not worth the same in the future. Money earns interest;

to take this into account, analyses have to discount future payments to determine what they are worth today. This discounting is necessary to compute the present value of costs and benefits (OMB, 1993: 7). By computing the present value of all future streams of costs, the analysis will present a more accurate picture of each alternative's costs. Analysts can find the appropriate discount rate to use in Appendix C of the OMB Circular A-94. The OMB recommends using the Gross Domestic Product (GDP) deflator in analyses that need some adjustment for inflation, because it is believed that the GDP deflator is a more accurate measure of inflation than the popular Consumer Price Index figure (OMB, 1993:7).

One thought to keep in mind when performing any analysis is that the analysis is not a decision making process in and of itself. It is just one step in the process to determine the best course of action (Shedden, 1984: 28).

Conclusion

The Air Force, faced with a shrinking budget, has looked for areas to reduce costs. Since logistics makes up a large portion of the costs, it makes sense that the Air Force would look to logistics to shed a large amount of costs. One area for review is the Air Force general purpose vehicle fleet.

Because of the lack of published literature on this topic, there were three goals for this non-traditional literature review; the first goal was a description of costs. It identified the different levels of cost and what costs an analysis should include in its computations. The second goal was to describe the benefits and give some examples of benefits companies have realized in the past with both leasing and purchasing. The review of

appropriate government guidance and the application of cost-benefit analysis completed the literature review, giving the reader a general understanding of what to look for in a cost-benefit analysis and potential pitfalls to avoid.

The overriding theme of this literature review is a cost-benefit analysis is an important tool in determining an effective course of action for lease-buy decisions. The goal of this thesis is to apply an accurate cost-benefit analysis to determine if the Air Force should lease or buy general purpose vehicles.

III. Methodology

Introduction

This chapter discusses the methodology used to answer the research questions raised in chapter one. The chapter begins with an overview of the methodical approach employed for this analysis followed by a description of the cost of ownership model, explaining the variables included in the model, how the models compute the values of the variables, and the data source for the computations. After the cost of ownership model, the details of the procedures used to compute the GSA cost of leasing model and commercial cost of leasing model are discussed using the same format as the cost of ownership model. Following the description of the cost models, the chapter concludes with details on sensitivity analysis for each of the models.

General Methodical Approach

The methodical approach employed by this analysis is to compare the costs and benefits of owning vehicles to leasing vehicles using three separate cost models: cost of ownership model, GSA cost of leasing model, and commercial cost of leasing model. This analysis compares the costs computed through each cost model to the other cost models to determine the least cost alternative. This research computes the costs for each alternative on a spreadsheet using various databases as the basis for information. The data analysis chapter discusses the benefits of each alternative, both calculable and non-calculable.

Cost of Ownership

Since the Air Force has primarily purchased all its vehicles up to FY99, the first model used in this analysis is the cost of ownership model, found in Appendix A and B. The cost of ownership model is divided into two categories, sedans and trucks/vans, and each category further divided into sub-categories according to vehicle type. The cost models classify sedans as subcompact, compact, midsize, or station wagon.

The first variable used in the cost of ownership model is the total authorizations. The cost-benefit analysis is based on the assumption that all vehicle categories were at their authorization level. The reason for using authorizations is the Air Force would delete the vehicle authorization if it no longer needed the authorization; therefore authorizations are the basis for all computations in all cost models. The CONUS authorizations are based on data given by the Consolidated Analysis Reporting System (CARS) D101 data system at Warner Robins Air Logistics Center's (WR-ALC) Vehicle Management Branch.

The second variable used in the cost of ownership model is the number of vehicles assigned. This variable is used to calculate the salvage value of the Air Force vehicle fleet and costs associated with GSA leasing. The CARS D101 data system at WR-ALC is again the source of data for vehicles assigned. The GSA cost of leasing section of this chapter will thoroughly discuss the leasing costs associated with the number of vehicles authorized.

The next variable is the number of vehicles the Air Force must replace annually, which is used to compute the annual cost of buying replacement vehicles. To determine

the number to replace annually, the total authorizations for each vehicle type is divided by the life expectancy of each vehicle, as reported in Technical Order 36A-1-1301. In the case of fractional answers, the cost models round the figures up or down to derive whole numbers. In conjunction with the amount replaced annually, the average cost of new vehicles in 1998, as reported by WR-ALC's CARS D101 database, is the other factor used to compute annual cost of replacing vehicles. Multiply the average cost by the amount replaced annually to derive the annual cost of replacing vehicles. The annual cost of replacing vehicles is the largest component of cost in this study.

Average annual mileage per vehicle and total annual mileage are variables identified on cost of ownership, though the variables are used primarily for computing per mile leasing costs. The cost of ownership model uses the C001 data from CARS to compute the mileage figures for each vehicle type. The total annual mileage for each vehicle type is divided by the number of vehicles assigned for each type to compute a per vehicle annual mileage for each vehicle type. The average annual mileage per vehicle is then multiplied by the number of authorizations to derive the total mileage for all the authorizations in each vehicle category.

Direct maintenance is one of the biggest costs associated with ownership. Some of the costs that comprise the direct maintenance costs reported by the "Agency Report of Motor Vehicle Data" (SF 82) are mechanics, parts, fluids and lubricants, tires, batteries, preventive maintenance, and accident repair. The SF 82 instructs preparers to list all costs that are traceable directly to a specific vehicle as direct maintenance costs. CARS C001 data lists the direct maintenance cost for each category of sedan and aggregates the

costs for trucks. The C001 data identifies truck direct costs as either for compact or under 8,500 gross vehicle weight (GVW) for the vehicles studied in this research. To compute the direct costs per vehicle type under trucks, the total number of vehicles assigned is divided by the total direct costs to derive a per vehicle direct cost figure for each type of truck under 8,500 GVW. The per vehicle direct cost is then multiplied by the total number of authorizations to compute the total direct cost for each truck type.

According to the SF 82 instructions, costs that are not traceable directly to a specific vehicle, such as higher headquarters' overhead, benchstock, office supplies, and facilities, are classified as indirect costs; the next variable in the ownership cost model. CARS C001 data lists indirect costs in the same manner as the direct costs in the paragraph above. Each sedan type has its own reported indirect cost, and CARS aggregates the trucks together. Since the indirect costs will not change significantly with the number of vehicles on hand, the total authorizations are summed and then divided by each truck type's number of authorizations to compute a percentage. This percentage is then multiplied by the total aggregate indirect costs reported on the C001 resulting in the indirect cost for each truck type. This method is similar to the method employed by the Air Staff Vehicle Management Branch for assigning indirect costs. Since most of the indirect costs represent fixed costs and therefore will not change much with leasing or buying, this analysis uses 50 percent of indirect costs in its calculation of ownership costs. The chapter will address the 50 percent rate for indirect costs in the sensitivity analysis section.

Since the Air Force does not report fuel in direct or indirect costs and GSA leasing rates include fuel, fuel cost is another variable used to compute the ownership costs. The SF 82 gives fuel cost totals for each general category of vehicle. The first part in calculating the fuel cost for each type of sedan is to divide the total gallons of fuel by the number of vehicles assigned in the CARS C001 database to compute the gallons of fuel consumed per vehicle. For the total fuel consumed by each vehicle type, the number of gallons of fuel per vehicle is multiplied by the number of authorizations for each vehicle type. The fuel cost on the SF 82 is then divided by the total gallons of fuel consumed to derive a cost per gallon. The total fuel cost for this analysis is the total fuel consumed multiplied by the cost per gallon. This analysis computes the cost per gallon for the truck types in the same manner as the sedans, by dividing the total fuel cost for trucks by the total gallons consumed by trucks. To calculate the gallons of fuel per vehicle, the number of vehicles assigned for each truck type is divided by the sum of the number of assigned trucks. Multiply the resulting percentage by the total gallons consumed for the general truck category (that is, trucks under 8,500 GVW). This results in the total gallons of fuel for each truck type. Since most large trucks' fuel efficiency is roughly the same, this method of calculating the fuel consumed by each truck type is a close approximate. The fuel cost per truck type is the total gallons of fuel for each type multiplied by the cost per gallon.

This analysis assumes that the Air Force would send their used vehicles to GSA for auctioning, and the money from vehicle resale would return back to the Air Force as opposed to the current method of allowing the Defense Re-utilization and Marketing

Organization (DRMO) to sell the vehicles. The cost model uses salvage value to show what the Air Force could receive for the resale of their vehicles, if permitted to resale the vehicles. Using the calculation tool on the FinanCenter.com website, the salvage value of a vehicle is simply the average cost of a new vehicle minus the accumulated depreciation (FinanCenter, 1999). To calculate the final variable of the ownership cost model, total annual salvage value, multiply the salvage value per vehicle by the number of vehicles replaced annually, which indicates how many vehicles GSA will auction off annually.

To determine the overall costs of ownership, add each vehicle type's annual cost of new vehicles, direct maintenance cost, indirect maintenance cost, and fuel cost together to derive the total gross cost of ownership. The gross cost of ownership minus the salvage value of the vehicles replaced annually reports the net cost of ownership for this year. To find the net cost of ownership for each vehicle type for the next seven years, compute the net present value of the payments for the next seven years using the average GDP deflator rate for the past 10 years, according to OMB guidance. Summing all of the net present values equates to the overall cost of ownership for this year and the next seven years (referred to in the following chapter as the next eight years).

GSA Cost of Leasing

By law, the Air Force is required to lease through GSA for vehicles unless GSA cannot support the request; therefore, the GSA cost of leasing model is the second alternative studied in this analysis and found in Appendix C and D. Similar to the cost of ownership model, this analysis breaks the GSA cost of leasing model into the same two

categories of sedans and trucks/vans and further broken down into sub-categories of vehicle types.

Using the same assumption regarding authorizations in the ownership cost model, the first part of the GSA cost of leasing model determines the number of vehicles to replace annually based on the number of authorizations and the GSA's replacement time in years for each vehicle type (Hampel, 1999). The GSA cost of leasing model calculates the variables for sedans and trucks/vans the same throughout the model. The only difference in the GSA cost of leasing model is individual monthly rates and mileage charges; therefore, this section discusses the overall variables in general terms instead of by each category as was done for the cost of ownership model.

The GSA homepage gives the 1998 monthly lease rate and mileage rate per vehicle, and the analysis uses the 1998 rates so all model costs start with the same reference year (General Services Administration, 1999). To determine the annual lease rate, the total authorizations are multiplied by the monthly lease rate then multiplied by 12.

The annual mileage cost is found by multiplying the annual mileage for each vehicle type as determined in the cost of ownership model by the mileage rate reported by GSA. These values are well established and used all the time for making lease/buy determinations. Fuel and maintenance costs are included in the GSA mileage rate; therefore, the GSA model does not include a fuel or maintenance category.

Analysts do not normally use the next three variables in lease/buy determinations regarding GSA. The first variable is the cost of leasing vehicles already bought by the

Air Force, which ties closely to the second variable, vehicle possession costs to the Air Force. When GSA converts an owned fleet over to leased fleet, GSA takes possession of the owned assets. For example, if GSA was converting the vehicle fleet at Base X where the Air Force owns all the vehicles, GSA would take possession of the Air Force vehicles and lease those same vehicles back to the Air Force at full lease price. The cost of leasing vehicles already bought by the Air Force is self-explanatory. The Air Force is paying full monthly lease rates and mileage charges on vehicles it has already previously bought. Until GSA replaces those previously owned vehicles with new vehicles, the cost of leasing previously purchased vehicles is an avoidable cost to the Air Force. Without leasing, the Air Force would not accrue that cost; therefore, this analysis adds this additional cost to the GSA cost of leasing model. The GSA cost of leasing model for sedans and trucks tracks the cost of leasing vehicles already bought for the first four years of leasing. GSA's vehicle replacement method is replacing 20 percent of the replacement eligible vehicles, based on GSA's replacement time criteria, over five years for all vehicles. Considering the average age of the Air Force vehicle fleet in the CONUS, this analysis assumes that GSA will replace all of the Air Force vehicles in the first five years, starting with 20 percent in the first year. To calculate the first year cost of leasing vehicles already bought, multiply 80 percent of the authorizations by the yearly lease rate. Added to this result is 80 percent of the annual mileage rate, which equates the total first year cost of leasing vehicles already owned by the Air Force. This analysis uses the same formula for the next three years substituting 60, 40, and 20 percent for the 80 percent value for the next respective years (Hampel, 1999).

Along the same lines, the vehicle possession cost to the Air Force is the value of the vehicle fleet when GSA assumes possession of the fleet. From telephone conversations with GSA, GSA considers the turn over of the vehicle fleet as a one-time contribution to GSA's vehicle fund (Hampel, 1999). The GSA cost of leasing model includes this cost because the Air Force has already bought the vehicles, and gives those vehicles to GSA without any compensation, which constitutes an avoidable cost to the Air Force. Unfortunately, historical data is not available to use in computing the total actual worth of the Air Force's vehicle fleet; therefore, this analysis uses an approximation to compute the value of the Air Force fleet. The method used to calculate the value of the Air Force vehicle fleet is to multiply the reciprocal of the cost of ownership model's life expectancy for each vehicle type by the value of a vehicle after one year's worth of depreciation in the first year of life, the value after two year's worth of depreciation in the second year, and continuing until the last year of the vehicle's life expectancy, the residual value. Summing all these values calculates the total vehicle possession cost to the Air Force for each vehicle type.

Another variable in the GSA cost of leasing model is the refurbishment costs. The Air Force incurs the refurbishment costs when GSA takes possession of a vehicle fleet and fixes the vehicle to resell in the used car market. The type of repairs included in the refurbishment costs are repairing vehicle modifications such as installed radios and repairing damage in excess of $250. Personnel at the Air Staff's Vehicle Management Branch stated they could justify a refurbishment cost of $250 per vehicle. The $250 cost is the average charge to the Air Force for fixing the vehicles so GSA can resell the

vehicles. To determine the total refurbishment cost, the $250 average refurbishment charge is multiplied by the number of vehicles assigned. This analysis uses assigned vehicles since this charge only applies to Air Force owned vehicles currently on hand and reflects a one-time charge (Wiley, 1999).

Finally, for the electric compact trucks in this analysis, GSA charges an incremental fee in the first year per vehicle based on the procurement cost of the vehicle. The incremental fee is standard procedure for GSA when dealing with alternate fuel vehicles (Hampel, 1999). The GSA cost of leasing model adds this cost in for each year of leasing under the appropriate vehicle type. Based on GSA's 20 percent replacement policy when converting a vehicle fleet, GSA will replace 13-14 of the electric compact trucks in the first five years of vehicle replacement. The first five years of leasing costs in the GSA cost of leasing model reflects the increased incremental cost. After the first five years, GSA will replace an average of 11 electric compact trucks annually and charge the Air Force an incremental cost based on the average of 11 electric compact trucks. The monthly lease rate and mileage charge for the electric compact trucks are the same as the conventional compact truck.

To determine the overall GSA cost of leasing, each vehicle type's annual lease payment, annual mileage charge, cost of leasing vehicles already bought, vehicle possession cost, and refurbishment cost are added together to derive the total GSA cost of leasing. This is the leasing cost for this year. To find the GSA cost of leasing for the next seven years, the net present value of each year's cost is calculated using the average GDP deflator rate for the past 10 years, according to OMB guidance. To determine the

overall costs of GSA leasing for this year and the next seven years, the net present values of each vehicle type are summed. This figure is reported as the cost of GSA leasing over the next eight years. Because the vehicle possession cost and vehicle refurbishment charge are one-time costs that appear in the first year with GSA leasing, this analysis also reports the cost of GSA leasing for years two through nine to develop a clearer picture of what the true cost of GSA leasing may equate to in the long run.

Commercial Cost of Leasing

Although public law does not allow the Air Force to commercially lease vehicles without first going through GSA, commercial leasing is a possible option to explore in this analysis. The vehicles in the cost of commercial leasing model (Appendix E and F) are broken down into sub-categories similar to the ownership cost model and GSA cost of leasing model. Because of the uniqueness of some of the vehicles under analysis in the truck category, commercial leasing may not have the exact vehicle available for a particular type. In this case, a suitable substitution will be sought and its cost reported under the appropriate type.

The first variable in the cost of commercial leasing model is the total authorizations based on the D101 database in CARS for each vehicle type. These are the same authorizations reported in each cost model. This analysis uses the commercial market's standard replacement time of three years, the second cost variable. Although there are one and two year replacement times available, a three-year replacement time gives a lower lease rate and will avoid enormous amounts of vehicles requiring replacement annually or biannually. A one- or two-year replacement cycle could have a

large impact on the used car market if the Air Force was permitted to commercially lease. The third cost variable, amount replaced annually, is simply the total authorizations divided by the replacement time.

The ownership cost model computes the annual mileage for each vehicle type, and the cost of commercial leasing model uses the reported annual mileage as the fourth variable to help in determining the appropriate lease rate. Commercial leasing applies an annual mileage ceiling (cap) the customer may reach without incurring a mileage penalty. Because the mileage penalty associated with breaching the mileage cap is quite severe ($.20 to $.45 per mile in excess), this analysis uses a commercial lease with sufficient mileage included to ensure no vehicles will incur a mileage penalty. The minimum annual mileage used in commercial leases is 12,000 miles and is used for all vehicles in this analysis except for the subcompact sedans, which has average annual mileage of approximately 16,000 miles per vehicle. For the subcompact sedans, the lease rate will be based on a 16,000-mile lease per vehicle. The allowed mileage figure reflects the 12,000-mile allowance multiplied by the number of authorizations. The allowed mileage figure for the subcompact sedans reflects the 16,000-mileage allowance multiplied by the number of authorizations.

As in the GSA cost of leasing model, the monthly lease rate per vehicle is multiplied by the number of authorizations and then by 12 months to compute the value of total annual lease payments, the cost of commercial leasing model's eighth variable. According to Mr. Naman of Joe Bullard Auto Group, to determine the vehicle lease rates, subtract the capital cost reductions (such as manufacturer rebates) from the vehicle capital

cost (cost of the vehicle); however, since vehicle rebates are not always offered on all vehicles, this analysis omits the capital cost reductions. To determine the capital cost reduction at any given time period, the Air Force must look at the different vehicle models for each vehicle class to identify any manufacturer rebates available. Because of the number of vehicles under analysis that the Air Force would lease commercially, the Air Force could expect the cost of the vehicles to be less than the manufacturers suggested retail price (MSRP). Using the MSRP would overstate the cost of commercial leasing; therefore, this analysis uses the average vehicle cost reported in the cost of ownership model as the vehicle capital cost. The resultant is the adjusted capital cost. Subtracting the residual value from the adjusted capital cost computes the depreciation of the vehicle that the user will pay over the course of the lease. Adding a rental charge to the depreciation equals the total of all lease payments. The monthly lease rate is determined by dividing the total of all lease payments by 36 months, the term of the commercial lease.

Due to the large number of variables involved in a specific lease rate, the computed lease rates are estimates of what the Air Force may expect to spend on commercially leased vehicles. Items such as specific vehicle prices, residual percentages, rental rate charges, and manufacturers' "cash back" offers at the time of leasing all play an integral part in the formulation of actual lease rates. The lease rate estimates in this analysis are based on General Motor's "Smartlease" rates.

Since commercial lessors will replace all leased vehicles every three years and all manufacturers have a 3 year, 36,000 mile bumper-to-bumper warranty, this analysis

assumes that the only maintenance required on commercially leased vehicles is scheduled maintenance, mainly oil changes. The vehicle manufacturers should cover any other repairs that are required on the leased vehicles. Oil service facilities recommend changing the oil every 3,000 miles or 3 months, whichever comes first. All vehicles in this analysis that operate up to the mileage limit of 12,000 miles will require four oil changes during the year. Any vehicles that have excess mileage will require more than four oil changes over the course of a year. The annual scheduled maintenance variable takes the number of annual oil changes into account and multiplies the total oil changes by the number of authorizations and by the nation-wide average price of $20 for the basic oil, filter, and lube service.

Because the Air Force would have to pay some costs up front for commercial leasing, a category entitled "acquisition costs" is included in the commercial cost of leasing model. Included in the acquisition cost category are costs such as an acquisition fee, the first month's payment, and initial title and registration fees. The total acquisition cost for each vehicle type is calculated by multiplying the number of vehicles replaced annually by the acquisition cost of each vehicle type.

Since commercial lease vehicle rates do not include fuel in the service, the cost of commercial leasing model adds the annual fuel cost, computed in the ownership cost model, into the model. This assumes that the Air Force could get a better fuel price than firms could in the commercial sector since the Air Force is exempt from paying certain fuel taxes.

Finally, the last variable in the cost of commercial leasing model is the salvage value of the Air Force owned vehicles. This is a one-time infusion of capital back to the Air Force, using the assumption stated previously that the money generated from the sale of vehicles would return to the Air Force. The salvage value in the commercial cost of leasing model uses the same numbers reported as the vehicle possession cost to the Air Force in the GSA cost of leasing model since this is the estimated amount of money the Air Force could receive for its currently owned vehicles.

To compute the total costs of commercial leasing for each vehicle type, the excess mileage charges, annual lease payments, annual scheduled maintenance costs, and fuel costs were summed. The salvage value of the Air Force owned vehicle fleet was then subtracted to compute the net cost of commercial leasing for the first year. The costs for years two through eight were calculated by summing the costs together, not figuring any salvage value, and determining the net present value of those costs for each vehicle type. To compute the total cost of commercial leasing for the eight years studied in this analysis, all the vehicle type net present values were summed.

Sensitivity Analysis

This section addresses what values this analysis will vary and the reasoning for varying those values to determine how overall costs and decisions will change. One such value this analysis will change is the inflation rate. The inflation rate is one value that certainly changes over time. The cost models reflect the inflation rate as the interest rate in computing the present value of the annual costs. To determine the inflation rate, this analysis will use the average GDP deflator rate over the last 10 years and include what

the forecasted GDP deflator rate will be in the next few years. As mentioned in the literature review, the GDP deflator rate is a more accurate gauge of inflation than the consumer price index. This analysis will vary the inflation rate to determine how the costs of each model will react to different inflation rates and at what point the decision to lease or buy changes.

Since fuel costs vary every year, the sensitivity section of the next chapter will use different values for the cost of fuel. Fuel costs represent a large cost in two of the models; the ownership cost model and the commercial cost of leasing model. By varying the cost of fuel, this analysis will determine if extreme fuel prices will have an effect on the decision to lease or buy vehicles.

Another value this analysis will vary is the amount of indirect costs charged to ownership. The base model uses a 50 percent value, stating that the Air Force could reduce its indirect costs by half. Since indirect costs do not tend to disappear much, the 50 percent value may be over optimistic; therefore, this analysis will also compute ownership costs based on values of 0, 10, 20, 30, and 40 percent of indirect cost avoidance to determine if the lease/buy decision changes, and if so, at what point does the decision change.

Another value to vary in this analysis is the mileage of each vehicle type. Since the Air Force has historically not met mileage-based utilization goals on a large number of general purpose vehicles, the base cost models will use the actual computed mileage figures for each vehicle type. The sensitivity analysis section of the data analysis chapter will determine what the costs for each alternative would be if all the Air Force vehicles

reached an average of 12,000 miles annually. This analysis uses the 12,000-mile point because most commercial leases are based on an average usage of 12,000 miles annually.

The last value this analysis will vary regards the salvage value in the cost of ownership model. The sensitivity section will re-compute the ownership cost, omitting the salvage value of the vehicles since the current method of DRMO auctioning does not generate any money for vehicle funding, and compare the various cost models to determine the net result. This is prudent to include in the sensitivity analysis section because current policy does not permit the Air Force to resell its vehicles on the open market, only through DRMO.

Conclusion

This chapter covered the methodical approach employed for this cost-benefit analysis. This chapter described all of the numerous variables used to represent the costs in the three different cost models and different methods used to calculate the values for all of the variables. Each of the cost models are described in separate sections in this chapter and followed by a sensitivity analysis section. The sensitivity section provides details on the areas this analysis will vary to determine how different values will affect the decision to lease or buy general purpose vehicles. The next chapter, Data Analysis, will describe the actual values computed and employed in each of the cost models and what the overall results are for this analysis.

IV. Results and Analysis

Introduction

This chapter discusses the results and analysis of the research data using the methodology discussed in Chapter 3. Chapter 4 begins with a thorough description of the calculations and results of each cost model by vehicle category along with a narrative identification of benefits associated with each alternative. The next part of this chapter is an overall comparison between each of the models' results based on the overall costs. Finally, this chapter concludes with an analysis of the sensitivity of each model's costs by varying certain key values used in the cost models.

Cost of Ownership

The cost of ownership model spreadsheets for sedans and trucks are located in Appendix A and B respectively. The first four variables for sedans in the cost of ownership model are total authorized, total assigned, life expectancy, and amount replaced annually. Table 1 shows the different values of the first four variables for sedans. The Air Force life expectancy for sedans is seven years and eight to ten years for trucks and vans, depending on the type of truck. The amount replaced annually is simply authorizations divided by the life expectancy. At the top of the next page, Table 1 shows the different amounts of each sedan type to replace annually such as 205 compact sedans, three subcompact sedans, and two midsize sedans. Under ownership, the Air Force should replace a total of 302 various sedans annually.

Table 1. Annual Sedan Replacement Calculations

	Sedans			
	Subcompact	Compact	Midsize	Station Wagons
Total Authorizations	19	1436	13	645
Total Assigned	16	1167	9	679
Life Expectancy in Years	7	7	7	7
Amount Replaced Annually	3	205	2	92

Appendix B identifies the first four variables for the different truck types and vans with the values calculated in the same manner as the sedans. Table 2 and Table 3 below identify the amount of vehicles replaced annually for several of the truck types and all of the van types. The number of replacements for the trucks can range from 1 dual wheel pickup trucks every eight years to 648 compact 4X2 trucks annually. Filling all the authorizations and replacing the appropriate amount of vehicles identified in the tables below and in Appendix B, the Air Force can expect to replace a total of 2,996 trucks/vans annually.

Table 2. Sample Annual Truck Replacement Calculations

	Trucks 4 X 2				
	Compact	Compact - Elec	3500 - 4500 GVW	4600 - 5799 GVW	Multistops (B180)
Total Authorizations	5182	67	62	3013	3893
Total Assigned	4547	56	94	2742	3624
Life Expectancy in Years	8	8	8	8	8
Amount Replaced Annually	648	8	8	377	487

Table 3. Annual Van Replacement Calculations

	Vans					
	7-Pax	8-Pax	9-Pax	15-Pax	4 X 4 PNL - 7000 GVW	4 X 2 PNL - 6999 GVW
Total Authorizations	554	988	106	697	3	1168
Total Assigned	436	940	291	569	0	1161
Life Expectancy in Years	7	8	10	10	8	8
Amount Replaced Annually	79	124	11	70	0	146

The next two variables in the cost of ownership model, average cost of new vehicles and annual cost of replacing vehicles, are interconnected with the amount replaced annually. Based on the average cost of new vehicles reported by the CARS D101 database, Table 4 identifies the annual cost of replacing vehicles. The average cost of new vehicles is multiplied by the amount replaced annually to derive the annual cost of replacing vehicles. From Table 4, the annual cost to replace vehicles ranges between $3,834 to $14,215,290. Based on the authorizations, the total annual vehicle replacement cost for the Air Force is $69,472,034 ($4,869,499 for sedans and $64,602,535 for trucks).

Table 4. Annual Cost of Replacing Vehicles Based on Average Replacement Costs

	Avg Cost	Annual Cost		Avg Cost	Annual Cost
Sedans			**4X2 Trucks**		
Subcompact	$20,656	$56,066	Compact	$12,534	$8,118,899
Compact	$14,735	$3,022,780	Compact-Elec	$39,091	$327,387
Midsize	$15,105	$28,052	3500-4500GVW	$18,462	$143,081
Station Wagon	$19,129	$1,762,601	4600-5799GVW	$19,337	$7,282,798
			Multistop(B180)	$29,212	$14,215,290
4X4 Trucks			Multistop(F176)	$33,898	$114,406
Compact	$16,947	$227,090	Stake-7000GVW	$19,343	$3,648,573
3500 GVW	$25,458	$1,139,246	8000 GVW	$26,239	$378,591
4600-5799GVW	$19,520	$2,300,571	9-Pass Utility	$29,598	$310,779
6000 GVW	$29,769	$2,154,531	4-Door	$25,618	$6,008,844
7500 GVW	$29,424	$1,051,908	**Vans**		
9-Pass Utility	$29,694	$486,239	7-Pax	$20,250	1,602,643
Duel Wheel	$30,672	$3,834	8-Pax	$20,050	$2,476,175
4-Door	$28,207	$8,109,513	9-Pax	$30,004	$318,042
Vans			15-Pax	$22,640	$1,578,008
Panel-7000GVW	$16,321	$6,120			
Panel-6999GVW	$17,808	$2,599,968			

Because GSA charges a per mile fee as part of its leasing that varies with the vehicle type, this analysis computes the total annual mileage for each vehicle type. Since the annual mileage amounts are based on vehicles currently owned by the Air Force, the mileage estimates are calculated in the cost of ownership model. The CARS C001 database tracks the annual mileage for each sedan type. The total annual mileage reported by the cost of ownership model, found by multiplying the average annual mileage per vehicle by the number of authorizations, for each sedan type is; 303,506 miles for subcompact sedans, 8,848,632 miles for compact sedans, 83,291 miles for midsize sedans, and 4,030,605 miles for the station wagons. The total annual mileage for sedans, based on authorizations, totals 13,266,034 miles.

The CARS C001 database reports the annual mileage for trucks in an aggregate form requiring some method to derive the mileage numbers per vehicle. The mileage figures reported in the CARS C001 are divided into four categories: 4X2 compact (24,695,104 total miles in 1998), 4X2 under 8,500 GVW (81,179,236 total miles in 1998), 4X4 compact (1,002,185 total miles in 1998), and 4X4 under 8,500 GVW (40,358,907 total miles in 1998). The C001 database classifies vans under the appropriate truck category, either 4X2 under 8,500 GVW or 4X4 under 8,500 GVW. Because of the aggregate mileage reported for the truck categories, the cost of ownership model develops a per vehicle average annual mileage. To compute the average annual mileage per vehicle, the total mileage reported for each aggregate truck category, listed above, was divided by the number of vehicles assigned under that category on the C001 report. Using this method, the average annual mileage per vehicle for each 4X2 truck

(other than compact) and van equates to 6,171 miles. Employing this same method to the 4X4 under 8,500 GVW trucks, the average annual mileage per vehicle is 8,951 miles, and the average annual mileage for each 4X4 compact trucks is 6,383 miles. Finally, because of the inclusion of a number of electric compact 4X2 trucks owned by the Air Force, this analysis computes the average annual mileage per vehicle for the compact 4X2 trucks to derive an average annual mileage for each compact 4X2 truck. The average annual mileage for the compact 4X2s equates to an average of 5,364 miles per truck. The total annual mileage for each vehicle type is the average annual mileage per vehicle multiplied by the number of authorizations that comprise that vehicle category. This calculation represents what the Air Force can expect the mileage to tally to each year with all authorizations filled. The total annual mileage for all the vehicles encompassing the truck and van categories is 162,610,639 miles. Table 5 presents the total annual mileage amounts for each truck and van vehicle type.

Table 5. Truck/Van Total Annual Mileage

	Annual Mileage		**Annual Mileage**
4X2 Trucks		**4X4 Trucks**	
Compact	27,796,248	Compact	855,322
Compact-Elec	359,388	3500 GVW	3,204,458
3500-4500GVW	382,602	4600-5799GVW	7,384,575
4600-5799GVW	18,593,223	6000 GVW	5,182,629
Multistop(B180)	24,023,703	7500 GVW	2,559,986
Multistop(F176)	166,617	9-Pass Utility	1,172,581
Stake-7000GVW	9,312,039	Dual Wheel	8,951
8000 GVW	623,271	4-Door	25,734,125
9-Pass Utility	518,364	**Vans**	
4-Door	13,026,981	7-Pax	3,418,734
Vans		8-Pax	6,096,948
Panel-7000GVW	26,853	9-Pax	654,126
Panel-6999GVW	7,207,728	15-Pax	4,301,187

Direct maintenance costs represent a major expense to the Air Force as part of the cost of owning vehicles. The direct maintenance costs for each sedan type is tracked separately by the Air Force; therefore, the figures reported on the cost of ownership model come directly from the CARS C001 report. The subcompact and compact sedans needed $27,686 and $673,598 respectively in direct maintenance for 1998. Also in 1998, the Air Force spent $19,188 in direct maintenance on midsize sedans. Completing the sedan category, the station wagons in the Air Force required $442,368 in direct maintenance costs for 1998. The total direct maintenance bill for these sedans in 1998 amounted to $1,162,840.

As with the mileage reporting above and other variables to follow for the cost of ownership model, the C001 database reports the direct maintenance costs for trucks and vans in an aggregate form. After summing the "In-house Direct Material," "In-house Direct Labor," "Commercial Contract," and "Other Government" categories for each aggregate vehicle type, the results indicate that the Air Force spent $2,924,433 in direct maintenance costs for 4X2 compact trucks, $13,361,474 for 4X2 under 8,500 GVW truck direct maintenance, $115,104 in direct maintenance for 4X4 compact trucks, and $6,308,790 for 4X4 under 8,500 GVW trucks in 1998. To derive the per truck direct maintenance cost, divide the direct maintenance costs above by the number of vehicles that comprise each of the aggregate categories. This calculation equates to an average direct maintenance cost of $635.20 for each compact 4X2 truck, $1,015.77 for each 4X2 truck under 8,500 GVW, $733.15 for each 4X4 compact truck, and $1,038.23 for each 4X4 truck under 8,500 GVW. Table 6 at the top of the next page identifies the total

annual amount the Air Force could spend on trucks in direct maintenance costs with all the authorizations filled. The total annual cost for direct maintenance to the Air Force could reach $25,048,060.

Table 6. Truck/Van Total Annual Direct Maintenance Costs

	Direct Maint		Direct Maint
4X2 Trucks		**4X4 Trucks**	
Compact	$3,291,575	Compact	$98,242
Compact-Elec	$42,558	3500 GVW	$500,897
3500-4500GVW	$62,978	4600-5799GVW	$1,154,303
4600-5799GVW	$3,060,524	6000 GVW	$810,111
Multistop(B180)	$3,954,404	7500 GVW	$400,158
Multistop(F176)	$27,426	9-Pass Utility	$183,289
Stake-7000GVW	$1,532,801	Dual Wheel	$1,399
8000 GVW	$102,593	4-Door	$4,022,571
9-Pass Utility	$85,325	**Vans**	
4-Door	$2,144,297	7-Pax	$562,738
Vans		8-Pax	$1,003,584
Panel-7000GVW	$4,197	9-Pax	$107,672
Panel-6999GVW	$1,186,423	15-Pax	$707,994

In addition to the direct maintenance, the indirect maintenance cost represents a sizable portion of the ownership costs. Assuming that the Air Force could eliminate 50 percent of its indirect costs through shop closures, personnel cuts, and other cost savings methods, the annual amount of indirect costs used in the cost of ownership model for each sedan type is $9,962 for subcompacts, $670,264 for compact sedans, and $5,312 for midsize sedans. The C001 database allocates $390,938 for station wagons. The total annual indirect cost in the cost of ownership model for sedans equates to $1,076,475.

Similar to the other cost variables for trucks, the C001 database reports all the indirect cost data in aggregate form except for the 4X4 compact trucks. As identified in the methodology chapter, the total authorizations for trucks are summed and then divided by each truck type's number of authorizations to compute a percentage. This percentage is then multiplied by the total aggregate indirect costs reported on the C001 resulting in the indirect cost for each truck type. Employing this method, Table 7 below highlights the amount of indirect cost for each truck and van type. The total annual indirect maintenance cost reported by the cost of ownership model for trucks is $13,179,614.

Table 7. Truck/Van Total Annual Indirect Maintenance Costs

	Indirect Maint		Indirect Maint
4X2 Trucks		**4X4 Trucks**	
Compact	$3,291,575	Compact	$98,242
Compact-Elec	$42,558	3500 GVW	$500,897
3500-4500GVW	$62,978	4600-5799GVW	$1,154,303
4600-5799GVW	$3,060,524	6000 GVW	$810,111
Multistop(B180)	$3,954,404	7500 GVW	$400,158
Multistop(F176)	$27,426	9-Pass Utility	$183,289
Stake-7000GVW	$1,532,801	Dual Wheel	$1,399
8000 GVW	$102,593	4-Door	$4,022,571
9-Pass Utility	$85,325	**Vans**	
4-Door	$2,144,297	7-Pax	$562,738
Vans		8-Pax	$1,003,584
Panel-7000GVW	$4,197	9-Pax	$107,672
Panel-6999GVW	$1,186,423	15-Pax	$707,994

Fuel cost represents another cost associated with ownership. Because fuel costs are reported in an aggregate form, this analysis computes the gallons consumed per vehicle over the course of a year by dividing the total fuel reported for each general

vehicle category by the number of vehicles assigned to that vehicle category. This figures to an annual consumption of 954 gallons of fuel for each subcompact sedan, 180 gallons of fuel for each compact sedan, 139 gallons of fuel for each midsize sedan, and 203 gallons for each station wagon. The average gallon of fuel expended by each type of truck is as follows: 252 gallons for 4X2 compact trucks, 379 gallons for 4X2 trucks under 8,500 GVW, 246 gallons for 4X4 compact trucks, 528 gallons for 4X4 trucks under 8,500 GVW, and 379 gallons for vans. Next, these average gallons for each vehicle type are multiplied by the number of authorizations in each vehicle type to compute the total gallons of fuel the Air Force may use in the course of a year with all vehicles assigned.

Dividing the total fuel cost by the total gallons of fuel consumed calculates the average price per gallon for fuel. The average price per gallon for sedans equals $.88, and the average price per gallon for 4X2 and 4X4 trucks is $.84 and $.91 respectively. Multiplying the average prices per gallon by the total gallons of fuel dispensed to each vehicle type calculates the total fuel cost for each vehicle type. Table 8 at the top of the next page identifies the annual fuel expense for each vehicle type. The total expected fuel cost for the sedans is $360,656 annually. The Air Force can expect to pay $5,687,078 annually in fuel cost for 4X2 trucks/vans and $4,444,312 annually for 4X4 trucks, summing to an overall annual fuel cost for trucks of $8,131,391.

Table 8. Annual Fuel Cost

	Annual Fuel Costs		Annual Fuel Costs
Sedans		**4X2 Trucks**	
Subcompact	$15,974	Compact	$1,100,933
Compact	$227,566	Compact-Elec	$1,806 (Electricity Cost)
Midsize	$1,589	3500-4500GVW	$19,852
Station Wagon	$115,527	4600-5799GVW	$964,738
		Multistop(B180)	$1,246,507
4X4 Trucks		Multistop(F176)	$8,645
Compact	$29,801	Stake-7000GVW	$483,170
3500 GVW	$170,998	8000 GVW	$32,339
4600-5799GVW	$394,060	9-Pass Utility	$26,896
6000 GVW	$276,558	4-Door	$675,925
7500 GVW	$136,607	**Vans**	
9-Pass Utility	$62,572	7-Pax	$177,386
Dual Wheel	$478	8-Pax	$316,350
4-Door	$1,373,239	9-Pax	$33,940
Vans		15-Pax	$223,174
Panel-7000GVW	$1,433	Panel-6999GVW	$373,984

Because the Air Force does not send its vehicles to GSA for auctioning at the end of a vehicle's useful life, previous analyses have not included the salvage value of vehicles; however, vehicle salvage values represent an unrealized potential source of capital for the Air Force to use in procuring additional vehicles, similar to the purchasing methods of GSA. The salvage value decreases the cost of ownership since the salvage values represent an inflow of money instead of an outflow. Using the FinanCenter website tool, the computed salvage value per vehicle on the ownership cost model is based on the CARS reported vehicle cost and the salvage value of a vehicle at the end of its life expectancy. Multiplying the salvage value per vehicle by the amount of vehicles replaced annually could generate $17,401 in funds for reselling subcompact sedans, $930,323 in funds for compact sedans, $8,706 in funds for midsize sedans, and $547,052

worth of revenue for station wagons. The potential annual revenue the Air Force could realize by reselling its sedans is $1,503,483. Due to the large number of vehicle types in trucks, Table 9 lists the annual salvage value for each truck type. The truck salvage values could net the Air Force $16,757,574 annually to help purchase vehicles.

Table 9. Annual Salvage Values for Trucks/Vans

	Salvage Value		Salvage Value
4X2 Trucks		**4X4 Trucks**	
Compact	$2,191,986	Compact	$46,940
Compact-Elec	$88,398	3500 GVW	$307,612
3500-4500GVW	$38,634	4600-5799GVW	$713,979
4600-5799GVW	$1,966,359	6000 GVW	$581,750
Multistop(B180)	$3,838,498	7500 GVW	$284,034
Multistop(F176)	$30,891	9-Pass Utility	$131,295
Stake-7000GVW	$985,188	Dual Wheel	$1,035
8000 GVW	$117,492	4-Door	$1,676,413
9-Pass Utility	$83,916	**Vans**	
4-Door	$1,411,555	7-Pax	$497,413
Vans		8-Pax	$668,629
Panel-7000GVW	$1,653	9-Pax	$65,741
Panel-6999GVW	$701,968	15-Pax	$326,196

To compute the total cost of ownership, the annual cost of replacing vehicles, direct maintenance, indirect maintenance, and fuel cost were summed. With this total, the total annual salvage value was subtracted to compute the total annual cost of ownership. By taking the net present value of the totals for eight years, the total cost of ownership for sedans is $41,879,398.

Using the same method for trucks, the total cost of ownership for eight years is $661,401,632 for trucks. Table 10 exhibits the total cost of ownership for each vehicle

type under analysis. Summing the sedan and truck ownership costs, the overall cost of ownership for the Air Force for the next eight years, considering the present value of the annual payments, is $703,281,030.

Table 10. Total Cost of Ownership for Eight Years for Each Vehicle Type

	Total Costs		Total Costs
Sedans		**4X2 Trucks**	
Subcompact	$647,826	Compact	$91,015,486
Compact	$25,719,348	Compact-Elec	$2,229,233
Midsize	$318,938	3500-4500GVW	$1,551,383
Station Wagon	$15,193,287	4600-5799GVW	$77,081,595
		Multistop(B180)	$124,216,863
4X4 Trucks		Multistop(F176)	$942,558
Compact	$2,893,613	Stake-7000GVW	$38,610,051
3500 GVW	$11,858,877	8000 GVW	$3,165,710
4600-5799GVW	$25,012,746	9-Pass Utility	$2,701,036
6000 GVW	$20,778,414	4-Door	$60,129,910
7500 GVW	$10,200,363	**Vans**	
9-Pass Utility	$4,694,839	7-Pax	$15,069,379
Dual Wheel	$36,465	8-Pax	$25,726,814
4-Door	$93,511,882	9-Pax	$3,169,933
Vans		15-Pax	$17,985,476
Panel-7000GVW	$81,818	Panel-6999GVW	$28,737,190

Benefits of Ownership

There are several benefits the Air Force gains through vehicle ownership. One large benefit is the flexibility the Air Force has over its vehicles through ownership. Periodically, bases go through vehicle validation visits where Major Command representatives verify authorizations at each base. Through these re-adjustments, bases gain and lose authorizations. By owning its vehicles, the Air Force can easily move vehicles to other bases. By leasing vehicles, the Air Force may not be able to accomplish

vehicle reassignments as easily, and in the case of commercial leasing, may not even be an option.

Another benefit of ownership is the costs associated with the War Reserve Material (WRM) fleet. One pillar of the U.S. mobility triad is prepositioning, which is where the WRM fleet falls. By owning its vehicles, the Air Force can preposition vehicles in different areas of the world. The costs for each vehicle are relatively minimal since the vehicles are stored and routine maintenance is usually the only maintenance performed on the vehicles. Since the vehicles are purchased up front, the annual outlay of funds for the WRM vehicles does not equate to a tremendous amount of money. If the Air Force leased all of its vehicles, the Air Force would have to negotiate with the lessor to store WRM identified vehicles. Storing leased vehicles does not make good financial sense. There is no reason to pay a per month charge to a lessor for a vehicle to sit in storage, not to mention the shipping charges every three to six years to replace vehicles.

The continued employment of general purpose vehicle mechanics is an additional benefit of ownership. Assuming Air Force UTCs will still require general purpose mechanics in its war plans, leasing all the CONUS vehicles will relegate the general purpose mechanics to only overseas assignments. This is not a realistic option for the Air Force's general purpose mechanics. Forcing general purpose mechanics to only overseas assignments may drive morale down and create larger retention problems in the career field for the Air Force. By owning general purpose vehicles in the CONUS, the Air Force will continue to give CONUS base options to general purpose mechanics.

Finally, ownership appears to be the choice for vehicles that attain high annual mileage rates and large amounts of usage, mainly the security police vehicles. Because the security police vehicles acquire such a large amount of mileage (21,817 miles per law enforcement sedan in 1998) and use annually, it may be beneficial to own the security police vehicles as opposed to leasing them due to the mileage rate charged by GSA.

Cost of GSA Leasing

The total authorizations reported by the GSA cost of leasing model are identical to the authorizations reported by the cost of ownership model. Appendix C and D, as well as Tables 1, 2, and 3, identify the number of authorizations for each vehicle type. The replacement time for GSA sedans is three years and 36,000 or four years total time. Since the Air Force on average does not reach the 36,000-mile mark, the cost of GSA leasing model uses the four-year figure. The replacement time for the trucks and vans under analysis is six years through GSA leasing. Under GSA leasing, five subcompact sedans would be replaced annually along with 359 compact sedans, three midsize sedans, and 161 station wagons for a total of 528 sedans each year after the first five years.

Table 11 at the top of the next page lists the number of trucks replaced annually for each vehicle type based on all the authorizations filled. The total number of trucks the Air Force can expect to turnover annually after the first five years is 4,126 vehicles, equating to an overall replacement of 4,654 vehicles annually through GSA.

Table 11. Number of Vehicles Replaced Annually under GSA

	Amt Replaced		Amt Replaced
Sedans		**4X2 Trucks**	
Subcompact	5	Compact	864
Compact	359	Compact-Elec	11
Midsize	3	3500-4500GVW	10
Station Wagon	161	4600-5799GVW	502
		Multistop(B180)	649
4X4 Trucks		Multistop(F176)	5
Compact	22	Stake-7000GVW	252
3500 GVW	60	8000 GVW	17
4600-5799GVW	138	9-Pass Utility	14
6000 GVW	97	4-Door	352
7500 GVW	48	**Vans**	
9-Pass Utility	22	7-Pax	92
Dual Wheel	1 every 6 years	8-Pax	165
4-Door	479	9-Pax	18
Vans		15-Pax	116
Panel-7000GVW	1	Panel-6999GVW	195

The next GSA cost of leasing is the annual lease payments for leased vehicles. Appendix C and D identify the 1998 monthly lease payment for each vehicle type. To find the annual amount of lease payments, the monthly lease rate was multiplied by the number of authorizations times 12 months. The total amount of annual lease payments the Air Force can expect to pay is $31,008 for subcompact sedans, $2,567,568 for compact sedans, $31,044 for midsize sedans, and $1,625,400 for station wagons. The total annual lease payment for sedans equates to $4,255,020.

The computation for the annual lease payment of trucks follows the same procedure as sedans. Table 12, on the next page, lists the annual lease payments for each truck type. The total amount of lease payments the Air Force may realize annually for trucks/vans is $58,055,144 and $62,310,164 annually for all vehicle lease payments.

Note that the lease rates are the base rates reported by GSA for each truck type. The rate does not include accessories such as power lift gates and snowplows. Adding accessories offered by GSA will increase the monthly lease rate and thus increase the total cost of GSA leasing. Also included in the analysis is the $22,450 incremental cost for each electric compact 4X2 pickup truck replaced annually.

Table 12. Total Annual Lease Payments for Trucks/Vans

	Lease Payment		Lease Payment
4X2 Trucks		**4X4 Trucks**	
Compact	$10,260,360	Compact	$284,616
Compact-Elec	$139,092	3500 GVW	$837,720
3500-4500GVW	$133,920	4600-5799GVW	$1,801,800
4600-5799GVW	$6,146,520	6000 GVW	$1,563,300
Multistop(B180)	$10,557,816	7500 GVW	$926,640
Multistop(F176)	$73,224	9-Pass Utility	$353,700
Stake-7000GVW	$3,603,492	Dual Wheel	$2,616
8000 GVW	$212,100	4-Door	$7,521,000
9-Pass Utility	$196,560	**Vans**	
4-Door	$4,939,740	7-Pax	$1,229,880
Vans		8-Pax	$2,371,200
Panel-7000GVW	$8,460	9-Pax	$254,400
Panel-6999GVW	$2,705,088	15-Pax	$1,881,900

The annual mileage charge is simply the total mileage the Air Force could realize with all the vehicle authorizations filled multiplied by the mileage rate charged by GSA. Similar to the lease rates, the GSA mileage rates used in this analysis are the 1998 rates published on the GSA homepage. The annual mileage charge the Air Force could expect to pay for sedans is as follows: $28,833 for subcompact, $884,863 for compact, $11,661 for midsize, and $403,061 for station wagons. As described in Chapter 3, the mileage

rate for large sedans is not applicable in the GSA cost of leasing model since GSA does not lease large sedans to the services. The total mileage charge to the Air Force for sedans equals $1,328,418 annually.

Because of the large number of vehicle types that comprise the truck category, Table 13 is included to display the total annual mileage cost for each truck vehicle type. The Air Force's bill for the trucks' annual mileage charge under GSA could reach $24,829,754. The Air Force could expect to pay $26,158,172 annually in mileage fees for all its vehicles leased through GSA.

Table 13. Total Annual Mileage Charge for Trucks/Vans

	Mileage Charge		Mileage Charge
4X2 Trucks		**4X4 Trucks**	
Compact	$3,613,512	Compact	$128,298
Compact-Elec	$46,720	3500 GVW	$464,646
3500-4500GVW	$51,651	4600-5799GVW	$1,107,686
4600-5799GVW	$2,417,119	6000 GVW	$829,221
Multistop(B180)	$4,084,030	7500 GVW	$422,398
Multistop(F176)	$28,325	9-Pass Utility	$187,613
Stake-7000GVW	$1,489,926	Dual Wheel	$1,522
8000 GVW	$99,723	4-Door	$4,374,801
9-Pass Utility	$80,346	**Vans**	
4-Door	$2,084,317	7-Pax	$461,529
Vans		8-Pax	$945,027
Panel-7000GVW	$4,565	9-Pax	$101,390
Panel-6999GVW	$1,117,198	15-Pax	$688,190

Assuming that GSA will adhere to its 20 percent annual replacement rule starting at the beginning of conversion, Appendices C and D illustrate the cost of leasing vehicles already bought for the first four years of leasing. After the fourth year, GSA should have

all the vehicles replaced. The total cost of leasing sedans already owned for the next 4 years is as follows: subcompact - $119,682, compact - $5,382,926, midsize - $85,388, and station wagons - $3,100,286. This equates to a total avoidable cost of $8,688,282 to the Air Force for leasing sedans from GSA that were previously purchased. The total avoidable cost for leasing trucks from GSA that were previously owned by the Air Force amounts to $165,669,796 over the next four years.

As described in Chapter 3, the vehicle possession cost to the Air Force is the estimated salvage value of the current vehicle fleet. Vehicle possession by GSA represents a cost to the Air Force, and is therefore included in the GSA cost of leasing model as a cost of converting the current Air Force vehicle fleet to all GSA leasing. The vehicle possession cost signifies the single largest cost to the Air Force for converting to GSA leasing. The Air Force will loose approximately $169,312 worth of subcompact sedans, $8,803,014 worth of compact sedans, $69,645 worth of midsize sedans, and $6,933,851 worth of station wagons, totaling to an estimated $15,975,822 worth of sedans given to GSA. These numbers are based on assigned vehicles because these costs represent actual vehicles the Air Force currently possesses.

As with the other costs associated with truck types, Table 14 on the next page lists the vehicle possession costs for each truck type in the analysis. The estimated vehicle possession cost to the Air Force for the truck category equals $232,345,502, and the overall total cost to the Air Force amounts to $248,321,324 for all the Air Force vehicles in this analysis.

Table 14. Vehicle Possession Cost for Trucks/Vans

	Veh Possession		Veh Possession
4X2 Trucks		**4X4 Trucks**	
Compact	$27,470,132	Compact	$881,291
Compact-Elec	$1,055,166	3500 GVW	$1,803,855
3500-4500GVW	$836,506	4600-5799GVW	$6,460,000
4600-5799GVW	$25,557,154	6000 GVW	$8,494,682
Multistop(B180)	$51,027,732	7500 GVW	$4,963,963
Multistop(F176)	$2,140,458	9-Pass Utility	$300,570
Stake-7000GVW	$13,127,488	Dual Wheel	$14,784
8000 GVW	$1,142,582	4-Door	$32,924,982
9-Pass Utility	$542,132	**Vans**	
4-Door	$20,739,745	7-Pax	$4,523,126
Vans		8-Pax	$9,084,748
Panel-7000GVW	$0	9-Pax	$3,752,416
Panel-6999GVW	$9,965,734	15-Pax	$5,536,256

The final cost of GSA leasing is the vehicle refurbishment cost. As the vehicle possession costs, the refurbishment cost is based on the number of vehicles assigned (on hand) since these are the only vehicles that will accrue refurbishment costs. This is the cost charged by GSA for repairing the Air Force vehicles before selling the vehicles on the open market to generate funds for further purchases. Using an estimate provided by HQ USAF/ILTV of $250 per vehicle, the Air Force can expect to be charged $4,000 for subcompact sedans, $291,750 for compact sedans, $2,250 for midsize sedans, and $169,750 for station wagons, equating to a total refurbishment cost of $467,750 for sedans.

The truck refurbishment costs, Table 15, range from a low of $250 for the dual wheel truck to a high of $1,136,750 for 4X2 compact pickup trucks. Since the Air Force does not currently have any 4X4 7,000 GVW panel vans on hand, there are no

refurbishment costs for this vehicle type. The total costs for truck refurbishment approximate to $5,188,500. The total overall cost of refurbishment for this study is $5,656,250.

Table 15. Vehicle Refurbishment Cost for Trucks/Vans

	Veh Refurbish		Veh Refurbish
4X2 Trucks		**4X4 Trucks**	
Compact	$1,136,750	Compact	$30,250
Compact-Elec	$14,000	3500 GVW	$36,750
3500-4500GVW	$23,500	4600-5799GVW	$161,500
4600-5799GVW	$685,500	6000 GVW	$148,000
Multistop(B180)	$906,000	7500 GVW	$87,500
Multistop(F176)	$32,750	9-Pass Utility	$5,250
Stake-7000GVW	$352,000	Dual Wheel	$250
8000 GVW	$21,250	4-Door	$679,000
9-Pass Utility	$9,500	**Vans**	
4-Door	$9,500	7-Pax	$109,000
Vans		8-Pax	$235,000
Panel-7000GVW	$0	9-Pax	$72,750
Panel-6999GVW	$290,250	15-Pax	$142,250

The total cost of leasing different vehicle types through GSA for the next eight years is displayed in Table 16 at the top of page 58. The total cost of leasing sedans through GSA for the next eight years equates to $63,442,828, which represents a $21,563,430 cost increase over the next eight years to the Air Force by leasing with GSA rather than owning the vehicles. Because of the inclusion of the vehicle possession charge and vehicle refurbishment cost, the first year of leasing sedans through GSA is significantly higher than ownership; however, after the first year, the cost of leasing through GSA becomes only slightly more than the cost of ownership over an eight-year

period. After the initial costs associated with GSA leasing (vehicle possession and refurbishment costs) are paid for in the first year, the cost increase of GSA leasing over Air Force ownership may increase to over $1.38 million over an eight-year time period beginning in year two.

Since the Air Force owns and uses more trucks than sedans, the differences in costs are more substantial in the truck category. The total cost of leasing trucks and vans under GSA for the next eight years amounts to $970,298,769. With this large amount, GSA leasing of trucks represents an increase of $308,897,137 over the current method of ownership. The GSA leasing cost increase, as in the case of the sedans, includes the first year initial costs of vehicle possession charge and refurbishment cost. For the next eight years starting in year two, the Air Force can realize a cost increase of $16,663,010 through GSA leasing over ownership.

The overall cost of GSA leasing over eight years equates to $1,033,741,597. The combined increase of GSA leasing over ownership figures to be $330,442,567 with the first year initial costs added in and approximately $18 million without the first year initial costs over an eight-year period. Analyzing the data at the vehicle type level without the first year costs, some vehicle types cost less to own than lease through GSA. Specifically, compact sedans, midsize sedans, station wagons, 4X2 compact trucks (including electric), stakebed trucks, compact 4X4 trucks, 7500GVW trucks, and all vans except the 7-passenger and 9-passenger vans all cost less to own than lease through GSA; however, as stated in the first chapter, this analysis assumes that the Air Force will only select one overall procurement method and not a mix of the different methods.

Table 16. Total Cost of GSA Leasing for Eight Years for Each Vehicle Type

	Total Costs		Total Costs
Sedans		**4X2 Trucks**	
Subcompact	$701,190	Compact	$151,330,255
Compact	$38,196,930	Compact-Elec	$4,673,063
Midsize	$450,097	3500-4500GVW	$2,487,599
Station Wagon	$24,094,611	4600-5799GVW	$101,743,529
		Multistop(B180)	$180,817,027
4X4 Trucks		Multistop(F176)	$3,014,275
Compact	$4,562,283	Stake-7000GVW	$58,447,351
3500 GVW	$13,385,483	8000 GVW	$3,906,939
4600-5799GVW	$32,339,660	9-Pass Utility	$3,001,609
6000 GVW	$29,698,033	4-Door	$82,699,062
7500 GVW	$16,918,462	**Vans**	
9-Pass Utility	$5,117,686	7-Pax	$19,560,398
Dual Wheel	$51,446	8-Pax	$38,581,630
4-Door	$138,565,696	9-Pax	$6,882,310
Vans		15-Pax	$28,401,570
Panel-7000GVW	$115,997	Panel-6999GVW	$43,997,407

Benefits of GSA Leasing

Now that the total cost of GSA leasing is computed, the question is what are the benefits of GSA leasing. One touted benefit of leasing is the relatively newer age of vehicles comprising the vehicle inventory. Just based on the replacement times, the average age of the sedan fleet under GSA should be more or less two years old, and approximately three years old for the trucks. The Air Force general purpose vehicle fleet's average age is significantly higher than the GSA average would be and is forecasted to continue to increase in the near future. With newer vehicles, there are fewer repairs and less down time for repairs, resulting in higher vehicle-in-commission rates and increased customer utilization. With higher vehicle reliability, the Air Force may be

able to reduce the number of vehicle authorizations throughout the CONUS, thus lowering vehicle costs even further.

One of the largest benefits of leasing is the relative stability of the budgeting process. With leasing, the amount of money needed each year, after adjusting for inflation, is virtually known with certainty. With ownership, there are peaks and valleys in costs associated with not only buying vehicles, but also with the costs associated with maintaining those vehicles. Leasing will allow the Air Force to accurately plan the vehicle budget for each year with relative ease. With a known annual budget amount, the Air Force may have an easier time getting congressional approval of the vehicle budget instead of the current method of programming for large amounts in some years and lesser amounts in other years. After a few budgetary cycles, the vehicle-leasing budget may become a non-issue in the budget process because of its relative stability over time and thus become funded with little or no debate on the issue.

By leasing vehicles through GSA, the Air Force can reduce its direct maintenance costs and part of its indirect costs associated with vehicle maintenance. Without owning vehicles, the Air Force will need very few general purpose vehicle mechanics. The only general purpose mechanics the Air Force would need is personnel at the MAJCOM level or higher as experts to oversee the leasing program. All the other direct costs would be eliminated by CONUS-wide GSA leasing. The Air Force would no longer need general purpose vehicles at the base level any longer nor would it need to buy vehicle parts for the general purpose fleet. The Air Force could eliminate all costs tied directly to the general purpose fleet.

The Air Force could possibly eliminate some of its indirect costs by leasing its general purpose fleet. This analysis assumes at the onset that 50 percent of the costs could be eliminated by converting the vehicle fleet to GSA; however, the 50 percent estimate is more than likely optimistic. The sensitivity analysis section addresses the percentage issue for indirect costs, but arguably, the Air Force could reduce some of its indirect costs tied to GSA leasing, thus becoming a benefit of leasing. Leasing does present the Air Force with options for reducing its vehicle overhead through facility closings, personnel reductions, reduced vehicle authorizations, etc.

An additional benefit numerous corporations have identified from leasing is the alleviation of environmental concerns associated with ownership. With ownership, the Air Force has to maintain not only the hazardous materials associated with upkeep of a vehicle fleet, but also the amount of training required for educating mechanics on proper handling and disposal of hazardous materials and waste. There are also the costs associated with purchasing equipment to comply with EPA requirements along with the periodic inspections that occur at vehicle maintenance facilities throughout the Air Force. With leasing, the environmental concern shifts from the bases to the lessors. This saves time and money spent on environmental compliance and allows those resources to be reallocated elsewhere in the Air Force.

Commercial Cost of Leasing

The amount of vehicles replaced annually under commercial leasing is computed in the same manner as the cost of ownership model and GSA cost of leasing model, by dividing the number of authorizations for each vehicle type by the replacement time in

years. Under commercial leasing, the lessor would replace six subcompact sedans, 479 compact sedans, four midsize sedans, and 215 station wagons annually. This amounts to 704 sedans turning over each year. Table 17 and Appendix E and F identify the number of trucks and vans that commercial leasing will replace annually for each vehicle type. Each year, commercial lessors would replace a total of 8,251 trucks and vans.

Table 17. Number of Vehicles Replaced Annually under Commercial Lease

	Amt Replaced		Amt Replaced
Sedans		**4X2 Trucks**	
Subcompact	6	Compact	1727
Compact	479	Compact-Elec	22
Midsize	4	3500-4500GVW	21
Station Wagon	215	4600-5799GVW	1004
		Multistop(B180)	1298
4X4 Trucks		Multistop(F176)	9
Compact	45	Stake-7000GVW	503
3500 GVW	119	8000 GVW	34
4600-5799GVW	275	9-Pass Utility	28
6000 GVW	193	4-Door	704
7500 GVW	95	**Vans**	
9-Pass Utility	44	7-Pax	185
Dual Wheel	1 every 3 years	8-Pax	329
4-Door	958	9-Pax	35
Vans		15-Pax	232
Panel-7000GVW	1	Panel-6999GVW	389

The annual mileage was already computed in the cost of ownership model, but is used in the cost of commercial leasing model to determine what mileage plan would fit the respective vehicle type. All vehicle categories would fit the 12,000-mileage cap except for the subcompact sedans. The subcompact sedans averaged 15,974 miles per vehicle last year; therefore, a 16,000-mile lease is used for the subcompact sedans. All of

other vehicle types' mileage fell within the 12,000-mile lease; therefore, this analysis uses the 12,000-mile cap.

The annual lease payments are found by multiplying the lease rate by the number of authorizations. The annual lease payment for subcompact sedans is $394,073, $24,375,942 for compact sedans, $267,871 for midsize sedans, and $14,010,290 for station wagons. This equates to total lease payments of $6,578,652 over eight years for sedans. Table 18 identifies the annual lease payments for each of the truck types under analysis. The total lease payments for commercially leased trucks over the next eight years is $100,305,179, resulting in $106,883,831 in total commercial lease payments the Air Force could expect to pay over the next eight years.

Table 18. Total Annual Lease Payments for Trucks/Vans

	Lease Payment		Lease Payment
4X2 Trucks		**4X4 Trucks**	
Compact	$11,244,133	Compact	$377,120
Compact-Elec	$453,406	3500 GVW	$1,715,704
3500-4500GVW	$215,479	4600-5799GVW	$3,031,578
4600-5799GVW	$10,967,893	6000 GVW	$3,244,724
Multistop(B180)	$21,408,226	7500 GVW	$1,584,173
Multistop(F176)	$172,295	9-Pass Utility	$564,816
Stake-7000GVW	$5,494,752	Dual Wheel	$5,774
8000 GVW	$498,889	4-Door	$15,266,157
9-Pass Utility	$361,001	**Vans**	
4-Door	$10,180,484	7-Pax	$2,250,431
Vans		8-Pax	$3,973,766
Panel-7000GVW	$8,972	9-Pax	$582,760
Panel-6999GVW	$3,811,206	15-Pax	$2,891,437

The next variable is the annual maintenance cost. If the Air Force commercially leased its fleet, it would only need to get the required scheduled maintenance on its vehicles, i.e., oil changes. The number of oil changes needed annually for each vehicle type is four (based on a 3,000 mile or 3 month oil change requirement) except for the subcompact sedans, which require five because of the amount of annual miles acquired. The number of oil changes for each vehicle type was multiplied by the number of authorizations and $20 for each oil change. Table 19 displays the results by vehicle type. The total bill for scheduled maintenance will run approximately $2,144,380 each year ($1,974,960 for trucks and vans and $169,420 for sedans).

Table 19. Scheduled Maintenance Cost

	Maint Costs		Maint Costs
Sedans		**4X2 Trucks**	
Subcompact	$1,900	Compact	$414,560
Compact	$114,880	Compact-Elec	$0
Midsize	$1,040	3500-4500GVW	$4,960
Station Wagon	$51,600	4600-5799GVW	$241,040
		Multistop(B180)	$311,440
4X4 Trucks		Multistop(F176)	$2,160
Compact	$10,720	Stake-7000GVW	$120,720
3500 GVW	$28,640	8000 GVW	$8,080
4600-5799GVW	$66,000	9-Pass Utility	$6,720
6000 GVW	$46,320	4-Door	$168,880
7500 GVW	$22,880	**Vans**	
9-Pass Utility	$10,480	7-Pax	$44,320
Dual Wheel	$80	8-Pax	$79,040
4-Door	$230,000	9-Pax	$8,480
Vans		15-Pax	$55,760
Panel-7000GVW	$240	Panel-6999GVW	$93,440

The annual acquisition cost (money required at the time of acceptance of the vehicles) included in the commercial cost of leasing model for each sedan type is as follows: $5,383 for subcompact sedans, $392,028 for compact sedans, $3,679 for midsize sedans, and $204,250 for station wagons. Appendix D identifies the acquisition cost for each of the truck types. The total acquisition cost for commercial leasing is $8,342,395 ($605,340 for sedans and $7,737,055 for trucks) annually.

One of the final variables in the commercial cost of leasing model is the fuel cost, since it is not included in the monthly lease rate. The fuel costs reported by the commercial cost of leasing model are the same as the fuel cost reported by the cost of ownership model and identified in Table 8 on page 46. The fuel cost the Air Force could expect to pay for sedans equates to $360,656 and $8,131,391 for trucks and vans annually, representing $8,492,047 in total fuel cost to the Air Force.

The last item on the commercial cost of leasing model is the salvage value of the vehicle fleet. This value is the same value reported on the GSA cost of leasing model as vehicle possession cost (Table 14 on page 55) since the value represents what the current Air Force fleet may be worth today if sold on the market. The inclusion of the salvage value assumes that the Air Force would be permitted to send its vehicles to GSA for auctioning and not to DRMO. The salvage value is subtracted off of the first year's cost of commercial leasing. The Air Force sedans would have an approximate salvage value of $15,975,822, and the trucks would have an approximate salvage value of $232,345,502, for an overall salvage value of $248,321,324.

The total costs for commercial leasing for each vehicle type is listed in Table 20 at the top of the next page, which is computed by adding the annual lease payments, the scheduled maintenance costs, the acquisition costs, and the fuel costs together, followed by subtracting the salvage value of the fleet in the first year. The total cost for leasing sedans commercially equates to $38,174,565 over the next eight years. To determine what the commercial cost of leasing would be after selling the current Air Force fleet, delete the salvage value off of the present value calculation, which results in a total cost of leasing commercial sedans after year one of $54,150,387 over eight years.

The total cost for commercially leasing trucks and vans for the next eight years could cost the Air Force approximately $597,021,198—an eight-year savings of $373,277,571 over GSA leasing and $64,380,434 over ownership. Deleting the effects of the first year's salvage value, leasing trucks and vans commercially over eight years could cost the Air Force $829,366,700, which creates an eight-year cost increase over ownership to $167,965,068 and causes commercial leasing to cost $151,302,058 more than GSA leasing.

The commercial cost of leasing for all vehicles under analysis for the first eight years adds to $635,195,763—a savings of $398,545,834 over GSA leasing and $68,085,267 over ownership. Negating the salvage value, commercial leasing of vehicles would cost the Air Force $180,236,057 more than ownership over an eight-year period, and commercial leasing would cost $108,042,087 more than GSA leasing.

Table 20. Total Cost of Commercial Leasing for Eight Years for Each Vehicle Type

	Total Costs		Total Costs
Sedans		**4X2 Trucks**	
Subcompact	$394,073	Compact	$71,566,232
Compact	$22,843,739	Compact-Elec	$2,322,784
Midsize	$247,308	3500-4500GVW	$979,325
Station Wagon	$14,689,445	4600-5799GVW	$66,266,984
		Multistop(B180)	$119,827,686
4X4 Trucks		Multistop(F176)	$-783,648
Compact	$2,312,083	Stake-7000GVW	$32,873,068
3500 GVW	$12,478,412	8000 GVW	$2,882,271
4600-5799GVW	$19,799,603	9-Pass Utility	$2,416,281
6000 GVW	$17,994,364	4-Door	$61,603,214
7500 GVW	$7,986,427	**Vans**	
9-Pass Utility	$4,471,113	7-Pax	$14,047,114
Dual Wheel	$32,192	8-Pax	$23,747,319
4-Door	$92,506,078	9-Pax	$898,606
Vans		15-Pax	$18,261,119
Panel-7000GVW	$80,683	Panel-6999GVW	$22,451,888

Benefits of Commercial Leasing

Several of the benefits of commercial leasing are similar to GSA leasing such as reduced direct maintenance costs, reduced indirect maintenance costs, and alleviation of environmental concerns. However, commercial leasing does provide benefits over GSA leasing such as market competition. If the Air Force leases vehicles through GSA, this puts GSA into a monopolistic position, placing the Air Force at a disadvantage in terms of bargaining power. GSA will be able to set the price for leasing, and the Air Force will have little or no input into the price. Commercial leasing provides benefits to the Air Force over GSA leasing because commercial leasing presents a better alternative in the area of competition. Assuming no single company in the U.S. could handle the volume of vehicles under this analysis, multiple leasing sources would be required to fulfill the

Air Force's vehicle needs. With commercial leasing, the Air Force could set up commercial leasing zones similar to the way Tricare is organized with different providers in different regions. Different leasing companies would handle the vehicle requirements for different areas of the CONUS. With the number of commercial lessors in existence, the Air Force could negotiate a fair and reasonable price as well as placing itself in a favorable bargaining position. Using this type of arrangement could help the Air Force to keep the vehicle leasing prices under control.

Another benefit is that commercial leasing will result in a lower average age fleet than either GSA leasing or ownership. The average age of the vehicle fleet under commercial leasing should be approximately 1½ years old. Because the Air Force purchases its own fuel under commercial leasing, this younger age will translate into better fuel economy to the Air Force, saving fuel costs each year. A younger average age may also translate into fewer repairs to the vehicles than GSA leasing, especially for the trucks and vans.

Because the Air Force will only have each commercial vehicle for a maximum of three years, the Air Force will not need to purchase a vehicle maintenance policy, an additional benefit of commercial leasing, with the leased vehicles because all vehicles produced today carry at least a 3-year/36,000-mile bumper-to-bumper warranty. Under GSA leasing, part of the mileage fee includes money for future vehicle repairs.

Finally, with commercial leasing, the Air Force will have more flexibility to choose the vehicles it desires in its vehicle fleet. With GSA leasing, the Air Force receives the vehicles GSA has chosen. Part of the negotiating process with commercial

lessors could entail specifying specific vehicle makes for the vehicle fleet, providing the Air Force with more of a vehicle choice than available through GSA.

Sensitivity Analysis

The goal of this section is to determine if the results of this analysis change with different values for various key components used in the cost models. One value that certainly varies over time is the inflation rate, as measured by the GDP deflator. The inflation rate is key because it is used to calculate the cost of each course of action over an eight year period. Table 22 on page 76 lists the different costs for each model for the different values used in this section.

Changes in Inflation. To determine inflation's effect on the results, change the rate used to compute the present value of the eight years worth of payments to five percent. With a five percent GDP deflator rate, the overall cost of ownership for sedans sums to $38,559,449. The total cost for truck types is $608,969,646, resulting in a total ownership cost of $647,529,095. The GSA leasing cost, using the same five percent inflation rate, totals $59,781,003 for sedans and $913,876,317 for trucks. The total GSA leasing cost amounts to $973,657,320, a cost increase of $326,128,225 over ownership. With the same five percent inflation rate, the commercial leasing cost for sedans sum to $33,881,844 and $531,273,940 for trucks, resulting in a total commercial lease cost of $565,155,784. Commercial leasing over eight years with a five percent inflation rate would equate to a savings of $408,501,536 over GSA leasing and $82,373,311 over ownership.

To determine what the resulting difference would be without the first year's costs associated with either leasing option affecting the output, the overall costs are computed for eight years beginning in year two. With a five percent GDP deflator rate, the total cost of ownership over eight years for sedans starting in year two is $38,559,449 and $608,969,646 for trucks for a grand total of $647,529,095 for ownership. Using the same five percent GDP deflator rate, the total cost of GSA leasing starting in year two equals $40,055,383 for sedans and $628,874,531 for trucks, totaling to $668,929,914 for the same eight years—a cost increase of $21,400,819 over ownership. The commercial leasing cost equals $813,477,108 ($49,857,666 for sedans and $763,619,442 for trucks), covering the same time period and inflation rate—costing $165,948,013 more than ownership and costing $144,547,194 more than GSA leasing.

The next step is to determine what the costs of each option be if the U.S. experienced a large growth in inflation, a GDP deflator rate of 10 percent. With a 10 percent GDP deflator rate, the present value of the total cost of ownership for the next eight years for sedans is $31,828,105 and $502,661,484 for trucks, equating to a grand total cost of $534,489,589 to the Air Force. With the same 10 percent GDP deflator rate, the present value of GSA leasing cost for sedans figures to $52,200,166 and $796,907,843 for a total cost of GSA leasing over the next eight years of $849,108,009—a $314,618,420 increase over ownership; however, the GSA leasing cost has the added one-time, first year payments of vehicle possession cost and refurbishment cost. The commercial cost of leasing for the 10 percent inflation figure amounts to $25,178,165 for sedans and $397,968,480 for trucks—a present value total of $423,146,645 over the next

eight years. Commercial leasing results in cost savings of $425,961,364 over GSA leasing and $111,342,944 over ownership.

To negate the effect of the first year's one-time costs, the costs of each option are computed for years two through nine, using the 10 percent GDP deflator rate. The total cost of ownership remains at $534,489,589 over eight years, starting in year two; however, the total cost of GSA leasing changes. Starting in year two, the present value of the total cost of GSA leasing over eight years for sedans sum to $33,531,137 and $41,153,987 for commercial leasing. Over the same eight years, the total cost of leasing trucks through GSA equals $528,428,255 and $630,313,982 for commercial leasing, resulting in total costs of GSA leasing and commercial leasing of $561,959,392 and $671,467,969 respectively. With a 10 percent GDP deflator rate and after the first year, the difference between the cost of ownership and GSA leasing is $27,469,803 in favor of ownership. The difference between the cost of GSA leasing and commercial leasing is $109,508,577 in favor of GSA leasing. The result of this section indicates that as the GDP deflator rate (inflation rate) increases, the cost difference between ownership and GSA leasing increases, in favor of ownership.

Changes in Fuel Prices. One variable that certainly retains a lot of variability is fuel prices. Fuel prices are changing almost on a daily basis; therefore, this analysis seeks to ascertain how much of an effect fuel price has on the decision to lease or buy. The first fuel price used in the model is an increase to $1. Fuel price increases are only going to affect the cost of ownership and cost of commercial leasing in the short term. The GSA rate is a set rate for the year; however, prolonged fuel prices will have an affect

on the mileage rate GSA charges since this rate also includes fuel cost. The total cost of ownership for sedans increases to $42,220,017, and trucks increase to $670,565,166. This results in a total ownership cost over eight years of $712,785,183. Since the GSA rate will stay relatively the same, an increase in the price of a gallon of fuel to $1 will cause ownership to cost $320,956,414 less over eight years. Fuel costs also affect the commercial cost of leasing by increasing the cost of leasing commercially when the fuel prices increase. An increase in the price of fuel to $1 per gallon will result in a commercial leasing cost over eight years of $38,515,184 for sedans and $606,184,732 for trucks, raising the total commercial leasing cost to $644,699,916.

If the fuel price climbed to $2 a gallon, ownership will cost even more than GSA leasing, provided GSA does not raise their mileage rate in direct proportion to the fuel price increase. At $2 a gallon for fuel, the cost of ownership for sedans over eight years increases to $45,092,332, and trucks increase to $736,795,881 for a total cost of ownership of $781,888,213. Using the same $2 per gallon fuel price, the cost of commercial leasing increases the sedan cost to $41,387,499 and the truck cost to $672,415,446, equaling a total cost of commercial leasing of $713,802,945. The effect of raising the price of fuel to $2 per gallon will cause ownership and commercial leasing total costs over eight years to increase further, thus making GSA leasing a more attractive choice. These results demonstrate that the higher the price per gallon of fuel, the larger the cost difference between ownership/commercial leasing and GSA leasing, in favor of GSA leasing, negating the effect of GSA's first year costs.

Indirect Cost Changes. Indirect costs are one of the most difficult costs to account for when performing an analysis. The difficult part is in determining how much of the indirect cost should be included in the analysis. The data analysis above was performed with using an assumption that the Air Force could reduce 50 percent of its indirect costs, thus the amount the Air Force could reduce was included in the cost of ownership model. The question remains what if the Air Force could only reduce 40 percent, 30 percent, 20 percent, or less of its indirect costs. This section addresses what the cost of each option would be at various levels of indirect cost reduction. The GSA cost of leasing and commercial cost of leasing is unaffected by indirect costs; therefore the overall cost of GSA leasing remains the same, $1,033,741,597 and the overall cost of commercial leasing remains at $635,195,763. Table 21 identifies what the associated ownership costs would be for different levels of indirect cost. For the first eight years of this analysis, any level of avoidable indirect costs still equates ownership as the least expensive alternative over GSA leasing.

Table 21. Total Cost of Ownership for Different Levels of Indirect Cost

Indirect Cost %	Total Sedan Costs	Total Truck Costs	Total Cost
40 percent	$40,368,093	$642,898,265	$683,266,358
30 percent	$38,856,789	$624,394,899	$663,251,688
20 percent	$37,345,484	$605,891,532	$643,237,016
10 percent	$35,834,180	$587,388,165	$623,222,345
0 percent	$34,322,875	$568,884,798	$603,207,673

Comparing the GSA leasing cost for eight years starting in year two, the results are different when comparing the models based on indirect cost. By studying the costs beginning in year two over eight years, GSA's total leasing cost of $721,324,613 is higher than the ownership cost at any level of avoidable indirect cost under 50 percent; however, if the Air Force could eliminate 60 percent or more of its indirect cost associated with ownership, then GSA leasing becomes the least expensive option. Using the same eight-year period starting in year two for commercial leasing, commercial leasing total cost of $883,517,087 is significantly higher than the total ownership cost at any reasonable level of indirect cost.

Mileage Increase to 12,000 Miles. The fourth area addressed in the sensitivity section is the costs associated with an increase in the utilization of Air Force vehicles to 12,000 miles annually. The reason for this mileage is the 12,000-mile mark represents the national average of vehicle use. The 12,000-mile figure is also used as the basis for the commercial lease rates. Because of the mileage increase to 12,000 miles, the fuel cost in the cost of ownership model increases proportionately. The cost of ownership for sedans rises to a total of $43,975,669 over eight years, and the total cost for owning trucks would be $700,004,817. This equates to a total cost of ownership for 12,000 miles of $743,980,486.

Based on the same 12,000-mile annual utilization, the GSA cost of leasing for sedans increases to $74,302,936 over the same eight-year period. The cost of leasing trucks through GSA sums to $1,148,872,060 over eight years, amounting to a total GSA cost of leasing of $1,223,174,996 for eight years. This represents an increase over

ownership of $479,194,510 over the eight-year period. To offset the effects of the large first year costs, the GSA cost of leasing model is used for the next eight years, starting in year two. The cost of leasing sedans through GSA decreases to $53,213,510 over eight years, and the leasing cost for trucks decrease to $841,731,203 for the same time period. The total cost of leasing through GSA measures to $894,944,713 for an eight year period starting in year two, a $150,964,227 increase over ownership.

As with the cost of ownership model, increasing the annual mileage to 12,000 miles causes only the fuel cost reported by the commercial cost of leasing model to increase because the Air Force would consume more fuel with the mileage increase. The commercial leases would already allow up to 12,000 miles annually, except for the 16,000-mile lease with subcompact sedans; therefore, there is no additional cost increase in the commercial leasing model, except for fuel. The commercial cost of leasing for sedans rises to $40,444,086 and trucks would increase to $642,930,662, resulting in a total commercial lease cost of $683,374,748, which is $539,800,248 less than GSA leasing and $60,605,738 less than ownership. After negating the first year's salvage value, commercial leasing's total cost of $931,696,072 is $187,715,586 more than ownership and $36,751,359 more than GSA leasing over an eight-year period.

Salvage Value Omission. The last value covered in the sensitivity analysis section is the salvage value. Specifically, what the costs of each model sum to using the current method of vehicle salvage, sending the vehicles to DRMO and receiving no money back into the vehicle budget from the DRMO sale. Removing the salvage value from the sedan portion of the cost of ownership model, the cost to the Air Force over the

next eight years increases to $52,433,383. After removing the truck salvage values, the cost of owning trucks in the Air Force climbs to $779,034,646. The total Air Force cost for owning the general purpose vehicles under analysis over eight years sums to $831,468,029. This amount represents a $202,273,568 decrease over GSA leasing for eight years. When the first-year costs of GSA leasing are removed, Air Force ownership of vehicles becomes $110,143,416 more expensive than GSA leasing over eight years.

Eliminating the salvage value in the commercial cost of leasing model, the total cost of leasing for eight years equates to $54,150,387 for sedans and $829,366,700 for leasing trucks. The total cost of commercial leasing, $883,517,087, is $162,192,474 higher than GSA leasing (after omission of GSA's first year's costs) and $52,049,058 higher than ownership without the salvage value included.

By allowing DRMO to sell Air Force vehicles at the end of the vehicles' life expectancy rather than selling the same vehicles through commercial auctions, the Air Force is raising its vehicle ownership costs by as much as $128,187,015 over eight years. This figure represents what the Air Force could possibly receive over eight years by sending its vehicles to GSA for auctioning in the commercial sector. The bottom line is the Air Force could make ownership more advantageous if it sent its vehicles to commercial auction at the end of the vehicles' life expectancy rather than sending the vehicles to DRMO.

Because of the vast amount of information and data presented in this chapter, table 22 at the top of the next page is included as a summary of the various cost

comparisons performed. The table allows for quick references of different conditions and what the corresponding costs sum to for cost model.

Table 22. Summary Cost Table

	Ownership w/ Salvage Value	Ownership w/o Salvage Value	GSA w/ 1st Year Cost	GSA w/o 1st Year Cost	Commercial Lease w/ Salvage Value	Commercial Lease w/o Salvage Value
Total Costs:						
Overall	$703,281,030	$831,468,029	$1,033,741,597	$721,324,613	$635,195,763	$883,517,087
5% Inflation	$647,529,095	$765,554,191	$973,657,320	$668,929,914	$565,155,784	$813,477,108
10% Inflation	$534,489,589	$631,910,980	$849,108,009	$561,959,392	$423,146,645	$671,467,969
$1/gallon fuel	$712,785,183	$840,972,182	$1,033,741,597	$721,324,613	$644,699,916	$893,021,240
$2/gallon fuel	$781,888,213	$910,075,212	$1,033,741,597	$721,324,613	$713,802,945	$962,124,269
40% Indirect Cost	$683,266,358	$811,453,357	$1,033,741,597	$721,324,613	$635,195,763	$883,517,087
30% Indirect Cost	$663,251,688	$791,438,687	$1,033,741,597	$721,324,613	$635,195,763	$883,517,087
20% Indirect Cost	$643,237,016	$771,424,015	$1,033,741,597	$721,324,613	$635,195,763	$883,517,087
10% Indirect Cost	$623,222,345	$751,409,344	$1,033,741,597	$721,324,613	$635,195,763	$883,517,087
0% Indirect Cost	$603,207,673	$731,394,672	$1,033,741,597	$721,324,613	$635,195,763	$883,517,087
12,000 miles	$743,980,486	$872,167,485	$1,223,174,996	$894,944,713	$683,374,748	$931,696,072
Omission of Salvage Value	$831,468,029	-	-	$721,324,613	-	$883,517,087

Conclusion

This chapter discussed the findings and analysis of each of the three vehicle procurement options available to the Air Force, employing the methodology outlined in Chapter 3. Each option's costs were computed and explained along with an explanation of the benefits associated with each option. By providing the costs and benefits for each option, decision-makers can make greater informed decisions. Each option's total costs were compared to determine which option provided the lowest cost to the Air Force. Finally, this chapter performed a sensitivity analysis on each of the cost models to determine if varying certain key variables had a significant effect on the analysis.

V. Conclusions and Recommendations

Research Conclusions

This section links the findings and analysis of the research data to the research questions posed in Chapter 1. To help answer the research question of which of the three options is the most efficient and effective method of procuring general purpose vehicles raised in Chapter 1, this research identified the costs and benefits associated with ownership, GSA leasing, and commercial leasing and how sensitive the models are to various inputs.

Costs and Benefits. The present value of the total cost to the Air Force by owning its vehicles equals $703,281,030 over eight years--$41,879,398 for sedans and $661,401,632 for trucks. Air Force ownership in this analysis proved to be the least costliest of all three options, even when the front-loaded costs associated with leasing were removed from the analysis. Some of the benefits the Air Force receives through ownership are flexibility in vehicle use, the continued need to deploy a WRM fleet, state-side bases for general purpose mechanics to rotate back to and from overseas locations, and a possible lower per vehicle cost on high mileage vehicles such as police sedans.

The cost of leasing general purpose vehicles through GSA sums to a present value of $63,442,828 for sedans and $970,298,769 for trucks. This equates to a total cost of $1,033,741,597 over the first eight years of leasing. Because of the large amount of costs associated with GSA leasing in the first year of leasing, the cost of GSA leasing was computed for eight years starting in year two. The present value of the total cost of GSA leasing becomes $721,324,613 over eight years. This proved to be the second least costly

option for the Air Force in the long run over an eight-year period. The benefits associated with GSA leasing include a newer vehicle fleet, budgetary stability, potential elimination of direct and indirect maintenance costs, and elimination of environmental concerns associated with general purpose vehicle work.

For the first eight years after converting to a commercially leased fleet, the Air Force may pay $38,174,565 for leasing sedans and $597,021,198 for leasing the truck types. The $635,195,763 cost of commercial leasing appears to be the largest bargain for the Air Force; however, the salvage value of the current vehicle fleet used in the commercial cost of leasing model masks the true cost. After eliminating the salvage value of the vehicle fleet from the commercial cost of leasing model, the cost of leasing general purpose vehicles commercially increases to $883,517,087--$54,150,387 for sedans and $829,366,700 for trucks, which keeps commercial leasing as the most expensive option of the three. The benefits associated with commercial leasing include benefits similar to GSA leasing such as reduced or eliminated direct maintenance costs, reduced indirect costs, and elimination of environmental concerns in the area of general purpose vehicle repair. Some additional benefits of commercial leasing include the Air Force not being placed in a monopolistic situation with only one vehicle provider (i.e., GSA), an even newer vehicle fleet than GSA, no funds expended for vehicle maintenance except for scheduled oil changes, and vehicle flexibility.

Most Efficient and Effective Method of Procurement. After considering the costs and benefits of each vehicle procurement method, the conclusion of this analysis is GSA leasing is the best method of procurement for the Air Force. One of the main

reasons for this conclusion is the overall cost. After payment of the large amount of up-front costs associated with GSA leasing such as vehicle refurbishment costs and vehicle possession costs, GSA leasing will provide the least expensive alternative over the long term. This is especially true because the Air Force does not auction off its vehicles at commercial auctions once the vehicles have reached their life expectancy, meaning the Air Force considers the salvage value of its vehicles as zero. If the Air Force were able to auction off the vehicles at commercial auctions, ownership would become the least expensive alternative. After the first year's cost are paid, GSA leasing could save the Air Force approximately $110 million over ownership for an eight-year period and over $162 million over commercial leasing for the same eight-year period. These savings make GSA leasing the most efficient of the three means of procuring vehicles.

Another main reason for concluding GSA as the best vehicle procurement method is the budget stability afforded by GSA leasing. As opposed to ownership with peaks and valleys in funding requests, GSA lease funding will remain relatively stable over time with adjustments for inflation. After some time, the vehicle funding part of the Air Force budget could become a non-player in the budgetary process in that the money will be allocated with little or no justification required. Budget officials will have a good idea what to expect each year for the vehicle budget.

The final reason for this research's conclusion is the newer age of the vehicle fleet. Through GSA leasing, the Air Force could attain a younger fleet than is possible through ownership, providing GSA replaces the vehicles as scheduled by their directives.

Any delay by GSA in replacing vehicles would negate this effect, especially for the trucks.

Model Sensitivity. The last area addressed in this analysis is model sensitivity to changes in the values for inflation, fuel cost, indirect cost, increase in mileage utilization, and omission of the vehicle salvage value. After varying each of the different values, this analysis reached the conclusion that ownership was the least expensive alternative except for the omission of the salvage value. Omitting the salvage value demonstrated that GSA leasing was the preferred method of vehicle procurement. Because the Air Force omits the salvage value by sending its vehicles to DRMO, this value became the determinant that GSA was the least costly alternative. Increasing the inflation rate as high as 50 percent proved ownership was still the least costly alternative. Fuel prices further increased the cost of ownership and commercial leasing since the Air Force would be responsible for purchasing the fuel under each alternative; however, fuel prices would have to rise dramatically with no corresponding increase in the GSA mileage rate before GSA becomes the better alternative. The amount of avoidable indirect cost was determined to have to reach a level of greater than 60 percent before GSA leasing costs less than ownership. Increasing the mileage utilization increased the cost of GSA leasing more than the other two options, and increased the cost difference between GSA leasing and ownership, in favor of ownership. Finally, omitting the salvage value increased both the cost of ownership and cost of commercial leasing, and made GSA leasing the more attractive option.

Research Recommendations

This research recommends the Air Force pursue converting its general purpose fleet to a GSA leased fleet. By converting the vehicle fleet to GSA leasing, valuable funding could be freed up for use in other programs within the Air Force. This research further recommends that the Air Force develop and utilize a specific code for money programmed for GSA leasing instead of including it in bases' general operations and maintenance (O&M) budget to prevent vehicle money being used for purposes other than paying for the leased vehicles.

This research further recommends the Air Force start reducing all of its direct maintenance cost while converting the vehicle fleet to GSA. This will require downsizing the 2T3X4 career field to only the levels required to support overseas bases and contingencies. One possible means of retaining some general purpose mechanics would be cross-training general purpose mechanics into the other mechanic career fields such as special purpose mechanics. The Air Force could actually realize a 100 percent manning level in some critical 2T3XX AFSCs such as special purpose, fire truck, and refueling mechanics.

If the Air Force wishes to pursue vehicle ownership further, it is recommended that the Air Force employ better cost-tracking methods. Currently, it is nearly impossible to determine the true salvage value of the Air Force vehicle fleet. After talking to several offices involved in vehicle procurement, it was discovered no one could find the historical prices for vehicles purchased in previous years. Without that data, it is difficult at best to determine what a vehicle is worth at any given point in time. Additionally,

costs for general purpose vehicles are only reported in an aggregate form. The Air Force is not currently studying the costs by vehicle type. By studying the costs by vehicle type, the Air Force may discover that only certain vehicle types are costing them large amounts of money, while other vehicle types cost significantly less. This would allow the Air Force to better determine if the Air Force should lease specific vehicle types and own other vehicle types to maximize vehicle funding.

Another recommendation is that the Air Force utilizes the use of used car auctions to dispose of Air Force vehicles that have reached their life expectancy instead of using DRMO. This would cause ownership to become the better alternative. By sending vehicles to DRMO instead of commercial auctions, the Air Force is losing out on extra revenue it could generate for its vehicle funding. Because of the large number of vehicles comprising the general purpose vehicle fleet, this analysis recommends that the Air Force reconsider its policy on the disposition of vehicles that the Air Force no longer needs.

Finally, this research recommends that the Air Force search for ways to reduce its indirect costs. Indirect costs represent a significant portion of vehicle costs; however, it was determined that indirect costs did not affect the outcome of this research. If the Air Force converts its vehicle fleet to GSA and does not reduce its overhead (indirect costs), the cost of owning special purpose vehicles will increase, and thus may become a future candidate for outsourcing.

Areas for Future Research

Throughout this research, various issues arose that would be interesting areas for future research. One such area for future research is determining the actual costs

associated with each vehicle type. The Air Force's aggregation of cost data only allowed this analysis to estimate each vehicle type's cost. More research is needed to determine the actual cost of each vehicle type, both general purpose and special purpose.

Another area for future research could be selecting certain vehicle types and determining commercial lease costs at different bases within the CONUS for general purpose vehicles assigned at the bases. Performing this analysis could create a more accurate commercial lease cost for comparison with ownership and GSA leasing.

How to manage the downsizing of the general purpose mechanic career field is another topic a future researcher could address. An analysis could be performed to determine if it is more economical to release general purpose mechanics or cross-train them into other 2T3XX career fields. Along the same lines, another topic of interest could be the possible merger of the general purpose and special purpose mechanic career fields. This has the potential of increasing the special purpose mechanic manning level to 100 percent while still maintaining the general purpose vehicle knowledge for use at overseas locations.

A future study into ways to reduce Air Force vehicle indirect costs warrants consideration. If the Air Force converts its general purpose fleet to GSA and does not find a means to lower its vehicle indirect costs, the cost of owning special purpose vehicles would increase because there will be fewer vehicles to be assigned indirect costs.

Converting the Air Force general purpose fleet to GSA will warrant future research on whether the Air Force realized an actual cost savings through leasing. Researchers can use the model developed for this analysis to once again compare

ownership, GSA leasing, and commercial leasing to determine if the vehicle procurement method chosen by the Air Force is still the best method of procuring vehicles for the Air Force.

Finally, one area of future research is to determine what the Air Force could gain, monetary wise, by sending its vehicles to used car auctions instead of DRMO. It would be a worthwhile venture to determine how much extra money the Air Force is foregoing by utilizing DRMO instead of commercial auctions.

Conclusion

This analysis concluded that the most efficient and effectiveness method of procuring vehicles is through GSA leasing. GSA leasing was the least costly of the three alternatives while providing a number of benefits such as stable budget input and a newer vehicle fleet. Choosing to convert the general purpose vehicle fleet to GSA, the Air Force loses some vehicle flexibility, certainty in its WRM fleet, and bases for general purpose vehicle mechanics to PCS to in the CONUS.

Once the Air Force decides to convert the general purpose fleet to GSA, it will be nearly impossible to return to ownership after conversion. This means the Air Force will be subject to GSA vehicle decisions with little recourse available. Because of the financial burden associated with converting a vehicle fleet back to ownership, the only option that would be available to the Air Force after converting its fleet is either GSA leasing or commercial leasing.

Appendix A: Cost of Ownership Model - Sedans

	Sedans				
	Subcompact	Compact	Midsize	Station Wagons	
Costs:					
Total Authorizations	19	1436	13	645	
Total Assigned	16	1167	9	679	
Life Expectancy in Years	7	7	7	7	
Amount Replaced Annually	3	205	2	92	
Avg Cost of New Vehicle	$20,656	$14,735	$15,105	$19,129	
Annual Cost of Replacing Vehicles	$56,066	$3,022,780	$28,052	$1,762,601	
Average Annual Mileage/Vehicle	15974	6162	6407	6249	
Total Annual Mileage	303,506	8,848,632	83,291	4,030,605	
Direct Maintenance Cost	$27,686	$673,598	$19,188	$442,368	
Avoidable Indirect Cost	$9,962	$670,264	$5,312	$390,938	
Fuel Cost (gallons X $/gallon)	$15,974	$227,566	$1,589	$115,527	
Salvage Value Per Vehicle	$6,411	$4,535	$4,688	$5,937	
Total Annual Salvage Value	$17,401	$930,323	$8,706	$547,052	
Totals:					**Sum of all Sedans**
Cost of Ownership for 8 Years	$647,826	$25,719,348	$318,938	$15,193,287	$41,879,398

Appendix B: Cost of Ownership Model - Trucks

	Trucks 4 X 2 Compact	Compact - Elec	3500 - 4500 GVW	4600 - 5799 GVW	Multistops (B180)
Costs:					
Total Authorizations	5182	67	62	3013	3893
Total Assigned	4547	56	94	2742	3624
Life Expectancy in Years	8	8	8	8	8
Amount Replaced Annually	648	8	8	377	487
Avg Cost of New Vehicle	$12,534	$39,091	$18,462	$19,337	$29,212
Annual Cost of Replacing Vehicles	$8,118,899	$327,387	$143,081	$7,282,798	$14,215,290
Average Annual Mileage/Vehicle	5364	5364	6171	6171	6171
Total Annual Mileage	27,796,248	359,388	382,602	18,593,223	24,023,703
Direct Maintenance Cost	$3,291,575	$42,558	$62,978	$3,060,524	$3,954,404
Avoidable Indirect Cost	$2,646,317	$34,215	$33,728	$1,639,065	$2,117,783
Fuel Cost (gallons X $/gallon)	$1,100,933	$1,806	$19,852	$964,738	$1,246,507
Salvage Value	$3,384	$10,555	$4,985	$5,221	$7,888
Total Annual Salvage Value	$2,191,986	$88,398	$38,634	$1,966,359	$3,838,498
Totals:					
Cost of Ownership for 8 Years	$91,015,486	$2,229,233	$1,551,383	$77,081,595	$124,216,863

Multistops (F176)	Stake - 7000 GVW	8000 GVW	9-Pax Utility	4-Door
27	1509	101	84	2111
131	1408	85	38	1781
8	8	7	8	9
3	189	14	11	235
$33,898	$19,343	$26,239	$29,598	$25,618
$114,406	$3,648,573	$378,591	$310,779	$6,008,844
6171	6171	6171	6171	6171
166,617	9,312,039	623,271	518,364	13,026,981
$27,426	$1,532,801	$102,593	$85,325	$2,144,297
$14,688	$820,892	$54,944	$45,696	$1,148,379
$8,645	$483,170	$32,339	$26,896	$675,925
$9,153	$5,223	$8,143	$7,992	$6,018
$30,891	$985,188	$117,492	$83,916	$1,411,555
$942,558	$38,610,051	$3,165,710	$2,701,036	$60,129,910

Trucks 4 X 4 Compact	3500 GVW	4600 - 5799 GVW	6000 GVW	7500 GVW	9 Pass Utility	Duel Wheel	4-Door
134	358	825	579	286	131	1	2875
121	147	646	592	350	21	1	2716
10	8	7	8	8	8	8	10
13	45	118	72	36	16	0	288
$16,947	$25,458	$19,520	$29,769	$29,424	$29,694	$30,672	$28,207
$227,090	$1,139,246	$2,300,571	$2,154,531	$1,051,908	$486,239	$3,834	$8,109,513
6383	8951	8951	8951	8951	8951	8951	8951
855,322	3,204,458	7,384,575	5,182,629	2,559,986	1,172,581	8,951	25,734,125
$115,104	$500,897	$1,154,303	$810,111	$400,158	$183,289	$1,399	$4,022,571
$87,160	$185,843	$428,270	$300,568	$148,467	$68,004	$519	$1,492,456
$29,801	$170,998	$394,060	$276,558	$136,607	$62,572	$478	$1,373,239
$3,503	$6,874	$6,058	$8,038	$7,945	$8,018	$8,282	$5,831
$46,940	$307,612	$713,979	$581,750	$284,034	$131,295	$1,035	$1,676,413
$2,893,613	$11,858,877	$25,012,746	$20,778,414	$10,200,363	$4,694,839	$36,465	$93,511,882

Vans 7-Pax	8-Pax	9-Pax	15-Pax	4 X 4 PNL - 7000 GVW	4 X 2 PNL - 6999 GVW	
554	988	106	697	3	1168	
436	940	291	569	0	1161	
7	8	10	10	8	8	
79	124	11	70	0	146	
$20,250	$20,050	$30,004	$22,640	$16,321	$17,808	
$1,602,643	$2,476,175	$318,042	$1,578,008	$6,120	$2,599,968	
6171	6171	6171	6171	8951	6171	
3,418,734	6,096,948	654,126	4,301,187	26,853	7,207,728	
$562,738	$1,003,584	$107,672	$707,994	$4,197	$1,186,423	
$301,375	$537,470	$57,664	$379,166	$1,557	$635,389	
$177,386	$316,350	$33,940	$223,174	$1,433	$373,984	
$6,285	$5,414	$6,202	$4,680	$4,407	$4,808	
$497,413	$668,629	$65,741	$326,196	$1,653	$701,968	
$15,069,379	$25,726,814	$3,169,933	$17,985,476	$81,818	$28,737,190	**Sum of all Trucks** $661,401,632

Appendix C: GSA Cost of Leasing Model - Sedans

	Sedans				
	Subcompact	Compact	Midsize	Station Wagons	
Costs:					
Total Authorizations	19	1436	13	645	
Replacement Time in Years	4	4	4	4	
Amount Replaced Annually	5	359	3	161	
Monthly Rental Rate per Vehicle	$136.00	$149.00	$199.00	$210.00	
Annual Mileage	303,506	8,848,632	83,291	4,030,605	
Mileage Rate	$0.095	$0.100	$0.140	$0.100	
Annual Rental Payments	$31,008	$2,567,568	$31,044	$1,625,400	
Annual Mileage Charge	$28,833	$884,863	$11,661	$403,061	
First Year Cost of leasing vehicles already bought	$47,873	$2,761,945	$34,164	$1,622,768	
Second Year Cost of leasing vehicles already bought	$35,905	$2,071,459	$25,623	$1,217,076	
Third Year Cost of leasing vehicles already bought	$23,936	$366,348	$17,067	$173,627	
Fourth Year Cost of leasing vehicles already bought	$11,968	$183,174	$8,534	$86,814	
Vehicle Possession Costs to Air Force	$169,312	$8,803,014	$69,645	$6,933,851	
Refurbishment Costs ($250/vehicle)	$4,000	$291,750	$2,250	$169,750	
Totals:					**Sum of all Sedans**
Cost of GSA Leasing for 8 Years	$701,190	$38,196,930	$450,097	$24,094,611	$63,442,828

Appendix D: GSA Cost of Leasing Model - Trucks

	Trucks 4 X 2 Compact	Compact - Elec	3500 - 4500 GVW	4600 - 5799 GVW
Costs:				
Total Authorizations	5182	67	62	3013
Replacement Time in Years	6	6	6	6
Amount Replaced Annually	864	11	10	502
Monthly Rental Rate Per Vehicle	$165	$173	$180	$170
Total Annual Mileage	27,796,248	359,388	382,602	18,593,223
Mileage Rate	$0.13	$0.13	$0.135	$0.13
Annual Rental Payments	$10,260,360	$139,092	$133,920	$6,146,520
Annual Mileage Charge	$3,613,512	$46,720	$51,651	$2,417,119
First Year Cost of leasing vehicles already bought	$11,099,098	$148,650	$148,457	$6,850,911
Second Year Cost of leasing vehicles already bought	$8,324,323	$111,487	$111,343	$5,138,183
Third Year Cost of leasing vehicles already bought	$5,549,549	$74,325	$74,229	$3,425,456
Fourth Year Cost of leasing vehicles already bought	$2,774,774	$37,162	$37,114	$1,712,728
Vehicle Possession Costs to the Air Force	$27,470,132	$1,055,166	$836,506	$25,557,154
Refurbishment Costs ($250/vehicle)	$1,136,750	$14,000	$23,500	$685,500
Incremental Cost for Electric Vehicle Per Vehicle		$22,450		
Totals:				
Cost of Ownership for 8 Years	$151,330,255	$4,673,063	$2,487,599	$101,743,529

Multistops (B180)	Multistops (F176)	Stake - 7000 GVW	8000 GVW	9-Pax Utility	4-Door (B217)
3893	27	1509	101	84	2111
6	6	6	6	6	6
649	5	252	17	14	352
$226	$226	$199	$175	$195	$195
24,023,703	166,617	9,312,039	623,271	518,364	13,026,981
$0.17	$0.17	$0.16	$0.16	$0.155	$0.16
$10,557,816	$73,224	$3,603,492	$212,100	$196,560	$4,939,740
$4,084,030	$28,325	$1,489,926	$99,723	$80,346	$2,084,317
$11,713,476	$81,239	$4,074,735	$249,459	$221,525	$5,619,246
$8,785,107	$60,929	$3,056,051	$187,094	$166,144	$4,214,434
$5,856,738	$40,620	$2,037,367	$124,729	$110,763	$2,809,623
$2,928,369	$20,310	$1,018,684	$62,365	$55,381	$1,404,811
$51,027,732	$2,140,458	$13,127,488	$1,142,582	$542,132	$20,739,745
$906,000	$32,750	$352,000	$21,250	$9,500	$9,500
$180,817,027	$3,014,275	$58,447,351	$3,906,939	$3,001,609	$82,699,062

Trucks 4 X 4 Compact	3500 GVW	4600 - 5799 GVW	6000 GVW	7500 GVW	9 Pass Utility	Duel Wheel	4-Door
134	358	825	579	286	131	1	2875
6	6	6	6	6	6	6	6
22	60	138	97	48	22	0	479
$177	$195	$182	$225	$270	$225	$218	$218
855,322	3,204,458	7,384,575	5,182,629	2,559,986	1,172,581	8,951	25,734,125
$0.15	$0.145	$0.15	$0.16	$0.165	$0.16	$0.17	$0.17
$284,616	$837,720	$1,801,800	$1,563,300	$926,640	$353,700	$2,616	$7,521,000
$128,298	$464,646	$1,107,686	$829,221	$422,398	$187,613	$1,522	$4,374,801
$330,331	$1,041,893	$2,327,589	$1,914,017	$1,079,230	$433,050	$3,310	$9,516,641
$247,749	$781,420	$1,745,692	$1,435,512	$809,423	$324,788	$2,483	$7,137,481
$165,166	$520,947	$1,163,795	$957,008	$539,615	$216,525	$1,655	$4,758,321
$82,583	$260,473	$581,897	$478,504	$269,808	$108,263	$828	$2,379,160
$881,291	$1,803,855	$6,460,000	$8,494,682	$4,963,963	$300,570	$14,784	$32,924,982
$30,250	$36,750	$161,500	$148,000	$87,500	$5,250	$250	$679,000
$4,562,283	$13,385,483	$32,339,660	$29,698,033	$16,918,462	$5,117,686	$51,446	$138,565,696

Vans 7-Pax	8-Pax	9-Pax	15-Pax	4 X 4 PNL - 7000 GVW	4 X 2 PNL - 6999 GVW	
554	988	106	697	3	1168	
6	6	6	6	6	6	
92	165	18	116	1	195	
$185	$200	$200	$225	$235	$193	
3,418,734	6,096,948	654,126	4,301,187	26,853	7,207,728	
$0.135	$0.155	$0.155	$0.16	$0.17	$0.155	
$1,229,880	$2,371,200	$254,400	$1,881,900	$8,460	$2,705,088	
$461,529	$945,027	$101,390	$688,190	$4,565	$1,117,198	
$1,353,127	$2,652,982	$284,632	$2,056,072	$10,420	$3,057,829	
$1,014,845	$1,989,736	$213,474	$1,542,054	$7,815	$2,293,372	
$676,564	$1,326,491	$142,316	$1,028,036	$5,210	$1,528,914	
$338,282	$663,245	$71,158	$514,018	$2,605	$764,457	
$4,523,126	$9,084,748	$3,752,416	$5,536,256	$0	$9,965,734	
$109,000	$235,000	$72,750	$142,250	$0	$290,250	
$19,560,398	$38,581,630	$6,882,310	$28,401,570	$115,997	$43,997,407	**Sum of all Trucks** $970,298,769

Appendix E: Commercial Cost of Leasing Model - Sedans

	Sedans				
	Subcompact	Compact	Midsize	Station Wagons	
Costs:					
Total Authorizations	19	1436	13	645	
Replacement Time in Years	3	3	3	3	
Amount Replaced Annually	6	479	4	215	
Monthly Lease Rate	$250.00	$219.00	$249.00	$350.00	
Annual Mileage	303,506	8,848,632	83,291	4,030,605	
Allowed Mileage	228,000	17,232,000	156,000	7,740,000	
Annual Lease Payments	$57,000	$3,773,808	$38,844	$2,709,000	
Annual Scheduled Maintenance	$1,900	$114,880	$1,040	$51,600	
Acquisition Cost	$5,383	$392,028	$3,679	$204,250	
Fuel Costs	$15,974	$227,566	$1,589	$115,527	
Salvage Value of Vehicles	$169,312	$8,803,014	$69,645	$6,933,851	
Totals:					**Sum of Sedans**
Cost of Commercial Leasing for 8 Years	$394,073	$22,843,739	$247,308	$14,689,445	$38,174,565

Appendix F: Commercial Cost of Leasing Model - Trucks

	Trucks 4 X 2				
	Compact	Compact - Elec	3500 - 4500 GVW	4600 - 5799 GVW	Multistops (B180)
Costs:					
Total Authorizations	5182	67	62	3013	3893
Replacement Time in Years	3	3	3	3	3
Amount Replaced Annually	1727	22	21	1004	1298
Monthly Lease Rate	$181	$564	$290	$303	$458
Total Annual Mileage	27,796,248	359,388	382,602	18,593,223	24,023,703
Allowed Mileage	62,184,000	804,000	744,000	36,156,000	46,716,000
Excess Mileage Charge	$0	$0	$0	$0	$0
Annual Lease Payments	$11,244,133	$453,409	$215,479	$10,967,893	$21,408,226
Annual Scheduled Maintenance	$414,560	$0	$4,960	$241,040	$311,440
Acquisition Cost	$1,348,737	$25,995	$18,386	$907,264	$1,373,273
Fuel Cost	$1,100,933	$1,806	$19,852	$964,738	$1,246,507
Salvage Value	$27,470,132	$1,055,166	$836,506	$25,557,154	$51,027,732
Totals:					
Cost of Commercial Leasing for 8 Years	$71,566,232	$2,322,784	$979,325	$66,266,984	$119,827,686

Multistops (F176)	Stake - 7000 GVW	8000 GVW	9-Pax Utility	4-Door
27	1509	101	84	2111
3	3	3	3	3
9	503	34	28	704
$532	$303	$412	$358	$402
166,617	9,312,039	623,271	518,364	13,026,981
324,000	18,108,000	1,212,000	1,008,000	25,332,000
$0	$0	$0	$0	$0
$172,295	$5,494,752	$498,889	$361,001	$10,180,484
$2,160	$120,720	$8,080	$6,720	$168,880
$10,186	$454,432	$34,058	$26,828	$704,991
$8,645	$483,170	$32,339	$26,896	$675,925
$2,140,458	$13,127,488	$1,142,582	$542,132	$20,739,745
-$783,648	$32,873,068	$2,882,271	$2,416,281	$61,603,214

Trucks 4 X 4 Compact	3500 GVW	4600 - 5799 GVW	6000 GVW	7500 GVW	9 Pass Utility	Duel Wheel	4-Door
134	358	825	579	286	131	1	2875
3	3	3	3	3	3	3	3
45	119	275	193	95	44	0	958
$235	$399	$306	$467	$462	$359	$481	$442
855,322	3,204,458	7,384,575	5,182,629	2,559,986	1,172,581	8,951	25,734,125
1,608,000	4,296,000	9,900,000	6,948,000	3,432,000	1,572,000	12,000	34,500,000
$0	$0	$0	$0	$0	$0	$0	$0
$377,120	$1,715,704	$3,031,578	$3,244,724	$1,584,173	$564,816	$5,774	$15,266,157
$10,720	$28,640	$66,000	$46,320	$22,880	$10,480	$80	$230,000
$37,276	$119,258	$249,211	$205,931	$101,205	$41,889	$360	$999,060
$29,801	$170,998	$394,060	$276,558	$136,607	$62,572	$478	$1,373,239
$881,291	$1,803,855	$6,460,000	$8,494,682	$4,963,963	$300,570	$14,784	$32,924,982
$2,312,083	$12,478,412	$19,799,603	$17,994,364	$7,986,427	$4,471,113	$32,192	$92,506,078

Vans 7-Pax	8-Pax	9-Pax	15-Pax	4 X 4 PNL - 7000 GVW	4 X 2 PNL - 6999 GVW	
554	988	106	697	3	1168	
3	3	3	3	3	3	
185	329	35	232	1	389	
$339	$335	$458	$346	$249	$272	
3,418,734	6,096,948	654,126	4,301,187	26,853	7,207,728	
6,648,000	11,856,000	1,272,000	8,364,000	36,000	14,016,000	
$0	$0	$0	$0	$0	$0	
$2,250,431	$3,973,766	$582,760	$2,891,437	$8,972	$3,811,206	
$44,320	$79,040	$8,480	$55,760	$240	$93,440	
$173,312	$307,982	$37,388	$219,718	$849	$339,467	
$177,386	$316,350	$33,940	$223,174	$1,433	$373,984	
$4,523,126	$9,084,748	$3,752,416	$5,536,256	$0	$9,965,734	
						Sum of all Trucks
$14,047,114	$23,747,319	$898,606	$18,261,119	$80,683	$22,451,888	$597,021,198

Bibliography

Bunjer, Verl A. and Gary L. Van Bemmel. A Comparative Analysis of Leasing and Purchasing General Purpose Vehicles at Wright-Patterson Air Force Base. MS thesis, AFIT/SLSR 4-73B. School of Systems and Logistics, Air Force Institute of Technology (AU), Wright-Patterson AFB, OH, August 1973 (AD-770968).

Candler, Julie. "Leasing's Link to Efficiency," Nation's Business: 83. 30-32 (May 1995).

Candler, Julie. "Leasing Passes the Road Test," Nation's Business: 85. 54-58 (May 1997).

Department of the Air Force. Vehicle Maintenance Management. AFI 24-302. Washington: HQ USAF, 19 May 1994.

Department of the Air Force. Vehicle Operations. AFI 24-301. Washington: HQ USAF, 1 September 1997.

FinanCenter, Inc. "FianCenter.com ClickCalcs." Unpublished calculation tool, n. pag. http://www.calcbuilder.com/cgi-bin/calcs/AUT2.cgi/FinanCenter. 25 March 1999.

General Accounting Office. "GAO Frequently Asked Questions." Excerpt from unpublished article, n. pag. http://www.gao.gov/faq/faq.htm. 6 April 1999.

General Accounting Office. Motor Vehicles: Better Management of the Military Services' Vehicles Could Save Millions. Report to the Chairman, Subcommittee on Readiness, Committee on Armed Services, House of Representatives. Washington: GPO, May 1991 (AA-L7249).

General Services Administration. "Interagency Fleet Management System Motor Vehicle Service Rates." Published rental rates, n. pag. http://pub.fss.gsa.gov/motor/. 25 February 1999.

Gill, H. Leroy. Life Cycle Cost and Reliability. Graduate School of Logistics and Acquisition Management, Air Force Institute of Technology, Wright-Patterson AFB, OH, (Spring 1998).

Gwartney, James D. and Richard L. Stroup. Microeconomics: Private and Public Choice (Eighth Edition). Orlando: The Dryden Press, 1997.

Hampel, Karen. Customer Service Representative, General Services Administration, Arlington VA. Telephone interview. 26 March 1999.

Henderson, Erv. Analyst, Air Force Audit Agency, Wright-Patterson AFB, OH. Telephone Interview. 21 August 1998.

HQ USAF/ILS. "General Purpose Leasing Information." Electronic Message. 221200Z, 22 July 1998.

Karzon, Mark A. and Charles E. Underwood. An Ownership/Lease Cost Comparison Analysis of Heavy Equipment Motor Vehicles in Air Force Materiel Command. MS thesis, AFIT/GLM/LAL/94S-23. Graduate School of Logistics and Acquisition Management, Air Force Institute of Technology (AU), Wright-Patterson AFB, OH, September 1994 (AAL-2804).

McDaniel, Michael B. Vehicle Buy and Vehicle Maintenance O&M Spending Analysis. Report LT9732000. Air Force Logistics Management Agency, Maxwell AFB, AL, July 1997 (AD-B233087).

Muczyk, Dr. Jan P. "The Changing Nature of External Threats, Economic and Political Imperatives, and Seamless Logistics," Air Power Journal: XI. 90 (Summer 1997).

Naman, Walter. Director of Fixed Operations, Joe Bullard Automobile Group, Mobile AL. Telephone interview. 14 May 1999.

Office of Management and Budget. Guidelines and Discount Rates for Benefit-Cost Analysis of Federal Programs. Circular No. A-94. Washington: GPO, 1993.

Office of Management and Budget. "OMB's Role." Excerpt from unpublished article, n. pag. http://www.whitehouse.gov/OMB/organization/role.html. 6 April 1999.

Shedden, James S. A Guide for Air Force Lease Versus Buy Decisions. MS thesis, AFIT/GOR/OS/84D-11. School of Engineering, Air Force Institute of Technology (AU), Wright-Patterson AFB, OH, December 1984 (AAJ-6017).

Waterman, Chris. "To Lease or Not To Lease," Business NH Magazine: 15. 10 (January 1998).

Wiley, Robert I. Headquarters, United States Air Force, Transportation Directorate, Vehicle Management Branch, Washington D.C. Electronic Mail Correspondence. 2 February 1999.

Vita

Captain Robert J. Neal Jr. was born on 11 March 1967 in Slidell, Louisiana. He graduated from Mandeville High School in Mandeville, Louisiana in May 1985. He attended Southeastern Louisiana University in Hammond, Louisiana and graduated with a Bachelor of Arts degree in Economics in May 1990. He enlisted in the Air Force as an avionics technician in January 1991 and reported to Elmendorf AFB, Alaska in August 1991. He attended Air Force Officer Training School and received his commission 11 August 1994, graduating as a Distinguished Graduate.

His first commissioned assignment was to the 81st Transportation Squadron at Keesler AFB, Mississippi as a Vehicle Operations Flight Commander in August 1994. In January 1996, he was assigned to the 366th Transportation Squadron at Mountain Home AFB, Idaho at the Combat Readiness Flight Commander. While at Mountain Home AFB, he deployed to Bahrain for Air Expeditionary Force V as the Transportation Commander, earning an "Outstanding" rating on the Air Force's first ever Operation Readiness Inspection conducted in a real-world threat environment. In May 1998, he entered the Graduate Transportation Management Program, School of Logistics and Acquisition Management, Air Force Institute of Technology. Upon graduation, he will be assigned to the Tanker/Airlift Control Center at Scott AFB, Illinois.

REPORT DOCUMENTATION PAGE	Form Approved OMB No. 0704-0188

1. AGENCY USE ONLY *(Leave blank)*	2. REPORT DATE	3. REPORT TYPE AND DATES COVERED
	September 1999	Master's Thesis

4. TITLE AND SUBTITLE
COST-BENEFIT ANALYSIS OF LEASING VERSUS BUYING AIR FORCE GENERAL PURPOSE VEHICLES IN THE CONTINENTAL UNITED STATES

5. FUNDING NUMBERS

6. AUTHOR(S)
Robert J. Neal, Jr., Captain, USAF

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
Air Force Institute of Technology
2750 P Street
WPAFB OH 45433-7765

8. PERFORMING ORGANIZATION REPORT NUMBER
AFIT/GTM/LAL/99S-5

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)
USAF/ILTV
1030 Air Force Pentagon
Washington D.C. 20330-1030

10. SPONSORING/MONITORING AGENCY REPORT NUMBER

11. SUPPLEMENTARY NOTES

12a. DISTRIBUTION AVAILABILITY STATEMENT
Approved for public release; distribution unlimited

12b. DISTRIBUTION CODE

13. ABSTRACT *(Maximum 200 words)*

Given the increasingly aging vehicle fleet and declining vehicle budget, this research performed a cost-benefit analysis of leasing versus buying various Air Force general purpose vehicles for the entire continental United States (CONUS). In contrast to previous analyses, which have examined the leasing versus buying issue on a base-by-base basis, this analysis studies the issue from an Air Force-wide perspective using a cost-buying model. Costs and benefits are calculated for three purchasing options (Air Force ownership, GSA leasing, and commercial leasing) to determine and recommend the best alternative for the Air Force. Finally, a sensitivity analysis is to test the results of the cost-benefit models.

The research demonstrates that the best alternative available to the Air Force is GSA leasing because of its overall lowest cost and accompanying benefits such as a newer vehicle fleet and a stable budget requirement. The current method of buying vehicles for ownership proves to be the least costly option for the Air Force when considering salvage value. Because the Air Force does not recognize salvage value, this study recommends that the Air Force convert the CONUS general purpose vehicle fleet to GSA leased vehicles.

14. SUBJECT TERMS	15. NUMBER OF PAGES
Transportation, Vehicle Management, Cost-Benefit Analysis, Vehicle Leasing, Vehicle Purchasing, Automobile Leasing	108
	16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
UNCLASSIFIED	UNCLASSIFIED	UNCLASSIFIED	UL

AFIT Control Number AFIT/GTM/LAL/99S-5

AFIT RESEARCH ASSESSMENT

The purpose of this questionnaire is to determine the potential for current and future applications of AFIT thesis research. **Please return completed questionnaire** to: AIR FORCE INSTITUTE OF TECHNOLOGY/ ENA 2950 P STREET, WRIGHT-PATTERSON AFB OH 45433-7765. Your response is **important.** Thank you.

1. Did this research contribute to a current research project? a. Yes b. No

2. Do you believe this research topic is significant enough that it would have been researched (or contracted) by your organization or another agency if AFIT had not researched it?
a. Yes b. No

3. **Please estimate** what this research would have cost in terms of manpower and dollars if it had been accomplished under contract or if it had been done in-house.

Man Years_____ $_____

4. Whether or not you were able to establish an equivalent value for this research (in Question 3), what is your estimate of its significance?

a. Highly Significant b. Significant c. Slightly Significant d. Of No Significance

5. Comments (Please feel free to use a separate sheet for more detailed answers and include it with this form):

_____ _____
Name and Grade Organization

_____ _____
Position or Title Address