AN OWNERSHIP/LEASE COST COMPARISON ANALYSIS OF HEAVY EQUIPMENT MOTOR VEHICLES IN AIR FORCE MATERIEL COMMAND

THESIS

Mark A. Karzon, Captain, USAF
Charles E. Underwood, Jr., Captain, USAF

AFIT/GLM/LAL/94S-23

DEPARTMENT OF THE AIR FORCE
AIR UNIVERSITY
AIR FORCE INSTITUTE OF TECHNOLOGY

Wright-Patterson Air Force Base, Ohio

AFIT/GLM/LAL/94S-23

AN OWNERSHIP/LEASE COST COMPARISON ANALYSIS OF HEAVY EQUIPMENT MOTOR VEHICLES IN AIR FORCE MATERIEL COMMAND

THESIS

Mark A. Karzon, Captain, USAF
Charles E. Underwood, Jr., Captain, USAF

AFIT/GLM/LAL/94S-23

Approved for public release; distribution unlimited

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

AFIT/GLM/LAL/94S-23

AN OWNERSHIP/LEASE COST COMPARISON ANALYSIS OF HEAVY EQUIPMENT MOTOR VEHICLES IN AIR FORCE MATERIEL COMMAND

THESIS

Presented to the Faculty of the Graduate School
of Logistics and Acquisition Management
of the Air Force Institute of Technology
Air University
in Partial Fulfillment of the
Requirements for the Degree of
Master of Science in Logistics Management

Mark A. Karzon, B.S.
Captain, USAF

Charles E. Underwood, Jr., B.S.
Captain, USAF

September 1994

Acknowledgements

We wish to thank Major Russ Anible and Major Judy Ford for their assistance and technical guidance in the completion of this thesis. We also wish to thank Mr. Robert Tait and Mr. Calvin Brownlow from the staff at Headquarters Air Force Material Command for the significant time and effort they spent in getting data for the research effort.

Mark A. Karzon

Charles E. Underwood, Jr.

Table of Contents

List of Tables

Abstract

The purpose of this thesis was to perform a ownership/lease cost comparison analysis, including the investigation of qualitative issues, of heavy equipment motor vehicles in Air Force Materiel Command (AFMC). The study examined 11 types of special purpose vehicles.

Ownership cost was determined using vehicles within the categories of interest from all AFMC installations. Four AFMC installations were sampled for lease cost data and qualitative information.

Once an ownership cost was determined, a comparative analysis was accomplished with lease cost information. This was done using hourly and annual cost data. Qualitative issues surrounding possible lease initiatives were addressed.

Findings indicated significant cost savings would be realized if short-term, or as needed, leasing practices were adopted for low utilization vehicles. Additionally, the research found qualitative issues and mission requirements may prohibit a complete conversion to a leased special purpose fleet.

The research concluded that leasing is cost effective and should be considered as a possible alternative to ownership in Air Force Materiel Command. Also, any lease

initiative must include cost, utilization, and qualitative information in the decision process.

AN OWNERSHIP/LEASE COST COMPARISON ANALYSIS OF HEAVY EQUIPMENT MOTOR VEHICLES IN AIR FORCE MATERIEL COMMAND

I. Introduction

Background

Air Force regulations define the requirement for motor vehicles by stating "the Air Force should have enough motor vehicles to support its military mission." Additionally, "Peak workload and unusual requirements for vehicles may be met by borrowing from other government agencies or renting or leasing vehicles from GSA or commercial sources" (Dixon, 1992:50).

Traditionally, the Air Force has owned and maintained its own vehicle fleet to support mission requirements. As funding for vehicle procurement was reduced and highly scrutinized by Congress in the 1950's, the Air Force did recognize leasing as an alternative to ownership (Connelly and others, 1958:3). However, this has primarily been accomplished in what the Air Force calls its general purpose fleet. Special purpose vehicles have traditionally been harder to lease, due to the unique capability of each vehicle, and still meet mission requirements (Tait, 1993). This was due to a number of factors which are illustrative of the era in which the Air Force operated.

During the 20-year period from the 1960s to the 1980s, Air Force installations were located throughout the United States at some remote locations making the leasing of special purpose vehicles difficult. These installations were, in effect, a self-sufficient community with assigned Air Force personnel performing all the required operations and maintenance on the installation (Tait, 1993).

The situation changed as the Air Force moved into the 1990s. Towns and cities grew around most U.S. bases which allows more reliance on the civilian community to meet military needs. Furthermore, the end of the Cold War and the subsequent reduction in personnel have forced the U.S. to close many military installations (Poindexter, 1994:3). Improvements in technology, such as phased-array radar, have enabled many smaller remote sites to cease operation or consolidate operations at fewer locations. The combined effect of these actions has resulted in fewer Air Force installations. Those installations remaining are usually surrounded by a significant civilian population which provides a diverse array of services that can be utilized by the installation. This situation provides a better opportunity to assess a lease alternative to purchasing Air Force special purpose motor vehicles.

Air Force Materiel Command (AFMC) has recognized the need to do a cost comparison analysis study of its special purpose fleet. The main impetus for this research is an Air Force Audit Agency report which identified potential savings

if the Air Force were to lease more special purpose vehicles (Dixon, 1992). Specifically, AFMC would like to know if there is a cheaper way to operate and maintain selected vehicles in its special purpose fleet. This subject will be the focus of this thesis.

Problem Statement

The U.S. Air Force's current method of procuring, operating, and maintaining special purpose vehicles is without consolidated quantifiable data by which to make a cost comparison with an alternative method. This thesis will investigate associated costs in order to consolidate and quantify the data and make a legitimate cost comparison between the current system and a leasing alternative within AFMC.

Research Questions

1. Can the cost of the current system be determined?
2. Is it cost effective to lease some special purpose vehicles for specified periods of time? (A lease can be for any period of time from one hour to indefinite.)
3. What non-monetary issues affect the lease decision?

Scope

The research is confined to AFMC bases. Certain special purpose vehicles were selected to be included in the study based on three factors: Inclusion in the previous Air Force Audit, commonality throughout AFMC bases, and

commonality of the equipment in the civilian sector. Table 1 below shows the vehicles selected for this study.

TABLE 1

VEHICLES INCLUDED IN THE STUDY

VEHICLE TYPE	MANAGEMENT CODE
ROAD GRADER	D653, D655
ROAD ROLLER	D676
BACKHOE	D626
DOZER	D569, D570, D572
LOADER	D631, D632
CRANE	D503, D515

Traditionally, the vehicle types in Table 1 have been operated by the Civil Engineering function on Air Force bases. As such, we will refer to this group of study vehicles as "CE vehicles" throughout the remainder of this thesis as a more exact identifier of this sub-group of special purpose vehicles.

While the data to determine current system costs includes all AFMC bases, the bases in Table 2 below are the bases used to do the current system cost comparison with a lease alternative.

TABLE 2

BASES USED FOR COST COMPARISON

BASE	LOCATION
Tinker	Oklahoma City, OK
Wright Patterson	Dayton, OH
Robins	Warner Robins, GA
Eglin	Valparaiso, FL

Tinker and Wright Patterson were selected due to their proximity to larger metropolitan areas while Robins and Eglin were selected due to their proximity to smaller population centers.

The impact of the research will primarily affect AFMC bases. However, the information is such that it may be generalizable to the entire Air Force fleet of U.S. based vehicles.

Limitations

1. Time and money. The researchers have time and money to verify lease alternative costs at four AFMC bases.

2. The research represents the best effort by the researchers to get valid data from Air Force, AFMC, and outside sources. This data's reliability is as good as that of the generating organizations.

Assumptions

1. The present method of providing CE vehicles within AFMC is meeting mission requirements.

2. Lease agreements could be written on CE vehicles to meet mission requirements.

3. Leaders within AFMC Civil Engineering functions would accept the concept of leased vehicles in their fleet, as long as mission requirements are met and money is provided for the lease.

Definitions

The following definitions are provided to assist the reader:

Air Force Audit: Written report outlining the "effectiveness, efficiency, and economy of Air Force program management." The report is issued by the Air Force Audit Agency (Reports from, 1993:87).

Air Force Audit Agency: Air Force agency which "provides independent evaluations of managerial responsibilities; financial, operational, and support" (Reports from, 1993:87).

Air Force Materiel Command: Air Force Major Command responsible for "integrating the management of research, development, test, acquisition, and support of weapon systems; produces and acquires advanced systems" (Reports from, 1993:67).

Annual hourly goals: Annual utilization goals for Air Force Materiel Command motor vehicles that have an hour meter to record use (AFM 77-310, Vol 1, AFMC Sup 1, 1992:A2-2).

Annual mileage goals: Annual utilization goals for Air Force Materiel Command motor vehicles that have odometers to record use (AFM 77-310, Vol 1, AFMC Sup 1, 1992:A2-2).

Backhoe: Air Force motor vehicle included in the study. The Air Force refers to this vehicle as a tractor, w/backhoe and loader, management code D626. Common models in the civilian sector are the Case 580, Caterpillar 416,

and John Deere 510 (AFM 77-310, Vol 2, Attachment 3, 1987:117).

Base logistics function: Air Force base function responsible for oversight of the base transportation function (AFM 77-310, Vol 1, 1992:11).

Base transportation function: Air Force base function responsible for vehicle management and maintenance at the installation (AFM 77-310, Vol 1, 1992:11).

Civil Engineering function: Air Force base function "responsible for providing civil engineering technical and professional support" (Report from, 1993:88). The Roads and Grounds section within this function commonly operates the motor vehicles included in this study.

CE Vehicle: Term used to identify the special purpose group of vehicles included in this study. CE is the abbreviation commonly used in the Air Force to identify the base civil engineering function.

Crane: Air Force motor vehicle included in the study. The Air Force refers to this vehicle as a Crane, Wheeled, Hydraulic, 15-Ton and Crane, Hydraulic, 7 and 1/2-Ton; management codes D503 and D515. Common models in the civilian sector are Koehring LRT 180 and Grove RT 515 for the 15-Ton and Koehring LRT 100 for the 7 and 1/2-Ton (AFM 77-310, Vol 2, Attachment 3, 1987:117).

Dozer: Air Force motor vehicle included in the study. The Air Force refers to this vehicle as Tractor, Full Tracked, Sizes T7, T9, or T4; management codes D569, D570,

and D572 respectively. Common models in the civilian sector are the Case 1550 and Caterpillar D6 for the T7, Caterpillar D7 for the T9, and Caterpillar D4, John Deere 550, and Case 550 for the T4 (AFM 77-310, Vol 2, Attachment 3, 1987:117).

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

General Services Administration (GSA): Government agency responsible for interagency motor pools; maintains a large fleet of vehicles for use by government agencies at competitive lease rates (AFM 77-310, Vol 1, 1992:55).

Hour meter: A meter on certain special purpose vehicles which records the vehicle's use in lieu of an odometer; used because vehicle's use is determined by hours operated and not miles driven (TO 36A-1-1301, 1992:1-2).

Lease/Leasing: Divided into short- and long-term. Short-term is one year or less; can be as little as one hour. Long-term is any period longer than one year. The term rental is sometimes used to refer to short-term leasing. However, only the term lease will be used in this study (AFM 77-310, Vol 1, 1992:53).

Loader: Air Force motor vehicle included in the study. The Air Force refers to this vehicle as either a Loader, Scoop, PT 1 and 1/2 to 2 Cubic Yard; or Loader, Scoop, PT 2 and 1/2 to 3 and 1/2 Cubic Yard; management codes D631 and D632 respectively. Common models in the civilian sector are the Caterpillar 918 and Case 621 for the 1 and 1/2 to 2

Cubic Yard and the Caterpillar 936 and Case 721 for the 2 and 1/2 to 3 and 1/2 Cubic Yard (AFM 77-310, Vol 2, Attachment 3, 1987:117).

Management code: Air Force alphanumeric code used to identify specific motor vehicle types (TO 36A-1-1301, 1992:2).

Motor vehicle: Self-propelled and non self-propelled equipment; mostly wheel-mounted. Non self-propelled, such as trailers, are used in conjunction with self-propelled equipment (Bunjer and Van Bemmel, 1973:15).

PCN SB004-245 Utilization Analysis Report: Fleet manager's report used to determine vehicle utilization and cost data (AFM 77-310, Vol 1, 1992:21).

Road Grader: Air Force motor vehicle included in the study. The Air Force refers to this vehicle as either a Grader, Road Motorized, Articulating Frame; or Grader, Road Motorized, Rigid Frame; management codes D653 and D655 respectively. Common models in the civilian sector are John Deere 570 and Caterpillar 140 for the Articulating Frame and John Deere 670 and Caterpillar 12 for the Rigid Frame (AFM 77-310, Vol 2, Attachment 3, 1987:117).

Road Roller: Air Force motor vehicle included in the study. The Air Force refers to this vehicle as a Road Roller, Tandem, 2 RI, 5-8 Ton; management code D676. Common models in the civilian sector are the Case W252 and Caterpillar 434 (AFM 77-310, Vol 2, Attachment 3, 1987:117).

Seasonal/Sporadic workload: Workload which, by its nature, does not occur consistently throughout the year (AFM 77-310, Vol 1, 1992:20).

Specialized management: Management of vehicles within specific categories the Air Force calls management codes (Burres and Smith, 1973:33).

Table of Allowances 012, Basis of Issue: Air Force document which establishes a baseline of types and quantities of motor vehicles for a given installation with a given mission (1993).

Technical Order 36A-1-1301, Vehicle Management Index File: Air Force document which establishes annual mileage goals for certain vehicles and also establishes life expectancy for all vehicles (1992).

Using organization: Base level organization which is supported by the base transportation function for motor vehicle support. For the purposes of this study, using organization will usually be the civil engineering function.

Vehicle Interactive Management System (VIMS): Air Force personal computer-based system that is used to manage the operation and maintenance of the motor vehicle fleet. Appendix 3 provides a glossary of terms and abbreviations used in VIMS (AFM 77-320, Vol 1, 1992:1).

Overview

Chapter 2 reviews the literature on this narrow subject. Chapter 3 discusses the research methodology used

to answer the research questions while Chapter 4 presents the findings and analysis in response to the research questions. Chapter 5 is a conclusion of the research with recommendations for future research.

II. Literature Review

Introduction

This chapter is a review of the utilization patterns and alternatives to ownership of a small, yet costly, category of Air Force Materiel Command (AFMC) special purpose vehicles. This small category of vehicles is operated by the Civil Engineering function on most bases and consists of heavy duty construction-type vehicles such as road graders, backhoes, road rollers, dozers, and other unique vehicles. As stated in chapter one, we will refer to these vehicles as "CE vehicles." These CE vehicles are particularly suited to short-term lease by the AFMC Civil Engineering (CE) functions due to the sporadic or seasonal nature of their use.

The purpose of this literature review is to provide a concise, yet comprehensive, review of all the pertinent literature concerning the utilization of these vehicles and determine if leasing is possible and consistent with the requirement to support the military mission. While vehicle utilization is not the primary focus of this thesis, it plays a large role in determining the number of CE vehicles assigned to a base. Therefore, it impacts the number of vehicles that may need to be leased. Also, it is clear from a thorough literature search that little has been written on the utilization or leasing of special purpose vehicles of which CE vehicles are a subcategory.

This review will include a definition of vehicle utilization and leasing and a historical review of how the Air Force and AFMC have addressed these issues. In addition to the historical literature review, we will also introduce the problems associated with the vehicle justification process and why an alternative to ownership should be studied as a means of cost comparison.

Discussion of the Literature

Definition. The Webster's New World Dictionary defines utilization as, "to put to use or make practical use of" (1979:1565). Interestingly, the Air Force does not define vehicle utilization. Instead, utilization is directly related to the original vehicle authorization. In order to assign a specific motor vehicle to an organization, the organization must document a valid need and justify an authorization. Air Force guidance on this subject states, "Types and quantities of vehicles required must be based on the minimum number necessary to accomplish the assigned military DOD mission. Their need must be clearly substantiated" (AFM 77-310, Vol 1, 1992:51). Proper and sufficient utilization of the authorized vehicle is required or the vehicle may be removed from the using organization (AFM 77-310, Vol 1, 1992:21). Therefore, it is imperative that a using organization document its needs to justify a motor vehicle authorization and utilize the vehicle properly to meet Air Force requirements.

The Webster's New World Dictionary defines lease as "a contract by which one party (landlord, or lessor) gives to another (tenant, or lessee) the use and possession of lands, buildings, property, etc. for a specified time and for fixed payments" (1979:804). In the Air Force's definition of the terms leasing and utilization and their application to vehicles, the term lease is much clearer than the term utilization. A historical review of how the Air Force and AFMC have dealt with the problems associated with determining proper motor vehicle utilization and the propriety of leasing follows.

Historical Review. Numerous studies have addressed the issue of vehicle utilization in the Air Force (Connelly, Vargas and Paolone, 1958; Tuck, 1959; Blake, 1968; Burres and Smith, 1973; Dixon, 1992). In performing an analysis on the determination of requirements for base vehicle services, Connelly and others stated, "there is a need for developing an optimum method for deciding the number and types of vehicles needed for mission accomplishment" (1958:3). The study attempted to determine how to measure or compute vehicle needs, and how to control utilization to provide more satisfactory levels of service. The Tuck study addressed the importance of the accuracy of basic data which documents vehicle utilization. He states, "The integrity of the originators of basic data is the key to the success of the whole management program extending from the installation itself to Air Force Headquarters. It is at this level that

the weakest links in the program are to be found" (1959:78). The Blake study also addressed the need for proper data, but carried it a step further by identifying a need for vehicle utilization standards. He acknowledged that "to establish a set of standards which will be applicable to the diverse and constantly changing organizational structures and operational requirements is a tremendous task" (1968:125).

The thread that ties the studies of Connelly and others, Tuck, and Blake together is the improvements made as a result of the research. Technical Order 36A-1-1301, Vehicle Management Index File, now establishes annual mileage goals for general use vehicles such as sedans, pickups, buses, and others in this class referred to as general purpose vehicles (1992:2-1). Data input is much easier now than it was in 1959 during the time of the Tuck study, and we now have analysis programs designed to determine data accuracy and other utilization issues (AFM 77-310, Vol 1, 1992:21). However, the application of the research results was more difficult for special purpose vehicles due to the diverse, yet distinct, utilization of these vehicles.

Special purpose vehicles received attention in the other two referenced works (Burres and Smith, 1973; Dixon, 1992). The Burres and Smith study identified the need to develop criteria for specialized management of special purpose vehicles (1973:33). Specialized management has been practiced to a small degree on certain special purpose

vehicles, since the 1973 study, but this does not address the larger problem of the proper utilization of the specific class of special purpose vehicles addressed in this thesis. The Air Force Audit Agency did address this issue directly in a 1992 audit. The Dixon-generated audit stated that utilization and utilization standards were significant problems for this class of special purpose vehicles in the Air Force (2,4). Another significant problem was the Air Force did not normally consider leasing these expensive vehicles instead of purchasing them.

One study did address the issue of vehicle leasing. Bunjer and Van Bemmel did a comparative analysis of leasing and purchasing vehicles (1973). However, their analysis only addressed general purpose vehicles at a single location. While their method of analysis is fairly comprehensive, they did not address special purpose vehicles and the unique problems with this vehicle group. Therefore, their study is of limited use in this effort.

There is a requirement for a using organization to consider leasing a vehicle instead of purchasing for sporadic or seasonal workload (AFM 77-310, Vol 1, 1992:50). However, as the audit identified and substantiated, this requirement is seldom heeded. Other than in the Dixon audit, leasing of special purpose vehicles is not discussed in the literature. The lack of leasing as a proposed alternative to ownership for the filling of an authorization warrants investigation.

Vehicle Authorization Process

Problems. Within AFMC, the problems with the current vehicle authorization process for most special purpose vehicles can be simply stated as one of no substantive oversight at any organizational level. The using organization requests and justifies an authorization. The base transportation function reviews and makes a recommendation to the base logistics function which approves or disapproves the request. AFMC Headquarters approves or disapproves the request. However, there are no specific criteria available to determine if these requests are reasonable for CE vehicles. Since these vehicles do not have odometers, hour meters and hourly use are the standard measure of utilization. General Purpose vehicles have annual mileage goals but CE vehicles do not have annual hourly goals that are established at Headquarters AFMC; a standard does not exist (Tait, 1993).

The unit justifies the need for vehicles on an Air Force Form 601, Equipment Action Request. However, since there are no Air Force mileage or hour meter standards on CE vehicles, the using organization makes a best guess of anticipated utilization in their justification of the vehicle. Of course, the using organization usually errs on the high side, inflating their estimates, in order to ensure the vehicle will be authorized (Springer, 1994).

The request is then sent to the base transportation function which reviews the request for adequacy. Again, the

transportation function suffers from the same lack of criteria in making a recommendation for approval or disapproval. Their recommendation to the Headquarters AFMC is usually based on the experience of the reviewer (Springer, 1994).

An additional tool that is used in this step of the process is the Table of Allowances 012, Basis of Issue (TA 012). TA 012 establishes a baseline of types and quantities of vehicles for a given base with a given mission. Within AFMC, if a vehicle is requested that complies with TA 012, it is usually approved without discussion. However, vehicles that are not in TA 012 are occasionally authorized if adequately justified (Tait, 1993).

Headquarters AFMC, in turn, usually bases its decision on how strong the installation level justification is. The Headquarters will usually determine that the base is in tune with local mission requirements as they relate to vehicle needs. As a general rule, it is unlikely that they will disapprove a request (Tait, 1993). They too, are hampered by the lack of definitive criteria for CE vehicles. (AFM 77-310, Vol 1, 1992:50)

Headquarters AFMC has initiated a goal program for CE vehicles. However, the goals are established by the using organization with no standardization or guidance from Headquarters AFMC. Vehicle utilization goals vary from base to base (Tait, 1993).

A major problem with the current process is lack of criteria (Tait, 1993). Therefore, a question to be considered is whether criteria can be established along with other ideas to alleviate problems with the current process. This is certainly a valid question that should be researched further. However, as stated earlier, the focus of this thesis is the potential leasing of CE vehicles as a cost reduction alternative. This idea will be introduced next.

A Cost Alternative

Leasing. It is a requirement for the transportation function to make a determination if leasing is a lower cost alternative to meeting the mission needs when justifying an authorization for a new vehicle (AFM 77-310, Vol 1, 1992:20). In reality, determining *if a lease is possible* is not always accomplished. Dixon reported that "vehicle managers were not complying with AFM 77-310 regarding a rental/lease versus purchase analysis prior to establishing vehicle authorizations" (1992:3). Dixon has made it clear that leasing is not used to the maximum extent possible with CE vehicles. Therefore, this study will evaluate leasing as a potential alternative to buying this high-cost equipment.

With the exception of the Dixon-generated audit, no other study has researched the issue of reduced cost alternatives to ownership of special purpose vehicles. This is largely due to special purpose vehicles being considered

too vital to the military mission to be considered as lease candidates on any scale (Tait, 1993).

Conclusion

It has been observed that the utilization rates and the potential for leasing of a small, yet costly, class of vehicles within Air Force Materiel Command Civil Engineering functions have received less than adequate attention.

The purpose of this literature review is to provide a comprehensive analysis of the information pertaining to this special class of vehicles, with an emphasis on their utilization and potential leasing. Definitions of vehicle utilization and leasing and a historical review of how the Air Force and AFMC have addressed these issues are discussed. In addition, the problems with the vehicle justification process and why leasing should be studied as a lower cost alternative are introduced.

It is clear from this literature review that the leasing of CE vehicles needs further examination. This thesis will research the issue of leasing as an alternative method of operating and managing the CE vehicle fleet in the Air Force Materiel Command.

III. Methodology

Introduction

The following chapter provides details of the methodology used to answer the research questions listed in chapter one. The chapter begins by explaining the methods and resources used to determine the actual cost of ownership for CE vehicles in AFMC during calendar year 1993 and how comparison costs are derived. Next, details are presented of procedures used to ascertain accurate lease cost data. The chapter concludes with the methods used to gain insight of qualitative issues surrounding any initiative to change the current system.

Cost of Ownership

The Vehicle Interactive Management System (VIMS) is used extensively as a data source of information to determine ownership costs and equipment utilization. Appendix A offers an explanation of terms, abbreviations, and data elements used in VIMS. A command level retrieval of VIMS data provides the following information by vehicle registration number and management code for the study group of eleven management codes:

1. Management Code
2. Vehicle Registration Number
3. National Stock Number
4. Make/Type of Vehicle
5. Owning Command

6. Using Command

7. Assigned Organization

8. Air Force Acceptance Date

9. Warranty Date

10. Vehicle Equivalents

11. Standard Price

12. Vehicle Inventory

13. Direct Operating Cost

14. Indirect Operating Cost

15. Maintenance Direct Cost

16. Maintenance Indirect Cost

17. Miles/Hours This Period

18. Cumulative Mileage (or Hours)

19. On-base Fuel Gallons

20. On-base Fuel Cost

21. Off-base Fuel Gallons

22. Off-base Fuel Cost

23. Vehicle Down for Maintenance (Hours and Percentage)

24. Vehicle Down for Parts (Hours and Percentage)

25. Vehicle Out of Commission (Hours and Percentage)

26. Maintenance Labor Cost

27. Maintenance Material Cost

28. Accident Labor Cost

29. Accident Material Cost

30. Contract Repair Cost

The PCN-245 Utilization Analysis Report provides an additional source of data. The PCN-245 Utilization Analysis Report is a summary source of VIMS information used by installation vehicle managers to determine operating costs and utilization of their fleet. The report can provide up to twelve months of summarized VIMS data on vehicles by management code and vehicle registration number. The following list indicates the information that can be extracted from the PCN-245 Utilization Analysis Report:

1. Management Code
2. Organization Code
3. Vehicle Registration Number
4. Cumulative Miles/Hours
5. Miles/Hours This Period
6. Average Miles/Hours Per Month
7. Percentage of Installation's Utilization Goal
8. Total Operating Cost
9. Total Maintenance Cost
10. Average Cost Per Mile/Hour
11. Percentage of Vehicle Out of Commission

Appendix B provides an example page from the Utilization Analysis Report.

While the PCN-245 Utilization Analysis Report is a product of VIMS originated data, it is useful as a summary source and a cross-checking tool. Cross-checking between a command level VIMS retrieval and the PCN-245 Utilization Analysis Report aids in the detection of input or program

errors. Whenever a program error is suspected, it is resolved through the use of a third report, the cost and performance report, and through consultation with the Headquarters AFMC Vehicle Management Specialist.

Two sources of input error are detectable. For example, it was noted in some cases that yearly hour meter readings were abnormally large in the command level VIMS retrieval when compared with cumulative hour meter readings on the PCN-245 Utilization Analysis Report. An example of this was vehicle registration number 85D107, a road grader located at Wright Patterson AFB, Ohio. The cumulative hour meter reading was 1377 and the yearly reading was 1053. When a physical check of the hour meter was performed by the researchers, it was obvious that the hour meter on this vehicle was inoperable; the hour meter read 0001. Two vehicles with unexplainable differences in cumulative and yearly hour meter readings were eliminated from the study. In addition, the researchers noted three cases of input error in the maintenance cost column of the PCN-245 Utilization Analysis Report when compared to the command level VIMS retrieval for three different vehicles. These costs were brought to the attention of the command Vehicle Management Specialist; the source of the bad cost data was detected and the data were reconciled. These vehicles remained in the study.

Finally, a program error is detected on the PCN-245 Utilization Analysis Report generated from Arnold AFB,

Tennessee. The problem is noted in the Operations and Maintenance Cost columns. While the individual cost for each vehicle is correct within the columns, the cumulative total by management code is incorrect. This disconcerting problem was brought to the attention of the AFMC Vehicle Management Specialist and a second report, a base-level retrieval called the Cost and Performance Report, was requested and received from Arnold AFB. The base-level retrieval totals are compared by management code with manual totals by management code from the PCN-245 Utilization Analysis Report. At this point, the cumulative totals match; based on this reconciliation, the affected costs and vehicles are retained in the study. Every effort is taken to ensure the research data is accurate.

In order to perform a cost comparison, the current ownership cost data from the command level VIMS retrieval and the PCN-245 Utilization Analysis Reports is compiled for the entire operating year of 1993 from all AFMC installations and computed to determine an hourly and annual cost. Hourly and annual costs are then compared with lease costs for the same periods.

Although cost and utilization for CE vehicles varies from year to year, the long sample period and the large sample size provides a good basis for comparison. The long sample period of one calendar year includes all the possible seasonal variables. This eliminates the possibility of sampling a seasonal effect, especially due to the seasonal

utilization associated with CE vehicles. Additionally, the large sample size of all AFMC installations negates the possibility of sampling unusual utilization that may be occurring at a particular installation due to large projects and unusual amounts of construction. Larger sample sizes tend to attenuate the effects of any abnormality.

The large number of installations and the diverse cross-section of geographic locations within the sample lend support to the premise that the data may be generalizable to other Air Force Commands with installations operating within the continental United States.

Fixed Cost. Fixed costs are the costs associated with a particular piece of equipment that do not change despite change in variable operating cost (Horngren and Foster, 1991:31). For the purpose of this research, fixed costs are defined as the cost to the Air Force for CE vehicles regardless of utilization. Additionally, for the purpose of this research, the fixed costs are costs associated directly with the vehicle; no attempt was made to determine the fixed cost of the support infrastructure. The fixed costs are the easiest to determine because the cost of CE vehicles do not vary from one installation to another due to the central procurement system mentioned in Chapter two. The fixed costs are formulated as the purchase price plus the cost of capital.

The purchase price for CE vehicles is obtained from Technical Order 36A-1-1301, Vehicle Management Index File

(1992). The purchase price represents the current replacement prices of CE vehicles and does not include any indirect costs associated with the procurement of new vehicles.

Cost of capital is not as objectively defined as other costs and warrants explanation for those unfamiliar with its definition or concept. Cost of capital recognizes that the use of money is not free. The money required to purchase a capital investment could be used for current consumption or otherwise invested. The money could be invested in an infinite number of ways with an equally infinite number of rates of return. More specifically, the cost of capital to any government agency is the cost of acquiring the funds used to purchase the capital investment. (Economic Projections, 1992:P1-36)

Determining the cost of capital is accomplished by multiplying the net acquisition cost of the capital investment by interest rates charged for the resources used to accommodate the acquisition for each year of the investment (Tait, 1993). For example, economic assumptions contained in the President's Budget of February 1993 utilized a rate of 6.9%, which at that time was the interest on treasury securities with a ten year maturity (Economic Projections, 1992:P1-36).

This thesis utilizes a discrete compound interest rate of 6% for cost of capital calculations based on the life expectancy of the vehicle as the capital investment period.

The conservative 6% rate is used to ensure ownership costs are not inflated and an unbiased cost-comparison can be accomplished.

Variable Cost. Variable costs are more difficult to determine than fixed costs. The wide variations in labor rates and other cost-drivers at each installation make it impractical to develop a standard cost-factor. To ensure accuracy, variable cost data is collected from each installation through extensive use of the VIMS.

Although a valid attempt is made to capture all variable costs, it must be recognized that the costs are not totally inclusive. The levels of indirect support outside of the maintenance organizations are difficult, if not impossible, to value. The installation supply system and personnel offices are two prime examples of indirect support not accounted for under VIMS. There is also no real indication of how the indirect levels of support would be affected in a lease initiative. For this reason, no attempt is made to include these costs in the cost comparison.

The variable costs are calculated by adding all Operations Costs and Maintenance Costs associated with a particular management code within the sample. The Operating and maintenance costs account for direct and indirect costs associated with their respective functions and vary with the utilization of each vehicle.

The operating direct cost includes all on-base and off-base fuel cost. Indirect operations costs account for bench

stock items, office supplies, small tools and equipment, cleaning or servicing the vehicle, and any tolls or travel expenses incurred during the movement of the vehicle.

The maintenance direct costs are replacement parts, special equipment, preventive maintenance, and all accident repair. The maintenance indirect costs account for lubricants, bench stock, commercial rental, small tools and equipment, and all travel expenses necessary for vehicle repair.

Hourly Cost. To arrive at the variable component of the hourly cost, the total operating and maintenance costs are first added together by management code to get a total variable cost for each type of vehicle. The total variable cost is divided by the total hours of utilization in the entire management code to get an average hourly figure to make valid comparisons. Additionally, operating costs by themselves are calculated in the same manner so those costs could be later added to the hourly lease rates to make the comparison valid because operating costs would also be incurred during the operation of leased vehicles

The fixed cost component of hourly cost is determined, by management code, for the life of each vehicle. The yearly cost for 1993 is determined by dividing the total fixed cost of the vehicle by the useful life expectancy of the vehicle. The yearly cost of each vehicle, within a given management code, is multiplied by the number of vehicles in the management code. Vehicles not in service for

the entire calendar year are pro-rated accordingly. Once a total yearly cost of individual management codes is determined, those costs are also divided by the hours of utilization of the entire management cost to establish an average hourly fixed cost of ownership.

As stated earlier in this chapter, the hourly and yearly ownership costs of the current system are necessary for comparison with leasing vehicles. These two measures provide the fairest basis of comparison.

Collection of Lease Data

Four installations are chosen as sites to collect lease cost data. The installations are selected based on the location of nearby civilian population centers. Wright-Patterson AFB in Dayton, Ohio, and Tinker AFB in Oklahoma City, Oklahoma, represent installations near larger cities with a greater number of leased vehicle suppliers available. Robins AFB in Warner Robins, Georgia, and Eglin, AFB in Valparaiso, Florida, represent bases near smaller cities or rural communities with smaller numbers of leased vehicle suppliers available.

The four AFMC installations sampled contain a large cross-section of geographic locations and provide a good sample of average lease costs. Unlike ownership costs, no available database exists to determine lease cost. Research time prevents sampling lease cost at each AFMC installation.

Appendix C contains lease information for the four installations.

Lease Rates. Four sample lease costs were taken from the local areas near each installation for each management code. The uniqueness of several management codes precluded four samples at each installation, but this will be discussed in detail in the following sections.

The lowest lease cost for each management code from each installation is added together and averaged to get an average lease cost for AFMC CE vehicles. The hourly cost is determined based on the averaged weekly lease rates divided by the 40 allowable hours of utilization in the weekly lease. Although longer periods would significantly reduce the hourly cost, a weekly rate is used to provide a realistic comparison of lease rates to ownership.

Lease Issues. Issues other than cost are also investigated at each installation. Equipment availability, proximity of the installation to a vendor and/or response time, and inclusive maintenance support of leased vehicles are some of the concerns of the research. Additionally, leased vehicle suppliers meet certain prerequisites before being considered valid for the sample. The suppliers must include maintenance in the lease cost and must be located within 60 miles of the leasing installation. The researchers concluded that 60 miles was a reasonable distance to ensure adequate response time.

Qualitative Issues

In addition to the cost comparison, the researchers determine if non-cost or qualitative issues are significant factors when considering leasing CE vehicles from the using organization's standpoint. To achieve this, personal interviews are conducted with leaders in the civil engineering functions at the four installations where the commercial lease data was obtained. Information obtained in these interviews is shown in its entirety in Appendix D and is discussed in Chapter 4.

Summary

This chapter describes the methodology used during the research to analyze research questions listed in Chapter 1. First, the methods are described for obtaining cost of ownership for CE vehicles and how sampling procedures are developed to acquire lease cost data. The chapter concludes with the methods used to gain insight into the qualitative issues surrounding the vehicle lease issue. The next chapter discusses the findings of the research and presents an analysis of the ownership and lease data.

IV. Findings and Analysis

Introduction

This chapter will discuss the findings and analysis using the methodology outlined in Chapter 3. First, actual cost of ownership and lease costs will be derived and explained. In addition, a thorough cost comparison between ownership and leasing will be accomplished and explained using narrative and tabular data. Finally, a thorough qualitative analysis will be performed showing non-cost issues that would be faced by using organizations if leasing became the primary means of heavy equipment support.

Cost of Ownership

The cost of ownership is averaged by management code from the sample size of 11 AFMC installations and the sample period of calendar year 1993. Ownership costs are divided into two categories, fixed and variable. Detailed definitions and methods used to calculate these costs are given in Chapter 3.

Fixed Cost. In order to arrive at a yearly fixed cost of CE vehicles to AFMC during 1993, the first step is to calculate the total fixed costs for CE vehicles over their useful life expectancy. Table 3 below lists the fixed cost for each management code for the useful life expectancy based on current replacement cost with cost of capital calculated at 6% discrete compound interest.

TABLE 3

TOTAL FIXED COSTS FOR CE VEHICLES

MANAGEMENT CODE	LIFE EXPECTANCY	UNIT PRICE	COST OF CAPITAL	TOTAL COST
D503	15	$ 197626	$276002	$ 473626
D515	15	177143	247398	424541
D569	10	99797	78919	178716
D570	10	17625	13938	31562
D572	10	55731	44072	99803
D626	12	57706	58410	116116
D631	10	58864	46549	105413
D632	11	77531	69646	147177
D653	12	76231	77161	153392
D655	12	78647	79606	158253
D676	17	24296	41128	65424

(TO 36A-1-1301, 1992:61-112)

Once the fixed costs for the life expectancy of CE vehicles were determined, a 1993 cost for each management code could be computed by dividing the total fixed cost by the life expectancy of the CE vehicle. Table 4 below illustrates the yearly fixed cost of each CE vehicle.

TABLE 4

YEARLY FIXED COSTS FOR CE VEHICLES

MANAGEMENT CODE	UNIT PRICE PER YEAR	COST OF CAPITAL PER YEAR	TOTAL FIXED COST PER YEAR
D503	$ 13175	$ 13400	$ 31575
D515	11810	16493	28303
D569	9980	7892	17872
D570	17625	13938	31563
D572	5573	4407	9980
D626	4807	4868	9675
D631	5886	4655	10541
D632	7048	6331	13380
D653	6353	6430	12783
D655	6554	6634	13188
D676	3848	1429	2419

The fixed hourly costs were determined by multiplying the yearly fixed cost of a CE vehicle by the number of vehicles within the management code and dividing the total by the hours of utilization during 1993. Vehicles not in use for the entire calendar year of 1993 were pro-rated accordingly. (New vehicles, and vehicles disposed of, during the year would be examples.) Table 5 illustrates the fixed cost per hour for CE vehicles.

TABLE 5

FIXED COST PER HOUR FOR CE VEHICLES

MANAGEMENT CODE	NUMBER OF VEHICLES	YEARLY COST PER VEHICLE	TOTAL HOURS	HOURLY COST
D503	27.9	$ 31575	10319	$ 85.37
D515	14.16	28303	2051	195.40
D569	26.85	17872	8719	55.04
D570	11	31562	4706	73.77
D572	11	36927	2003	54.81
D626	36.91	9674	13832	25.81
D631	28.6	10541	11430	26.38
D632	11.75	13380	4204	37.40
D653	7.08	12783	1749	51.75
D655	29.33	13188	11605	33.30
D676	13.4	3848	1331	38.74

Variable Cost. The variable cost data was collected from each installation through extensive use of the VIMS. Variable costs consist of operating and maintenance costs; detailed descriptions of each are listed in Chapter 3. Table 6 below illustrates the total operating and maintenance costs of CE vehicle management codes during calendar year 1993.

TABLE 6

CE VEHICLE TOTAL VARIABLE COSTS FOR 1993

MANAGEMENT CODE	OPERATIONS COST	MAINTENANCE COST	TOTAL COST
D503	$ 36570	$ 211388	$247958
D515	1828	26931	28759
D569	36582	160334	196916
D570	18305	53860	72165
D572	3183	36927	40110
D626	42508	172458	214966
D631	28430	105321	133751
D632	12327	90135	102462
D653	2744	48486	51230
D655	27659	187874	215533
D676	932	17018	17950

As with fixed costs, it was also necessary to determine the hourly cost figure of variable costs. The variable cost per year was computed by dividing the 1993 total variable cost in each management code by the hours of utilization within the management code. Table 7 below indicates the variable hourly costs for CE vehicles.

TABLE 7

CE VEHICLE VARIABLE COSTS FOR 1993

MANAGEMENT CODE	TOTAL HOURS	TOTAL VARIABLE COST	HOURLY COST
D503	10319	$ 247958	$ 24.03
D515	2051	28759	14.02
D569	8719	196916	22.58
D570	4706	72165	15.33
D572	2003	40110	20.02
D626	13832	214966	15.54
D631	11430	133751	11.70
D632	4204	102462	24.37
D653	1749	51230	29.29
D655	11605	215533	18.57
D676	1331	17950	13.49

Comparative Cost. Determining the hourly fixed and hourly variable costs for CE vehicles during calendar year 1993 allows the cost of ownership to be translated into a form suitable for comparison to lease cost data. All CE vehicle leases encountered were based on specific time periods and hours of utilization. Therefore, it was necessary to establish common units of measurement for comparison.

This thesis established hourly and yearly as two appropriate measures of comparison. The hourly measure was simply the addition of the calculated fixed and variable cost of ownership of CE vehicles. Table 8 below lists the cost of ownership per hour during calendar year 1993 for CE vehicles.

TABLE 8

CE VEHICLE COST PER HOUR, 1993

MANAGEMENT CODE	VARIABLE COST	FIXED COST	TOTAL COST
D503	$ 24.03	$ 85.37	$109.40
D515	14.02	195.40	209.42
D569	22.58	55.04	77.61
D570	15.33	73.77	89.10
D572	20.02	54.81	74.83
D626	15.54	25.81	41.35
D631	11.70	26.38	38.08
D632	24.37	37.40	61.77
D653	29.29	51.75	81.03
D655	18.57	33.30	51.88
D676	13.49	38.74	52.23

Annual cost provides a quantitative input to longer period lease decisions. Annual cost of ownership is based

on annual fixed cost plus annual maintenance cost for each vehicle within each management code. For annual cost comparison, 1993 maintenance costs were included for CE vehicles. The addition of 1993 maintenance costs allows for a more equitable snapshot comparison between ownership and leasing since all leasing cost samples included maintenance cost. Existing 1993 maintenance cost data made it more reliable to add that information to ownership cost rather than factor out maintenance cost from the lease data. Table 9 below illustrates annual costs suitable for quantitative comparison.

TABLE 9

ANNUAL COST FOR CE VEHICLES, 1993

MANAGEMENT CODE	FIXED COST	MAINTENANCE COST	ANNUAL COST
D503	$31575	$ 7577	$ 39152
D515	28303	1902	30205
D569	17872	5971	23843
D570	31563	4896	36459
D572	9980	3357	13337
D626	9675	4672	14347
D631	10541	3683	14224
D632	13380	7671	21051
D653	12783	6848	19631
D655	13188	6412	19600
D676	2419	1270	3689

Leasing

Cost. The lease costs are based on an average from the four sample locations. The average was computed, by management code, using the lowest sample cost from each location. The lowest cost was used based on a common

business practice of accepting the lowest bid on equivalent items. Caution was used to insure low costs were representative of collected data and not obvious outliers. As previously mentioned, hourly and annual costs were deemed appropriate measures for a quantitative analysis. Appendix D contains actual lease data.

The hourly costs were derived by using the average weekly lease rate and dividing by the 40 hours of available utilization, generally specified in lease contracts, within the lease period. To give a realistic lease cost, the average AFMC operating cost per hour during 1993 was added to the vehicle per hour lease cost. Table 10 below lists the lease costs per hour, the average 1993 operations cost per hour, and the comparative total.

TABLE 10

LEASE COSTS PER HOUR

MANAGEMENT CODE	LEASE COST PER HOUR	OPERATIONS COST PER HOUR	TOTAL
D503	$ 32.28	$ 3.54	$35.82
D515	19.75	.89	20.64
D569	43.95	4.20	48.15
D570	68.94	3.89	72.83
D572	20.75	1.59	22.34
D626	12.33	3.08	15.41
D631	22.08	2.49	24.57
D632	26.05	2.93	28.98
D653	29.45	1.57	31.02
D655	36.58	2.38	38.96
D676	12.40	.70	13.10

The yearly lease costs were averaged from the lowest cost sample at the four locations (B1 + B2 + B3 + B4 divided

by 4 = Yearly Lease Cost). All leased vehicle suppliers indicated the annual costs were somewhat inflated and could be drastically reduced during actual contract bidding. Most of the yearly costs were derived by multiplying the lease vehicle suppliers monthly rate times 12, based on average monthly utilization of 160 hours. Lower utilization, longer lease periods, and multiple vehicles from the same supplier would reduce the annual lease costs significantly. Table 11 below shows the annual lease cost for CE equivalent vehicles with maintenance costs included.

TABLE 11

ANNUAL LEASE COST FOR CE EQUIVALENT VEHICLES

MANAGEMENT CODE	ANNUAL LEASE COST
D503	$ 48150
D515	26220
D569	56490
D570	90490
D572	27021
D626	15300
D631	27725
D632	35620
D653	40800
D655	48900
D676	16050

Issues. During the course of the research, issues surrounding CE vehicle leasing surfaced and would warrant consideration in any vehicle leasing initiative.

The 15-Ton and 7-1/2-Ton cranes, management codes D503 and D515 respectively, were difficult to lease without an operator at all sample locations. At Robins AFB in Warner Robins, Georgia, there was not a 7-1/2-ton crane available

to lease within the established criteria requiring the leased vehicle supplier be located within 60 miles of the sample installation. Although leased crane suppliers were found at other sample installations, not one installation satisfied the four-sample requirement for these management codes. The availability of cranes without an operator and the lack of a 7-1/2-ton crane at some locations must be considered in lease decisions.

A similar problem existed with the large dozer, management code 572. This size dozer is not built by all heavy equipment manufacturers. Therefore, it is not offered for lease by some of the common lease vehicle suppliers. Lease suppliers were available at each installation sampled. However, this particular vehicle is not as readily available as the other vehicles included in this research.

The issue of transportation to and from the lease vehicle supplier was not addressed or quantitatively analyzed throughout the study. Although all CE vehicles in this study are self-propelled, most cannot be operated on paved surfaces. For this reason, CE vehicles are usually transported to the job site. All AFMC bases currently have some transportation capability to transport CE vehicles. Until a specific mix of owned and leased vehicles are determined, it would be difficult to assess if additional resources would be required to support a leased fleet.

All lease rates listed in Tables 11 and 12 are FOB the supplier. The Air Force is responsible for transportation.

Analysis

A primary goal of this thesis was to perform a comprehensive analysis of quantitative data and qualitative issues surrounding a lease vehicle initiative. The researchers considered quantitative data or cost to be an input to decision making and not a solitary basis for decision making. Therefore, a substantial effort was spent integrating qualitative issues into the final analysis.

Cost Comparison. Once the cost of ownership for CE vehicles during calendar year 1993 was determined, and the current lease costs were gathered, a quantitative analysis was performed. The analysis was performed for two time periods. The first for short periods using hourly measures as a comparative figure, and the second using annual measures as a comparative figure.

Table 12 below indicates the results of comparison of hourly ownership and hourly lease costs.

TABLE 12

HOURLY OWNERSHIP/LEASE COST COMPARISON

MANAGEMENT CODE	HOURLY OWNERSHIP COST	HOURLY LEASE COST
D503	$ 109.40	$ 35.82
D515	209.42	20.64
D569	77.61	48.15
D570	89.10	72.83
D572	74.83	22.34
D626	41.35	15.41
D631	38.08	24.57
D632	61.77	28.98
D653	81.03	31.02
D655	51.88	38.96
D676	52.23	13.10

Based on an hourly comparison, the cost of leasing CE vehicles is significantly lower than the cost of ownership. In every management code, lease costs per hour were less than 1993 ownership costs per hour.

The obvious and primary advantage to short period leasing is less cost to the Air Force. The benefits at base level result primarily from reduced maintenance workloads and the advantage of using newer equipment, as many leased vehicles are newer than comparative Air Force-owned vehicles.

The yearly comparison was based on the annual cost of ownership for vehicles in each management code for 1993 and the current annual lease cost.

The annual lease cost comparison of CE vehicles may not be accurately portrayed. The vehicle lease suppliers indicated annual costs were negotiable and could be significantly reduced. The dramatic difference in annual cost is attributable to full utilization lease samples and low utilization ownership samples. Utilization is one of the primary cost drivers in lease negotiation. If records indicate low utilization, as in the case of most AFMC CE vehicles, the lease contracts can be negotiated to those lower levels resulting in lower overall annual lease costs. Additionally, the leasing of multiple vehicles from the same supplier and longer lease periods would also contribute to lower annual lease costs. Table 13 below lists the annual cost of ownership and the annual lease cost.

TABLE 13

ANNUAL OWNERSHIP/LEASE COST COMPARISON

MANAGEMENT CODE	ANNUAL OWNERSHIP COST	ANNUAL LEASE COST
D503	$ 39152	$ 48150
D515	30205	26220
D569	23843	56490
D570	36459	90750
D572	13337	27021
D626	14347	15300
D631	14224	27725
D632	21051	35620
D653	19631	40800
D655	19600	48900
D676	3689	16050

The current annual lease costs indicated are higher than the cost of ownership for 1993. Although it appears no savings could be achieved with annual leasing, other factors make it worthy of consideration.

Annual leasing could provide benefits at base level. The installation civil engineering function would benefit in multiple ways. The operators would have maximum vehicle utilization due to minimum downtime for equipment failure. Maintenance repair for leased vehicles is the responsibility of the lease vehicle supplier. Vehicles are replaced by the supplier if they are not readily repairable. Under the current ownership system, CE vehicles are not available to the using organization while awaiting and during maintenance. For this type of vehicle, replacements are extremely unlikely. Additionally, CE-leased vehicles would be new or relatively new vehicles with fewer expected breakdowns.

The base-level vehicle maintenance function could potentially be reduced if CE vehicles were leased. With regard to these vehicles, the maintenance function would be reduced to preventive or service maintenance only. The reduction in maintenance requirement would equate to less manpower and potential cost savings.

Break-even Point. The data collected during the research was used to determine a break-even point for each management code. The break-even point was determined using annual fixed cost, hourly variable cost (operations + maintenance), and hourly lease cost (lease + operations). The break-even establishes a actual utilization point where cost of ownership and cost to lease are equal.

If utilization is less than the break-even point, it is more cost effective to lease the vehicle. If utilization is greater than the break-even point, then it is more cost effective to own the vehicle.

The break-even point is based on quantitative data and should not be the only consideration in lease decisions. However, the break-even point could be useful to fleet managers searching for lease candidates in their fleet.

The formula used to determine the break-even point is: Annual Fixed Cost + (x)Hourly Ownership Cost = (x)Hourly Lease Cost. The answer (x) is the number of hours of actual utilization required to break-even on an annual basis. Table 14 below gives the annual break-even point for CE vehicles.

TABLE 14

ANNUAL BREAK-EVEN POINT

MANAGEMENT CODE	UTILIZATION(HOURS)
D503	3320
D515	4563
D569	944
D570	634
D572	5749
D626	*
D631	1105
D632	4566
D653	11347
D655	961
D676	*

* Indicates hourly variable cost higher than hourly lease cost; vehicle is not practical to own in terms of cost only.

All CE vehicles with annual utilization lower than the hours listed in Table 14 could be leased at a cost savings to AFMC.

Qualitative Issues. In addition to the cost comparison data, it was important to determine if non-cost, or qualitative issues were factors in CE vehicle lease decisions. To determine if this was the case, personal interviews were conducted with base civil engineering personnel at the four sample sites. The results of these interviews are in Appendix D.

Information gained in these interviews did raise substantial questions on the vehicle lease issue in the minds of civil engineering personnel. The major concerns of each site will be discussed.

Eglin AFB. The most significant issue raised by civil engineering personnel at this location was the concern

that leased vehicles would not be available as assets to be deployed in a time of war. Although no vehicles are currently tasked for deployment, as needed, or notional tasking possibilities exist. While a concern, the researchers are unsure if lease agreements can be written to ensure the deployability of lease assets if the need presents itself.

The second issue raised at this location was the practicality of leasing CE vehicles for short periods. With 1300 miles of unimproved roads and a large CE vehicle fleet, this base was very uncomfortable with a short period lease initiative.

The final issue discussed involved the idea of long term leasing. Personnel at this location were strong advocates of the long term leasing of CE vehicles if deployability is addressed. It was felt that long term leasing would provide better vehicle in-commission rates which would improve productivity. They were very supportive of this idea (O'Brian, 1994).

Wright Patterson AFB. This base raised two new issues and one old one surrounding the leasing of CE vehicles. The first involved funding. Currently, there is not a mechanism available to release Air Force funds earmarked for central procurement to satisfy base-level leasing costs. Even if such a mechanism existed, this base was concerned such funds would be used for other purposes leaving leasing underfunded while the workload remained.

Another issue was how work would be performed while waiting for leased vehicles to arrive on site or in between breakdowns. The example was used that six people might have to be used to do the work that one person and a vehicle would otherwise perform. It was felt this was a poor utilization of resources.

This installation also raised the concern over the deployability of vehicle assets in time of war (Perales, 1994).

Robins AFB. The main concern of this installation was location. It was felt that some CE-leased vehicles may be hard to get and still meet mission requirements. At this location, this concern was substantiated by the researchers for crane and large dozer leases. This was not true for other vehicles. However, it is a valid concern that would have to be addressed (Welles, 1994).

Tinker AFB. This installation liked the idea of short period leasing of CE vehicles. This was due largely to their experience with the high maintenance downtime of the current CE vehicle fleet. They felt that leased vehicles would provide higher utilization rates.

They did express concern over the mechanism to use procurement funds to lease CE vehicles. They felt if this could be overcome, leasing would be an excellent idea (Laughlin, 1994).

Impact. An objective of this study, as stated in research question three, was to determine if non-cost issues

impacted the lease decision. The researchers concluded that these qualitative issues are real and they would impact a lease decision. However, due to the very subjective nature of the data, it cannot be determined if these factors outweigh the potential dollar savings of a leased CE vehicle fleet.

Summary

This chapter discussed the findings and analysis using the methodology outlined in Chapter 3. Actual costs of ownership and lease costs were derived and explained. Also, a thorough cost comparison between ownership and leasing was accomplished and explained. Finally, a thorough qualitative analysis was performed showing non-cost issues that would be faced by using organizations if the leasing of CE vehicles were seriously considered.

V. Summary and Recommendations

Research Conclusions

This section combines the findings and analysis of the research data and relates the information to the original research questions. The original research questions asked if the cost of ownership was determinable, if leasing was a cost-effective option, and are there qualitative issues to be weighed before considering a lease initiative?

Cost of Ownership. The research found that a completely inclusive cost of ownership would be difficult to determine due to the many different levels of indirect support outside the transportation organization that contribute to the maintenance and operations of CE vehicles. However, through extensive use of the VIMS and information obtained from procurement sources, the research found a reasonable cost of ownership could be determined.

The 1993 cost of ownership for CE vehicles was determined by averaging the operations and maintenance cost of each management code from all AFMC bases and adding the calculated annual fixed cost of each vehicle. The fixed cost included replacement cost of the vehicle and cost of capital only.

Once the cost of ownership was determined, a basis had to be established for comparison to lease data. The researchers chose hourly and annual costs as snapshots for comparison. The hourly cost of ownership for CE vehicles

was determined by the total annual cost associated with a management code divided by the total hours of utilization of the management code during 1993. The annual and hourly costs were determinable and provide a fair basis of comparison.

Lease Cost Comparison. Four samples of lease data were collected from four AFMC installations and averaged to get a lease comparison cost. The AFMC installations were selected due to location in relationship to surrounding metropolitan areas. Two bases were close to large cities, while two were selected near small communities. This ensured a representative cross section of AFMC bases was sampled.

Once the lease costs were determined, a comparative analysis was performed with the cost of ownership.

The analysis indicated a significant savings could be realized if short period, or as needed, leasing was implemented. The hourly cost of leasing was less than the hourly cost of ownership in each management code.

The annual cost analysis, on the surface, indicated that ownership overall is more cost effective. However qualitative issues must be considered in this decision. Although the cost was less for annual leasing in one management code and extremely close in another, in most management codes, the leasing costs were 20% more or greater than the cost of ownership. Annual leasing costs differed in one respect from hourly cost; annual lease costs are

somewhat negotiable and actual annual cost could be reduced at the time of contract implementation.

Once comparison costs were determined, an actual break-even point was established. The break-even point is the actual utilization point, based on an hourly comparison, where the cost of ownership and cost to lease are equal. The break-even point was determined using annual fixed cost, hourly variable cost (operations + maintenance), and hourly lease cost (lease + operations). The break-even point establishes that a number of CE vehicles could be leased at a lower overall cost, when cost is the sole criteria for leasing.

Qualitative Issues. It was determined that non-cost, or qualitative issues, were indeed factors in a potential CE vehicle lease initiative. Major concerns with such an initiative included the deployability of CE vehicle assets in time of war, the practicality of continually leasing vehicles for short periods, the lack of funding for leasing, manpower utilization, and the availability of leased vehicles. Some installations did indicate support for both short- and long-term leasing of CE vehicles, mainly due to the perception that leased vehicles would have higher in-commission rates which should increase productivity.

Research Recommendations

In order for any lease initiative to transpire, the current funding system must be changed. The researchers

recommend a mechanism be developed and adopted to transfer Air Force funds from central vehicle procurement to base-level operations and maintenance for the express purpose of leasing in lieu of Air Force purchased vehicles. This would change the current system of dis-incentives which force base level managers to spend their unfunded operations and maintenance funds even when leasing would save Air Force Funds in the long term.

When funding is made available, Headquarters AFMC should establish criteria, based on a break-even point similar to Table 14, to highlight possible lease candidates. The low utilization vehicles could be examined for replacement with leased vehicles for short period, or as needed, leasing, as they approach the end of their useful life.

The researchers also recommend any vehicle deemed economically beneficial to lease annually should be leased. Annual leasing would provide civil engineering with newer equipment and reduce current vehicle out-of-commission rates.

Recommendations for Future Studies

Throughout the research, issues arose that would be suited for future studies.

A similar study could be performed to include operator cost. The total cost of ownership, including the Air Force operator, could be compared to the cost of contracting to

have the service performed. This comparison could determine if contracting for the service is more cost effective than owning or leasing a fleet.

The researchers found the current vehicle authorization process for CE vehicles lacks adequate criteria and guidelines. A future study could examine the process and determine if criteria could be developed to aid and validate the process.

A study of only one or two CE vehicle management codes could be performed to get more accurate long term lease data. Periods greater than one year should be studied with negotiated costs determined. This could provide AFMC with a better idea of long term lease costs.

Conclusion

The research concluded that current ownership costs are determinable and that selective leasing is cost effective and should be considered a possible alternative to CE vehicle fleet ownership in Air Force Materiel Command. Additionally, qualitative issues and mission requirements may prohibit a complete conversion to a leased fleet.

Any lease initiative decision must consider cost, utilization, and qualitative issues information in a lease decision. However, this study presents sufficient information on the leasing of CE vehicles to recommend it as a potential option. Air Force Materiel Command should consider a lease option for CE vehicles.

Appendix A: Terms, Abbreviations, and Data Elements Used in VIMS

Acceptance Date - The date that a vehicle was accepted by the Air Force. Normally located on the vehicle' data plate.

Accident Cost - All cost associated with an accident repair work order.

Accident Indicator - Shows the repairs listed on a work order were the result of an accident.

Accident Labor Cost - The cost associated with the time spent working on an accident work order.

Accident Labor Hours - The amount of labor hours associated with the repair of an accident work order.

Accident Material Cost - The cost of parts associated with the repair of an accident work order.

Accident Other Government Agency Cost - The cost of repairs associated to an accident work order performed by other government agencies.

Accident Repair Indicator - See Accident Indicator.

Accident VOC - the out-of-commission hours associated with the repair of an accident work order.

Accident VOC Percent - The percentage of the time the vehicle was out-of-service due to accident repairs.

Accumulated Miles/Hours/Kilometers - The miles/hours/kilometers that a vehicle has accumulated to date.

Action Code - Supply data element which passes through VIMS so the transaction can be input to the Standard Base Supply System (SBSS).

Action Taken Code - This code identifies what type repair was accomplished on the vehicle system or component and is used for each job number contained in the work order.

Action Taken/Demand Code - A Base Supply data element that passes through VIMS so the transaction can be input to the base supply system without change.

Actual Miles - The mileage that was last accepted on transactions containing mileage readings.

Additive Miles/Hours/Kilometers - The miles/hours/kilometers in addition to those shown on the vehicle odometer/ hourmeter. The result of a vehicle with a broken/inoperative odometer/hourmeter.

Amortization Date - The date a vehicle must be retained in order to justify performance of major repairs.

Assigned Duty Air Force Specialty Code - The Air Force Specialty to which a member is assigned.

Assigned Labor Code - The labor category to which the employee is normally assigned.

Assigned Labor Hours - The available labor hours for the individual or organization for the month. Calculated at hours per day times workdays per month, excluding holidays, and weekends.

Assigned Organization Code - A two-digit alphanumeric code that identifies a specific organization.

As-of Date - The date a transaction file, product, report, etc., was processed.

Authorized AFSC - The authorized Air Force specialty for a specific UMD position or job.

Available Hours - The quantity of hours a vehicle is available for use during any given time period (normally one month); the quantity of hours available for the period; the number of hours an employee is available for the period.

Available Hours Total - The total military and civilian labor hours available during the month.

Average Cost Per Mile - The average cost associated with each mile, hour, or kilometer a vehicle is used/driven/operated.

Average Cost Per Unit - The average cost associated with each vehicle per month.

Average Cumulative Miles/Hours Per Vehicle - The average miles/hours of utilization per vehicle each month.

Average Direct Cost Per Vehicle - The average direct cost per vehicle each month.

Average Direct Labor Hours Per Vehicle - The average direct labor hours expended against each vehicle per month.

Average Hourly Wage Rate - The average rate of pay per person for the work center or shop.

Average Hours Operated Per Vehicle - The average hours operated/used per vehicle each month.

Average Hours Per Gallon - The average hours operated/used per gallon of fuel.

Average Miles Driven Per Vehicle - The average miles driven per vehicle each month.

Average Miles Per Day - The average miles/hours/kilometers driven per vehicle each day.

Average Miles Per Gallon - The average miles driven per vehicle for each gallon of fuel.

Backlog Hours - The hours it would take to perform all the identified jobs for a particular vehicle, group of vehicles or all vehicles.

Base Code - The geographic location code.

Base DODAAC - The six-digit alphanumeric designator for a base.

Begin Date - The date you want an inquiry to begin.

Bin Location - The physical location where parts are stored.

Budget Code - Supply data element that allows VIMS transactions to be input to the SBSS without change.

Bypass Indicator - Used to signal the computer to accept transactions that have had certain areas manually verified as being correct.

Data Code - A one-person alpha code that identifies the basic transaction. Used in conjunction with the type transaction.

Data ID - The identifier for quarterly products. Always 1, 2, 3, or 4.

Cause Code - The alphanumeric code that identifies the cause or reason for an error condition on the parameter cards.

Charge Code - An alpha code that identifies how a part is to be charged or not charged.

Civilian Fringe Benefit Percent - The factor that is included for civilian employee's fringe benefits such as leaves, holiday pay, etc.

Civilian Overtime Labor Rate - The rate of pay per civilian for labor hours documented as overtime.

Close Date - The date vehicle repairs are completed.

Close Time - The time (24-hour clock) which repairs were completed.

Closed Indicator - Used to show a work order have "closed" in the system. Remains on PCN SB004018 until removed from the vehicle work order file.

Command Code - The code that identifies the major command that owns the vehicle.

Composition Select - A code that identifies how monthly analysis statistics are displayed.

Contract Cost - The cost of repairs performed by contract maintenance.

Contract Maintenance Indicator - An indicator that shows that a vehicle is having repairs performed by a contractor.

Contract Maintenance Labor Hours - The labor hours expended by contractors performing vehicle repairs.

Contract Material Cost - The cost of parts expended by contractors performing vehicle repairs.

Contract or OGA Cost - The cost of repairs performed by contract maintenance or other government agencies.

Contract Repair Maintenance Man-Hours Accident - Total hours expended by contractors repairing accident damaged vehicles.

Contract Repair Cost - Total cost of repairs performed by a contractor.

COPARS Material Cost - Cost of parts procured through the Contractor Operated Parts Store.

COPARS Part Number - The number which identifies a specific part.

COPARS Sales Slip Number - The control number of the parts invoice used by the Contract Operated Parts Store to issue vehicle parts and supplies.

Cost - The dollar value of a part or piece of equipment or expended labor.

Cost Per Hour - The total cost associated with each hour operated.

Cost Per Mile/Hour/Kilometer - The total cost associated with each mile, hour, or kilometer is used/driven/operated.

Cost Per Vehicle - The cost of operation/maintenance of a vehicle for a given period of time. Calculated by dividing total cost by inventory.

Cumulative Miles/Hours/Kilometers - The total miles/hours/kilometers that a vehicle has accumulated to date.

Curb Shipping Weight - The weight of a vehicle (in pounds) in a state of shipping readiness.

Current Miles/Hours/Kilometers - The most-current miles/hours/kilometers on a vehicle at any given time.

Date - The date the repairs were accomplished.

Date Assigned to Organization - The date that the vehicle was assigned to the using organization.

Date (BEGIN) - The date you want the inquiry to begin.

Date Delayed - The date at which maintenance was delayed for any reason.

Date Due - The date the next scheduled maintenance is required.

Date (END) - The Date you want the inquiry to end.

Date of Last Actual Update - The last date that the vehicle Master Record was updated.

Date Opened - The date the maintenance repair actions begin.

Date Read - The date the odometer/hourmeter was read and recorded on PCN SB004-064.

Date Received - The date the vehicle was turned in for maintenance.

Date Released - The date the vehicle repairs were completed.

Date Warranty Expires - The date the vehicle warranty will expire.

Day-of-the-Week Indicator - A single-character indicator used to "set" the system to a specific day of the week. Normally depicts Monday through Friday.

Delay Code - A single alpha character that identifies the reason a repair action cannot be accomplished at a particular time.

Delayed Days - The number of days a vehicle repair has been delayed for maintenance repair action.

Delayed Maintenance Indicator - An asterisk which indicates the vehicle has delayed maintenance repairs pending.

Delayed Reason - A clear-text abbreviated message that identifies the reason for a vehicle being delayed.

Depot Rebuild Date - The date the vehicle last received depot level maintenance repairs.

DIFM Indicator - A single-character that identifies those parts to be turned into Base Supply for Transportation to receive credit.

Direct Civilian Overtime Production Hours - The total indirect productive labor hours documented by civilians.

Direct Contract Cost - The total cost for parts and labor for repairs performed by a civilian contractor.

Direct Hours - The amount of time expended toward repair of vehicles or equipment.

Direct Hours (Civilian) - The amount of time spent performing direct labor by civilian employees.

Direct Hours Percent - The percentage of the available time spent performing direct maintenance.

Direct Hour Total - The total direct labor hours expended by civilian and military personnel.

Direct Labor Cost - The calculated cost of labor hours spent repairing vehicles/equipment.

Direct Maintenance Cost - The calculated cost of labor hours and parts for vehicle/equipment repair.

Direct Maintenance Labor Cost - The calculated cost of the labor charged for working on a vehicle.

Direct Maintenance Labor Hours (Civilian) - The documented labor hours by civilians toward vehicle/equipment repairs.

Direct Maintenance Labor Hours (Military) - The documented labor hours by military personnel toward vehicle/equipment repair.

Direct Maintenance Man-hours - The amount expended by military and civilian personnel toward vehicle/equipment repair.

Direct Maintenance Material Cost - The cost of all parts used to repair vehicles/equipment.

Direct Material Cost - The cost of all parts used to repair vehicles/equipment.

Direct Military Overtime Productive Hours - The total indirect productive labor hours documented by military personnel for overhead jobs.

Direct Operating Costs - The total operations direct cost and total operations indirect cost.

Direct to Estimated Labor Hour Variance - The percentage that the estimated hour are of the direct hours.

Document Number - The identification number assigned to each Base Supply requisition document.

ERRC - A Base Supply data element that passes through VIMS to allow the VIMS card to be input to the Base Supply System without change.

Effective Date - The date the employee is assigned duty in the appropriate work center.

Element of Expense Investment Code (EEIC) - Used by Base Supply to identify specific stock fund divisions and sources of supply.

Employee Name - The last name of the employee that performed the maintenance.

Employee Number - A locally assigned identification number used to identify each employee assigned.

End Date - The date you want the inquiry to end.

Estimated Hours - The usual number of hours needed to complete a repair job, either as established locally or found in commercial flat rate schedules.

Estimated Labor Hours - See Estimated Hours.

Estimated vs Direct Hours Percent - The total estimated hours divided by the total direct hours.

Extended Cost - The total cost of all fuel, oil or parts issued to a particular vehicle.

FAD CODE - Force Activity Designator.

File Identifier - A code used to identify the file you are wishing to access.

Fuel Code - A code used to identify the type fuel used by the vehicle's prime mover engine.

Fuel Cost - The cost of fuel for any given period for a vehicle, group of vehicles, or the entire fleet.

Fuel Gallons - The amount of fuel issued to a vehicle/equipment in gallons.

Fuel Grade Code - A three-digit code used to identify the grade of fuel used in vehicles/equipment.

Fuel Quantity - See Fuel Gallons.

Fuel Type - See Fuel Code.

Grade - A step or degree in a graduated scale which relates to the employee's wage rate as established by law or regulation.

Group Code - An optional use code to assign vehicles to categories for grouping on the daily VOC report and the monthly executive summary.

Height - The actual height of the vehicle in inches.

Home Base Organization - A code which identifies a specific vehicle's home organization.

Hourly Delayed Code C - The total backlog hours identified with maintenance code "C".

Hourly Labor Rate - The employee's actual hourly wage rate. For military, get from AFM 177-101. For civilians, get from civilian payroll unit.

Hourly Wage Rate - See hourly labor rate.

Hours This Period - The amount of hours operated during this reporting period.

Indirect Cost - Total of all indirect cost which includes 20-series time or all overhead associated with the maintenance activity.

Indirect Civilian Overtime Productive Hours - The indirect productive labor hours documented as overtime by civilian employees.

Indirect Facility and Utilities Expense - The calculated cost for facility and utility expense.

Indirect Hours - The number of hours associated with overhead or administrative support functions not related to a specific vehicle.

Indirect Hours Percent - The percentage of the available time spent doing overhead tasks.

Indirect Labor Expense - The calculated cost for 20-, 40-, or 50-series labor hours documented.

Indirect Maintenance Costs - Total of all L9999 parts and 20-, 40-, or 50-series labor, plus all time charged on J9996, J9998, and J9999 work orders.

Indirect Maintenance Labor Costs - The cumulative total of 20-, 40-, and 50-series time plus all time charged on J9996, J9998, and J9999 work orders.

Indirect Maintenance Material Cost - The cumulative total of all L9999 parts purchased with charge code "M" and $.75 times the number of vehicles.

Indirect Maintenance Nonproductive Cost - The calculated total of all 40- and 50-series labor hours.

Indirect Maintenance Nonproductive Hours - The total time spent in 40- or 50-series labor. The hours do not represent a productive effort in the maintenance activity.

Indirect Maintenance Productive Cost - The calculated total of all 20-series labor hours.

Indirect Maintenance Productive Hours - The total time spent performing overhead tasks.

Indirect Material Expense - The cumulated total of all L9999 parts purchased with charge code "M" and $.75 per vehicle for facilities and utilities expense.

Indirect Military Overtime Productive Hours - The indirect 20-series labor hours documented as overtime for military employees.

Indirect Operating Cost - The cumulative total of 20-series labor cost, 40- and 50-series labor cost, $.167 per registered vehicle and an amount of prorated cost.

Indirect Productive (20) Hours - The total indirect productive labor hours for the month for overhead tasks.

In-House Maintenance Repair Hours Accident - The amount of hours used in-house to repair vehicles having accident damage.

In-House 01 Cost - The total of all parts and labor expense accomplished in-house.

In-Shop Direct Labor Cost - The calculated cost of all direct labor expended against work orders.

In-Shop Direct Labor Hours - The total direct labor hours documented on work orders.

In-Shop Direct Material Cost - The total of all parts used in the repair of vehicles/equipment.

In-Shop Total Direct Cost - The calculated sum of labor and material costs used in the repair of vehicles/equipment.

Interval Miles/Hour/Kilometers - The interval in either miles/hours/kilometers between scheduled inspections.

Interval in Months - The interval in months between scheduled inspections.

In-Use National Stock Number - An identification number assigned to each vehicle/equipment to be used in determining replacement.

Inventory - The number of vehicles assigned to a particular group code, management code, series, organization, or base.

Issue Date - The date that the part was issued from either COPARS or Base Supply.

Issue Organization - The organization to which the fuel issue was made.

Issuing Station - A two-digit alphanumeric code which identifies the fuel servicing location.

I & E Standard Price - The replacement cost of a vehicle or piece of equipment.

Item Code - A Base Supply data element which passes through VIMS in the "REM" and "FCI" transactions and allows "FCI" transactions to be input to the SBSS without change.

Job Number - The number on the work order forms corresponding to a line containing a description of the work to be accomplished.

Julian Date - The date format received in the VIM cards from Base Supply.

Labor Code - Used to identify the type of work to be completed.

Labor Cost - The cost associated with the time spent working on vehicles/equipment.

Labor Hours - The amount of time spent working on a particular repair action on a vehicle as is recorded on the work order.

Labor Time - See Labor Hours.

Last Calendar Day of the Processing Month - The date entered in the new-month parameter card.

Last Day of the New-Month - See last calendar day of the processing month.

Last Name, First Initial - The last name and first initial of the employee being loaded in VIMS.

Last Two of Registration Number - The last two digits of the vehicle registration number as input on the "WZ" transaction.

Length - The actual length of the vehicle in inches.

Life Expectancy Years - The total number of years that a vehicle is projected to last as reflected in TO 36A-1-1301.

Lower Control Limit - The calculated value used to plot values on the Automated Analysis.

Maintenance Code - A code that identifies the reason a repair cannot be accomplished at that particular time.

Maintenance (01) Hours Recorded - The total direct hours for maintenance repairs documented for the month.

Maintenance Labor Cost - The cost of the labor charged for working on a vehicle.

Maintenance Material Cost - The cost of all parts used to repair a vehicle or piece of equipment.

Maintenance Schedule Date, Week 1, 2, 3, 4 - The projected scheduled maintenance actions for the month as shown in weekly intervals.

Major Command Code - The code that identifies that command that owns the vehicle.

Employee Number - A locally assigned identification number used to identify each assigned employee.

Manufacturer Code - A code used in the SBSS "REM" transactions to aid in identifying manufacturers.

Material Cost - See Maintenance Material Cost.

Mean - The computed center point used in charting figures on Automated Analysis.

MRF Code - A Base Supply data element which passes through VIMS in the "REM" and "FCI" transaction; thus allowing the "FCI" card to be input to the SBSS with change.

Mile/Hour/Kilometer/Unit Code - A code that identifies how the vehicle/equipment utilization is recorded.

Miles/Hours/Kilometers - The odometer/hourmeter of a vehicle/equipment when it is turned into maintenance as recorded on the work order.

Miles/Hours/Kilometers Per Gallon - An estimated average on initial input; otherwise, the 6-month weighted average applies.

Miles/Hours/Kilometers Per Day - An estimated average on initial input; otherwise, the 6-month weighted average applies.

Miles/Hours/Kilometers Warranty Expires - The miles/hours/kilometers at which the warranty will expire.

Miles This Period - The miles/hours/kilometers accumulated during this reporting period.

Minor Maintenance VDM Hours - The amount of hours a vehicle/equipment was out-of-commission due to minor repairs.

Minor Maintenance Work Orders Closed - The number of times vehicles/equipment were repaired using work order number J9999.

Months - The monthly interval that a particular scheduled maintenance action is due.

Name - The last name and first initial for each assigned employee.

National Stock Number - An identification number assigned to each vehicle or piece of equipment.

Next-Due Date - The date when the next scheduled maintenance action is due in for maintenance.

Next-Due Miles/Hours/Kilometers - The actual miles/hours/kilometers when the next scheduled maintenance action is due.

Next-Due Date - The actual miles/hours/kilometers and date when the next scheduled maintenance action is due.

Nomenclature - A short description of a vehicle, part, or piece of equipment.

Nonproductive (40) Hours Recorded - The total indirect nonproductive hours expended for leave for the month.

Nonproductive (50) Hours Recorded - The indirect nonproductive hours spent for military duties, meetings, etc., for the month.

Nonshop Direct Contract Cost - See Contract Cost.

Nonshop Direct OGA Cost - See Contract of OGA Cost.

Nuclear Certified Indicator - A one-digit alpha designator assigned to those vehicles identified in TO 00-110N-16 as nuclear certified.

Number of Accidents - The total number of work orders identified as accident repair.

Number of Days Being Processed - The number of days processing being input in VIMS daily input deck.

Number of Hours - The actual number of hours it takes to complete a vehicle/equipment repair.

Number of Vehicles Delayed - The total number of vehicles/equipment having delayed maintenance.

Number of Work Orders Opened - The number of open work orders accepted during the month.

Obligated Cost COPARS - The total cost, other than Base Supply items, expended during the month regardless of the work order number used to order them.

Obligated Cost Supply - The total cost, other than COPARS item, expended during the month regardless of the work order number used to order them.

Off-Base Cost - The total of all service obtained from commercial services.

Off-Base Fuel Cost - The cost of all fuel purchased from commercial services.

Off-Base Fuel Gallons - The amount of gallons of fuel purchased from commercial sources.

Off VDP Date - The date parts are received for a deadlined maintenance repair.

Off VDP Time - The 24-hour clock time at which deadlined parts are received.

OGA Cost - See Contract/OGA Cost.

OGA Material Cost - The total cost of parts used for a vehicle repair by another government agency.

Oil Quantity - The amount of oil issued to a vehicle/equipment in quarts.

Oil Quarts - See Oil Quantity.

OLVIMS Indicator - a single character used to identify the type site to the computer.

On-Base Fuel Cost - The cost of all fuel purchased through the base supply system.

On-Base Fuel Gallons - The amount in gallons of fuel purchased through the base supply system.

One-Time Repair Limit - The total dollar amount that can be spent to repair a vehicle or piece of equipment at any one time.

One-Time Repair Limit Exceeded Indicator - Used to signal the computer that repairs will not be made because the one-time limit would be exceeded. This will cause the computer to update the replacement code.

On VDP Date - The date a vehicle or piece of equipment is placed out of commission due to a lack of parts.

On VDP Time - The 24-hour clock time a vehicle or piece of equipment is placed out of commission due to a lack of parts.

OPS and Maintenance Direct Material Cost - The total amount of all labor expended toward maintenance repair.

Optional Product Indicator - A indicator "Y" put in the YB End-of-Day processing transaction to enable the users to select products (PCNs) they want.

Organization Code - A two-digit alphanumeric code that identifies a specific organization.

Organization Fuel Code - A code used to identify the specific organization receiving the fuel.

Other Government Agency Repair Cost - See contract/OGA cost.

Other Government Agency Repair Indicator - Indicates the repairs listed on that work order were completed by another government repair agency.

Overtime (20) - The total overtime spent as supervision for the month.

Overtime Indicator - Shows the repairs were completed by an individual working overtime.

Overtime Labor Rate - The overtime rate of civilian employees only, as received from the civilian payroll unit.

Overdue Indicator - An asterisk (*) to show the scheduled maintenance for a vehicle is overdue.

Owning Command Code - The code that identifies the major command that owns the vehicle.

Parts Availability Date - The date when the delayed parts were received.

Parts Cost - The dollar amount that the parts received cost.

Parts Status Code - A code used to indicate that parts have been partially or completely received.

Part Number - An identification number assigned to each part. Used when parts are procured through commercial sources and are not in the Air Force stock list.

Parts Total - The total cost of parts for a work order.

PCN Selection - An indicator used to identify to the computer which listings are to be produced.

Percent of Inventory - The calculated percentage of vehicles within specified replacement code block.

Percent VDM - The percentage of time the vehicle was out-of service due to maintenance.

Percent VDP - The percentage of time the vehicle was out-of service due to lack of parts.

Percent VIC - The percentage of time the vehicle was in-commission (serviceable).

Percent VOC - The percentage of time the vehicle was out-of-commission for parts and labor.

Percentage Direct Hours - The number of direct hours expended for the month versus the available hours.

Percentage Indirect Nonproductive Hours - The number of indirect nonproductive hours expended for the month versus the available hours.

Percentage Indirect Productive Hours - The number of indirect productive hours expended for the month versus the available hours.

Period Hours - The total number of hours operated for a specific vehicle or group code.

Period Miles - The total number of miles estimated/driven for a vehicle or group code.

Post-Post Indicator - An indicator to signal the computer that the part was issued post-post and special action is required.

Primary AFSC - The employee's primary Air Force specialty code as listed in the personnel records. The AFSC in which the individual is most qualified to perform duty.

Processing As-of Date - The date a transaction file, product, report, etc., was processed.

Processing Day-of-the-Week Code - A code used to set the system to a specific day of the week. Normally depicts Monday through Friday.

Product ID - A code used in the SBSS computer to identify either oil or fuel issues.

Quantity Issued - The number of items received.

Quantity Used - The number of parts used in the repair action.

Rank/Grade Code - A three-digit code that identifies the civilian/military status and rank/grade.

Ratio Indirect/Direct - The calculated percentage which represents what portion indirect productive time is to direct time.

Rebuild Date - The date the vehicle last received depot level maintenance repairs.

Record Close Out Date - The last day of a reporting period.

Record Count - The total number of records within a particular management code or group.

Record ID - An identifier used to help locate the particular record you wish to access.

Registration Number - An identification number assigned to each vehicle/piece of equipment for which Transportation has the maintenance responsibility. For registered vehicles, it is assigned by Warner Robins ALC. For nonregistered vehicles, it is assigned locally.

Release Date - The date vehicle repairs were completed as recorded on the work order.

Rental/Leased Indicator - A single-character used to identify to the computer the vehicle is rented or leased and no VIM transaction will be produced.

Repair Amortization Date - The date to which a vehicle must be retained in order to justify performing major repairs.

Replacement Code - A code assigned to a vehicle that shows its eligibility for replacement.

Replacement Miles/Hours/Kilometers Criteria - The miles/hours/kilometers at which a vehicle or piece of equipment is expected to reach its life expectancy.

Report Date - The date any given report was produced.

Responsibility Center/Cost Center (RC/CC) Code - A code that identifies resource consuming areas to the lowest level possible within an organization.

Annual Inspections (Safety) Overdue - The total number of vehicles which have system code 34 overdue by mileage or date.

SBSS - Standard Base Supply System.

Scheduled Inspections Overdue - The total number of vehicles which have system codes 35-38 overdue by mileage or date.

Scheduled LOF Inspection - A planned inspection or service against system code 35.

Scheduled Maintenance - A planned inspection or service performed at regular intervals of either calendar time, miles/hours/kilometers of operation.

Scheduled Maintenance System Codes - The system codes 34-38 that identify specific scheduled maintenance actions.

Scheduled/Lube Oil Filter, M/H/K Date - The next time a vehicle is due a lube, oil, and filter change, either by miles, hours, kilometers, or date.

Shop Code - A two-digit code assigned by Base Supply to identify the shop receiving the issue.

Source - The organization that procured the parts, either Base Supply or COPARS.

Special Inspection (1, 2, 3) M/H/K/Date - The next miles/hours/kilometers or date that the particular special inspections are due.

Standard Price - The unit price of an item listed on the Air Force stock list.

Status Code - An identifier that shows the status/condition/location of a particular vehicle.

Stock Record Account Number (SRAN) - A code used to identify the Base Supply fuels account.

Supply Document Number - The identification number assigned to each Base Supply requisition document.

System Code - A code number that identifies the vehicle system and component that received repairs.

This Period Average Maintenance Cost Per Vehicle - The calculated cost of all total maintenance cost versus the inventory.

This Period Average Maintenance/Ops Cost Per Vehicle - The calculated cost of the total maintenance costs and the total operating cost.

This Period Average Miles/Hours Per Vehicle - The calculated average of total miles/hours versus inventory count.

This Period Average VDM Percent - The calculated percentage of VDM hours versus available hours.

This Period Average VDP Percent - The calculated percentage of VDP hours versus available hours.

This Period Average VIC Percent - The calculated percentage of total in-commission hours versus available hours.

This Period Total Ops and Maintenance CPMI/HR - The total cost associated with each mile/hour/kilometer a vehicle is used/driven/operated this reporting period.

Total Backlog Hours - The hours it would take to perform all the identified jobs for a particular vehicle, group of vehicles or for all vehicles.

Total Direct Cost - The total cost of all parts and labor associated to a work order.

Total Maintenance Cost - The total of all parts and labor charged to the repair of vehicles in the reporting period.

Total Operating Cost - The total of all operating (fuel, oil, etc.,) costs charged to vehicles during the period.

Total Operating Direct Cost - The cost of both on-base and off-base fuel cost.

Total Operating Indirect Cost - The cost of 20-, 40-, and 50-series labor hours documented by vehicle operations and a proration of indirect cost.

Total Ops and Maintenance Direct Cost - The total of all indirect and direct costs associated with the fleet.

Transient ID - A code used to show a vehicle that is not assigned to the base where services were received.

Type Inquiry ID - A code used to identify to the computer the type of inquiry desired.

Uneconomical Repair Cost - The total cost for all work orders that exceeded the applicable vehicle's one-time repair limit.

Unit of Issue - The unit of measurement to show how items are issued.

Unit Price - The dollar value of each item-of-issue.

USAF Management Code - A code assigned to a vehicle for identification purposes.

Vehicle Amortization Date - The date a vehicle must be retained in order to justify performance of major repairs.

Vehicle Deadlined for Maintenance (VDM) - A vehicle placed in an out-of-commission status for needed maintenance.

Vehicle Deadlined for Maintenance Hours - The amount of hours that a vehicle was out-of-commission for maintenance.

Vehicle Deadlined for Maintenance Percent - The percentage of the time the vehicle was out-of-commission for maintenance.

Vehicle Deadlined for Parts (VDP) - A vehicle placed in an out-of-commission status because of the nonavailability of parts.

Vehicle Deadlined for Parts Hours - The amount of hours that a vehicle was out-of-commission for the nonavailability of parts.

Vehicle Deadlined for Parts Percent - The percentage of time the vehicle was out-of-service because of nonavailability of parts.

Vehicle Equivalent - A unit of measure that denotes the maintenance complexity of a vehicle or item of equipment. Used to determine manning, shop space and shop equipment requirements.

Vehicle Inventory - The total number of vehicles assigned.

Vehicle Make/Type - A short nomenclature that identifies the vehicle by manufacturer and design.

Vehicle Out-of-Commission - A vehicle placed in an out-of-commission status due to lack of parts or needed maintenance.

Vehicle Out-of-Commission Percent - The percentage of time the vehicle was out-of-commission for parts and labor.

Warranty Expiration Date - The date warranty on a vehicle will expire.

Warranty Expiration Miles/Kilometers - The miles/kilometers at which the warranty will expire.

Work Center Code - A sequestered section within the vehicle maintenance activity that performs service, repair, administrative, or support functions.

Work Order Number - A locally assigned number used to control the work order an to indicate to the computer any special costing procedures.

Work Order Total - The total of parts and labor for a work order.

Work Order Closed - The total number of work orders closed against the vehicle for the month.

Work Orders Open - The number of work orders opened on the vehicle for the period of the report.

(AFM 77-320, Vol 1, 1992:A3-1 through A3-26)

Appendix B: Utilization Analysis Report Example Page

PREPARED 94 JAN 28 — FLEET MANAGEMENT REPORT — AS OF 94 JAN 28 — PCN SB004-245

MGMT CODE	ORGN CODE	RESIS NUMBER	CUM M/H/K	M/H/K THIS PER	AVG MHK PER MO.	% OF AF GOAL	OPS COST	MAINT COST	O&M CST P MI	VOC %	MONTHS
D503	OD	87D00971	1019	77	8.6	0.0	75.40	704.42	10.13	3.8	9
D503	3Y	88D00792	961	212	17.7	0.0	6861.12	4351.72	52.89	2.0	12
D503	5I	80D01050	8799	1832	152.7	0.0	6920.57	6025.47	7.07	8.5	12
D503	5I	82D00217	7407	662	55.2	0.0	6937.60	5558.86	18.88	10.2	12
D503	5I	87D00971	963	90	30.0	0.0	21.70	1551.62	17.48	12.0	3
MGMT CODE TOTALS :			19149	2873			20816.39	18192.09	13.58		

TOTAL VEH IN MGT CODE: 5
AF GOAL FOR MILEAGE : 0
AVG MILES PER VEHICLE: 575
AVG COST PER VEHICLE : 7801.70
AVERAGE AGE : 9.2

MGMT CODE	ORGN CODE	RESIS NUMBER	CUM M/H/K	M/H/K THIS PER	AVG MHK PER MO.	% OF AF GOAL	OPS COST	MAINT COST	O&M CST P MI	VOC %	MONTHS
D547	3N	88D00492	393	68	5.7	0.0	28.70	4566.75	67.58	2.5	12
D547	3Y	88D00493	415	168	14.0	0.0	50.60	310.59	2.15	0.7	12
D547	3Y	88D00494	466	54	4.5	0.0	25.20	4377.49	81.53	3.6	12
MGMT CODE TOTALS :			1274	290			104.50	9254.83	32.27		

TOTAL VEH IN MGT CODE: 3
AF GOAL FOR MILEAGE : 0
AVG MILES PER VEHICLE: 97
AVG COST PER VEHICLE : 3119.78
AVERAGE AGE : 6.0

MGMT CODE	ORGN CODE	RESIS NUMBER	CUM M/H/K	M/H/K THIS PER	AVG MHK PER MO.	% OF AF GOAL	OPS COST	MAINT COST	O&M CST P MI	VOC %	MONTHS
D548	MR	78D00202	3992	251	20.9	0.0	0.00	696.67	2.78	0.8	12
MGMT CODE TOTALS :			3992	251			0.00	696.67	2.78		

TOTAL VEH IN MGT CODE: 1
AF GOAL FOR MILEAGE : 0
AVG MILES PER VEHICLE: 251
AVG COST PER VEHICLE : 696.67
AVERAGE AGE : 16.0

MGMT CODE	ORGN CODE	RESIS NUMBER	CUM M/H/K	M/H/K THIS PER	AVG MHK PER MO.	% OF AF GOAL	OPS COST	MAINT COST	O&M CST P MI	VOC %	MONTHS
D560	MR	94D00366	844	92	7.7	0.0	60.20	362.32	4.59	1.4	12
MGMT CODE TOTALS :			844	92			60.20	362.32	4.59		

Appendix C: Lease Information for Four AFMC Installations

EGLIN AFB

Management Code and Nomenclature	Rates Hourly	Daily	Weekly	Monthly	Yearly
D503 - Crane (15 Ton)					
D515 - Crane (7 1/2 Ton)					
D569 - Dozer (T7)			$ 2200	$ 6500	$ 70200
D570 - Dozer (T9)			2850	8500	91800
D572 - Dozer (T4)			1000	3000	32400
D626 - Backhoe (w/loader)			550	1600	17280
D631 - Loader (1-1/2 to 2 CY)			1100	3250	35100
D632 - Loader (2-1/2 to 3-1/2 CY)			1400	4000	43200
D653 - Grader					
D655 - Grader			1500	4500	48600
D676 - Road Roller (5-8 Ton)			600	1750	18900

Name of Firm: Thompson Tractor Company

Phone Number of Firm: (901) 526-2241

Miles From Base: 55

Maintenance Included?: Yes

Date of Contact: 22 June 1994

EGLIN AFB

Management Code and Nomenclature	Rates Hourly	Daily	Weekly	Monthly	Yearly
D503 - Crane (15 Ton)					
D515 - Crane (7 1/2 Ton)					
D569 - Dozer (T7)		$ 500	$ 2000	$ 5800	$ 69600
D570 - Dozer (T9)					
D572 - Dozer (T4)		300	1000	2750	33000
D626 - Backhoe (w/loader)		250	900	2700	32400
D631 - Loader (1-1/2 to 2 CY)		250	1000	2800	33600
D632 - Loader (2-1/2 to 3-1/2 CY)		275	1100	3290	39480
D653 - Grader		250	1200	3300	39600
D655 - Grader		325	1300	3900	46800
D676 - Road Roller (5-8 Ton)		250	1000	2800	33600

Name of Firm: Beard Construction Company

Phone Number of Firm: (901) 769-4844

Miles From Base: 50

Maintenance Included?: Yes

Date of Contact: 22 June 1994

EGLIN AFB

Management Code and Nomenclature	Rates Hourly	Daily	Weekly	Monthly	Yearly
D503 - Crane (15 Ton)					
D515 - Crane (7 1/2 Ton)		$ 275	$ 900	$ 2650	31800
D569 - Dozer (T7)		450	1750	5200	56160
D570 - Dozer (T9)					
D572 - Dozer (T4)		280	1100	2800	30240
D626 - Backhoe (w/loader)		185	595	1500	16200
D631 - Loader (1-1/2 to 2 CY)					
D632 - Loader (2-1/2 to 3-1/2 CY)					
D653 - Grader					
D655 - Grader					
D676 - Road Roller (5-8 Ton)		175	550	1450	17400

Name of Firm: Coastal Machinery Company

Phone Number of Firm: (901) 476-7988

Miles From Base: 50

Maintenance Included?: Yes

Date of Contact: 22 June 1994

EGLIN AFB

Management Code and Nomenclature	Rates Hourly	Daily	Weekly	Monthly	Yearly
D503 - Crane (15 Ton)	$ 87	$ 466	$ 1380	$ 3650	$ 43800
D515 - Crane (7 1/2 Ton)	(Hourly rate is with operator; other rates are without operator)				
D569 - Dozer (T7)					
D570 - Dozer (T9)					
D572 - Dozer (T4)					
D626 - Backhoe (w/loader)					
D631 - Loader (1-1/2 to 2 CY)					
D632 - Loader (2-1/2 to 3-1/2 CY)					
D653 - Grader					
D655 - Grader					
D676 - Road Roller (5-8 Ton)					

Name of Firm: Deep South Equipment

Phone Number of Firm: (901) 785-7099

Miles From Base: 60

Maintenance Included?: Yes

Date of Contact: 22 June 1994

EGLIN AFB

Management Code and Nomenclature	Rates Hourly	Daily	Weekly	Monthly	Yearly
D503 - Crane (15 Ton)	$ 65 (With operator; only lease hourly)				
D515 - Crane (7 1/2 Ton)					
D569 - Dozer (T7)					
D570 - Dozer (T9)					
D572 - Dozer (T4)					
D626 - Backhoe (w/loader)					
D631 - Loader (1-1/2 to 2 CY)					
D632 - Loader (2-1/2 to 3-1/2 CY)					
D653 - Grader					
D655 - Grader					
D676 - Road Roller (5-8 Ton)					

Name of Firm: Steel City Equipment

Phone Number of Firm: (901) 785-9596

Miles From Base: 55

Maintenance Included?: Yes

Date of Contact: 22 June 1994

EGLIN AFB

Management Code and Nomenclature	Rates Hourly	Daily	Weekly	Monthly	Yearly
D503 - Crane (15 Ton)					
D515 - Crane (7 1/2 Ton)					
D569 - Dozer (T7)			$ 2070	$ 6200	$ 74400
D570 - Dozer (T9)			3350	10000	120000
D572 - Dozer (T4)			740	2800	33600
D626 - Backhoe (w/loader)			600	1800	21600
D631 - Loader (1-1/2 to 2 CY)			1000	3000	36000
D632 - Loader (2-1/2 to 3-1/2 CY)			1350	4000	48000
D653 - Grader			1350	4000	48000
D655 - Grader			3000	6000	72000
D676 - Road Roller (5-8 Ton)					

Name of Firm: Tractor Equipment Company

Phone Number of Firm: (901) 763-4659

Miles From Base: 60

Maintenance Included?: Yes

Date of Contact: 22 June 1994

TINKER AFB

Management Code and Nomenclature	Rates Hourly	Daily	Weekly	Monthly	Yearly
D503 - Crane (15 Ton)					
D515 - Crane (7 1/2 Ton)					
D569 - Dozer (T7)		$ 550	$ 1650	$ 4950	$ 59400
D570 - Dozer (T9)					
D572 - Dozer (T4)		190	570	1710	20520
D626 - Backhoe (w/loader)		220	660	1980	23760
D631 - Loader (1-1/2 to 2 CY)		345	1034	3100	37200
D632 - Loader (2-1/2 to 3-1/2 CY)		434	1300	3900	46800
D653 - Grader					
D655 - Grader					
D676 - Road Roller (5-8 Ton)		145	434	1300	15600

Name of Firm: OCT Equipment

Phone Number of Firm: (405) 789-6812

Miles From Base: 20

Maintenance Included?: Yes

Date of Contact: 22 June 1994

TINKER AFB

Management Code and Nomenclature	Rates Hourly	Daily	Weekly	Monthly	Yearly
D503 - Crane (15 Ton)					
D515 - Crane (7 1/2 Ton)					
D569 - Dozer (T7)		$ 600	$ 1700	$ 4500	$ 54000
D570 - Dozer (T9)		950	2800	8500	102000
D572 - Dozer (T4)		300	900	2500	30000
D626 - Backhoe (w/loader)		200	660	1900	22800
D631 - Loader (1-1/2 to 2 CY)		300	750	2500	30000
D632 - Loader (2-1/2 to 3-1/2 CY)		400	700	3300	39600
D653 - Grader		400	1175	3500	42000
D655 - Grader		475	1350	4000	48000
D676 - Road Roller (5-8 Ton)		350	1100	3250	39000

Name of Firm: C. L. Boyd Company

Phone Number of Firm: (405) 235-4563

Miles From Base: 7

Maintenance Included?: Yes

Date of Contact: 22 June 1994

TINKER AFB

Management Code and Nomenclature	Rates Hourly	Daily	Weekly	Monthly	Yearly
D503 - Crane (15 Ton)				$ 3600	$ 43200
D515 - Crane (7 1/2 Ton)				2400	28800
D569 - Dozer (T7)			$ 2000	6000	72000
D570 - Dozer (T9)			3000	9000	108000
D572 - Dozer (T4)			885	2650	31800
D626 - Backhoe (w/loader)					
D631 - Loader (1-1/2 to 2 CY)			800	2400	28800
D632 - Loader (2-1/2 to 3-1/2 CY)			1100	3300	39600
D653 - Grader					
D655 - Grader			1350	4000	48000
D676 - Road Roller (5-8 Ton)			900	2700	32400

Name of Firm: Kirby-Smith Machinery Inc.

Phone Number of Firm: (405) 495-7820

Miles From Base: 15

Maintenance Included?: Yes

Date of Contact: 22 June 1994

TINKER AFB

Management Code and Nomenclature	Rates Hourly	Daily	Weekly	Monthly	Yearly
D503 - Crane (15 Ton)			$ 1150	$ 3500	$ 42000
D515 - Crane (7 1/2 Ton)					
D569 - Dozer (T7)			2167	6500	62400
D570 - Dozer (T9)			2967	8900	90000
D572 - Dozer (T4)			767	2300	19500
D626 - Backhoe (w/loader)			420	1250	15000
D631 - Loader (1-1/2 to 2 CY)			834	2500	20700
D632 - Loader (2-1/2 to 3-1/2 CY)			1334	4000	34800
D653 - Grader			1500	4500	44400
D655 - Grader			1415	4250	42000
D676 - Road Roller (5-8 Ton)			867	2600	27600

Name of Firm: Darr Equipment

Phone Number of Firm: (405) 947-6771

Miles From Base: 12

Maintenance Included?: Yes

Date of Contact: 22 June 1994

TINKER AFB

Management Code and Nomenclature	Rates Hourly	Daily	Weekly	Monthly	Yearly
D503 - Crane (15 Ton)	$ 70	$ 225	$ 950	$ 2700	$ 32400
D515 - Crane (7 1/2 Ton)					
D569 - Dozer (T7)					
D570 - Dozer (T9)					
D572 - Dozer (T4)					
D626 - Backhoe (w/loader)					
D631 - Loader (1-1/2 to 2 CY)					
D632 - Loader (2-1/2 to 3-1/2 CY)					
D653 - Grader					
D655 - Grader					
D676 - Road Roller (5-8 Ton)					

Name of Firm: Allied Steel Construction Company

Phone Number of Firm: (405) 232-7531

Miles From Base: 30

Maintenance Included?: Yes

Date of Contact: 22 June 1994

ROBINS AFB

Management Code and Nomenclature	Rates Hourly	Daily	Weekly	Monthly	Yearly
D503 - Crane (15 Ton)	$ 50	$ 400	$ 2000	$ 8000	$ 96000
D515 - Crane (7 1/2 Ton)					
D569 - Dozer (T7)					
D570 - Dozer (T9)					
D572 - Dozer (T4)					
D626 - Backhoe (w/loader)					
D631 - Loader (1-1/2 to 2 CY)					
D632 - Loader (2-1/2 to 3-1/2 CY)					
D653 - Grader					
D655 - Grader					
D676 - Road Roller (5-8 Ton)					

Name of Firm: Rosson Sign Company

Phone Number of Firm: (912) 788-3905

Miles From Base: 20

Maintenance Included?: Yes

Date of Contact: 23 June 1994

ROBINS AFB

Management Code and Nomenclature	Rates Hourly	Daily	Weekly	Monthly	Yearly
D503 - Crane (15 Ton)	$ 100	$ 720	$ 3600	$ 14400	NA
D515 - Crane (7 1/2 Ton)					
D569 - Dozer (T7)					
D570 - Dozer (T9)					
D572 - Dozer (T4)					
D626 - Backhoe (w/loader)					
D631 - Loader (1-1/2 to 2 CY)					
D632 - Loader (2-1/2 to 3-1/2 CY)					
D653 - Grader					
D655 - Grader					
D676 - Road Roller (5-8 Ton)					

Name of Firm: Specialty Cranes, Inc.

Phone Number of Firm: (912) 923-7595

Miles From Base: 1

Maintenance Included?: Yes

Date of Contact: 22 June 1994

ROBINS AFB

Management Code and Nomenclature	Hourly	Daily	Rates Weekly	Monthly	Yearly
D503 - Crane (15 Ton)					
D515 - Crane (7 1/2 Ton)					
D569 - Dozer (T7)		$ 670	$ 2000	$ 6000	$ 72000
D570 - Dozer (T9)		960	2880	8600	103200
D572 - Dozer (T4)		300	900	2700	32400
D626 - Backhoe (w/loader)		170	500	1500	18000
D631 - Loader (1-1/2 to 2 CY)		320	950	2800	33600
D632 - Loader (2-1/2 to 3-1/2 CY)		470	1410	4200	50400
D653 - Grader		585	1750	5250	63000
D655 - Grader		555	1665	5000	60000
D676 - Road Roller (5-8 Ton)		415	900	2700	32400

Name of Firm: Yancy Brothers Equipment

Phone Number of Firm: 1-800-282-1561

Miles From Base: 20

Maintenance Included?: Yes

Date of Contact: 22 June 1994

ROBINS AFB

Management Code and Nomenclature	Hourly	Rates Daily	Weekly	Monthly	Yearly
D503 - Crane (15 Ton)					
D515 - Crane (7 1/2 Ton)					
D569 - Dozer (T7)		$ 400	$ 1800	$ 6000	$ 72000
D570 - Dozer (T9)					
D572 - Dozer (T4)		275	1000	3000	36000
D626 - Backhoe (w/loader)		170	550	1600	18000
D631 - Loader (1-1/2 to 2 CY)		300	1100	3800	45600
D632 - Loader (2-1/2 to 3-1/2 CY)		350	1200	4200	50400
D653 - Grader					
D655 - Grader					
D676 - Road Roller (5-8 Ton)		150	600	1600	19200

Name of Firm: Central Georgia Equipment

Phone Number of Firm: (912) 956-3833

Miles From Base: 15

Maintenance Included?: Yes

Date of Contact: 22 June 1994

ROBINS AFB

Management Code and Nomenclature	Rates Hourly	Daily	Weekly	Monthly	Yearly
D503 - Crane (15 Ton)					
D515 - Crane (7 1/2 Ton)					
D569 - Dozer (T7)			$ 1934	$ 5800	$ 61800
D570 - Dozer (T9)					
D572 - Dozer (T4)			1135	3400	37200
D626 - Backhoe (w/loader)			770	2300	24600
D631 - Loader (1-1/2 to 2 CY)			1070	3200	36000
D632 - Loader (2-1/2 to 3-1/2 CY)			1200	3600	37200
D653 - Grader			1035	3100	34800
D655 - Grader			1370	4100	46800
D676 - Road Roller (5-8 Ton)					

Name of Firm: Forest Services Inc.

Phone Number of Firm: (912) 788-1586

Miles From Base: 8

Maintenance Included?: Yes

Date of Contact: 23 June 1994

WRIGHT PATTERSON AFB

Management Code and Nomenclature	Rates Hourly	Daily	Weekly	Monthly	Yearly
D503 - Crane (15 Ton)	$ 75	$ 300	$ 700	$ 2100	$ 25200
	(Hourly rate is with operator; other rates are without operator)				
D515 - Crane (7 1/2 Ton)					
D569 - Dozer (T7)			2070	6200	74440
D570 - Dozer (T9)			3350	10000	120000
D572 - Dozer (T4)			850	2200	26000
D626 - Backhoe (w/loader)			600	1800	21600
D631 - Loader (1-1/2 to 2 CY)			1000	3000	36000
D632 - Loader (2-1/2 to 3-1/2 CY)			1350	4000	48000
D653 - Grader			1350	4000	48000
D655 - Grader			2000	6000	72000
D676 - Road Roller (5-8 Ton)					

Name of Firm: Carlisle Equipment Company

Phone Number of Firm: (513) 268-3438

Miles From Base: 10

Maintenance Included?: Yes

Date of Contact: 24 June 1994

WRIGHT PATTERSON AFB

Management Code and Nomenclature	Rates Hourly	Daily	Weekly	Monthly	Yearly
D503 - Crane (15 Ton)					
D515 - Crane (7 1/2 Ton)					
D569 - Dozer (T7)		$ 722	$ 2467	$ 6500	$ 63528
D570 - Dozer (T9)		1072	3217	9650	94320
D572 - Dozer (T4)		283	850	2550	24924
D626 - Backhoe (w/loader)		200	600	1800	17592
D631 - Loader (1-1/2 to 2 CY)		300	900	2700	26388
D632 - Loader (2-1/2 to 3-1/2 CY)		469	1408	4225	41292
D653 - Grader		778	2333	7000	68424
D655 - Grader		761	2283	6850	66948
D676 - Road Roller (5-8 Ton)		150	415	1250	15000

Name of Firm: Holt-Refakis Equipment

Phone Number of Firm: (513) 236-4111

Miles From Base: 12

Maintenance Included?: Yes

Date of Contact: 21 June 1994

WRIGHT PATTERSON AFB

Management Code and Nomenclature	Rates Hourly	Daily	Weekly	Monthly	Yearly
D503 - Crane (15 Ton)					
D515 - Crane (7 1/2 Ton)					
D569 - Dozer (T7)					
D570 - Dozer (T9)					
D572 - Dozer (T4)		$ 250	$ 875	$ 2600	$ 31200
D626 - Backhoe (w/loader)		185	650	1850	22200
D631 - Loader (1-1/2 to 2 CY)					
D632 - Loader (2-1/2 to 3-1/2 CY)					
D653 - Grader					
D655 - Grader					
D676 - Road Roller (5-8 Ton)					

Name of Firm: New Carlisle Tractor

Phone Number of Firm: (513) 845-3843

Miles From Base: 10

Maintenance Included?: Yes

Date of Contact: 21 Jun 1994

WRIGHT PATTERSON AFB

Management Code and Nomenclature	Rates Hourly	Daily	Weekly	Monthly	Yearly
D503 - Crane (15 Ton)				$ 2500	$ 20400
D515 - Crane (7 1/2 Ton)				2000	18000
D569 - Dozer (T7)			$ 1833	$ 5500	$ 54000
D570 - Dozer (T9)			2500	7500	78000
D572 - Dozer (T4)			833	2500	25200
D626 - Backhoe (w/loader)			500	1500	12000
D631 - Loader (1-1/2 to 2 CY)			833	2500	24000
D632 - Loader (2-1/2 to 3-1/2 CY)			1167	3500	36000
D653 - Grader			1500	4500	48000
D655 - Grader			1833	5500	60000
D676 - Road Roller (5-8 Ton)			400	1200	12000

Name of Firm: Columbus Equipment Company

Phone Number of Firm: (513) 239-1523

Miles From Base: 12

Maintenance Included?: Yes

Date of Contact: 21 June 1994

WRIGHT PATTERSON AFB

Management Code and Nomenclature	Rates Hourly	Daily	Weekly	Monthly	Yearly
D503 - Crane (15 Ton)	$ 75 (Hourly rate with operator only)				
D515 - Crane (7 1/2 Ton)					
D569 - Dozer (T7)					
D570 - Dozer (T9)					
D572 - Dozer (T4)					
D626 - Backhoe (w/loader)					
D631 - Loader (1-1/2 to 2 CY)					
D632 - Loader (2-1/2 to 3-1/2 CY)					
D653 - Grader					
D655 - Grader					
D676 - Road Roller (5-8 Ton)					

Name of Firm: Schumacher Crane Rental

Phone Number of Firm: (513) 298-3112

Miles From Base: 7

Maintenance Included?: Yes

Date of Contact: 21 June 1994

WRIGHT PATTERSON AFB

Management Code and Nomenclature	Rates Hourly	Daily	Weekly	Monthly	Yearly
D503 - Crane (15 Ton)	$ 75 (Hourly rate with operator only)				
D515 - Crane (7 1/2 Ton)					
D569 - Dozer (T7)					
D570 - Dozer (T9)					
D572 - Dozer (T4)					
D626 - Backhoe (w/loader)					
D631 - Loader (1-1/2 to 2 CY)					
D632 - Loader (2-1/2 to 3-1/2 CY)					
D653 - Grader					
D655 - Grader					
D676 - Road Roller (5-8 Ton)					

Name of Firm: Custom Industrial Equipment

Phone Number of Firm: (513) 228-1197

Miles From Base: 8

Maintenance Included?: Yes

Date of Contact: 21 June 1994

WRIGHT PATTERSON AFB

Management Code and Nomenclature	Rates Hourly	Daily	Weekly	Monthly	Yearly
D503 - Crane (15 Ton)	$ 75 (Hourly rate with operator only)				
D515 - Crane (7 1/2 Ton)					
D569 - Dozer (T7)					
D570 - Dozer (T9)					
D572 - Dozer (T4)					
D626 - Backhoe (w/loader)					
D631 - Loader (1-1/2 to 2 CY)					
D632 - Loader (2-1/2 to 3-1/2 CY)					
D653 - Grader					
D655 - Grader					
D676 - Road Roller (5-8 Ton)					

Name of Firm: Harold J. Becker Equipment

Phone Number of Firm: (513) 426-4951

Miles From Base: 4

Maintenance Included?: Yes

Date of Contact: 22 June 1994

WRIGHT PATTERSON AFB

Management Code and Nomenclature	Rates Hourly	Daily	Weekly	Monthly	Yearly
D503 - Crane (15 Ton)					
D515 - Crane (7 1/2 Ton)					
D569 - Dozer (T7)		$ 833	$ 2500	$ 7500	$ 90000
D570 - Dozer (T9)					
D572 - Dozer (T4)		310	935	2800	33600
D626 - Backhoe (w/loader)		322	966	2900	34800
D631 - Loader (1-1/2 to 2 CY)		400	1200	3600	43200
D632 - Loader (2-1/2 to 3-1/2 CY)		500	1500	4500	54000
D653 - Grader		433	1300	3900	46800
D655 - Grader		700	2100	6500	78000
D676 - Road Roller (5-8 Ton)					

Name of Firm: Tiger Machinery Company

Phone Number of Firm: (513) 224-0572

Miles From Base: 10

Maintenance Included?: Yes

Date of Contact: 23 June 1994

Appendix D: Personal Interviews with Civil Engineering Personnel

WRIGHT PATTERSON AFB

Question 1. Is the concept of leasing CE vehicles a reasonable one if funds are available?

Answer 1. In theory, it would be a good idea if the funds could be fenced and could not be used for other purposes. However, in reality, this would not be the case since there is no mechanism to earmark funds from procurement to O&M leasing and there is no way to mandate vehicle leasing funds could not be used for other purposes. The funds to lease CE vehicles could be used for other purposes leaving CE leasing underfunded. Loss of productivity could result.

Question 2. Are there any reasons why CE vehicle leasing should not be considered?

Answer 2. Lack of machine availability could translate into increased use of man-hours. An example would be six people needed to complete a job that normally takes one person and a machine to complete. This could happen while waiting for leased vehicles to arrive on-site or in between breakdowns. Also, the question of deployability of leased vehicles is a concern. If needed, our current vehicles can be deployed.

Name of Contact: Major Richard G. Perales
Position of Contact: Commander, 645th Civil Engineering Maintenance Squadron

EGLIN AFB

Question 1. Is the concept of leasing CE vehicles a reasonable one if funds are available?

Answer 1. For short-term leasing, it doesn't seem practical for a location like Eglin. With 1300 miles of unimproved roads and a large fleet, it is not likely that short-term leasing would be a good solution. We like the idea of long-term leasing because we feel newer vehicles could be leased and that would provide us with better vehicle in-commission rates which should improve productivity.

Question 2. Are there any reasons why CE vehicle leasing should not be considered?

Answer 2. We are very concerned about the issue of deploying CE vehicles. We are unsure if leased vehicles could be deployed in a time of war.

Name of Contact: Colonel David S. O'Brian
Position of Contact: Commander, 96 Civil Engineering Group

ROBINS AFB

Question 1. Is the concept of leasing CE vehicles a reasonable one if funds are available?

Answer 1. Our main concern is our location. We are not sure that we could get all the types of vehicles we need to support the mission. Our location may make it necessary to go to Atlanta to lease vehicles. We are not sure if the response time would be adequate.

Question 2. Are there any reasons why CE vehicle leasing should not be considered?

Answer 2. Just the issue of equipment availability here in the Warner Robins area.

Name of Contact: MSgt Michael Welles
Position of Contact: Vehicle Control Officer, 653rd Civil Engineering Squadron

TINKER AFB

Question 1. Is the concept of leasing CE vehicles a reasonable one if funds are available?

Answer 1. If a true mechanism existed to transfer procurement funds to O&M leasing funds, it is a good idea.

Question 2. Are there any reasons why CE vehicle leasing should not be considered?

Answer 2. Not if the funding issue is resolved. We like the idea of short-term leasing because we currently have a high maintenance downtime with our current fleet. We think leased vehicles would provide higher utilization rates.

Name of Contact: Mr. William P. Laughlin
Position of Contact: Vehicle Control Officer, 654th Civil Engineering Squadron

Bibliography

Blake, Daril E. Resource Management Systems: Motor Vehicle Management Accounting System for the Wing/Base Level Organization. MS Thesis, AFIT/SLSR-33-68. School of Systems and Logistics, Air Force Institute of Technology, Wright-Patterson AFB OH, August 1968 (AD-846438).

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, Wright-Patterson AFB OH, August 1973 (AD-770968)

Burres, Keith E. and Michael H. Smith. An Analysis of the Need for Specialized Management of the Air Force Special Purpose Fleet. MS Thesis, AFIT/SLSR 3-73A. School of Systems and Logistics, Air Force Institute of Technology, Wright-Patterson AFB OH, March 1973 (AD-760080).

Connelly, B.C., and Roger E. Vargas, and Joseph J. Paolone. An Analysis of the Determination of Requirements for Base Vehicle Services. MS Thesis, AFIT/L-SRP-C752. School of Systems and Logistics, Air Force Institute of Technology, Wright-Patterson AFB OH, June 1958.

Department of The Air Force. On-Line Vehicle Interactive Management System. AFR 77-320, Volume 1. Washington: HQ USAF, 1 May 1992.

-----. Table of Allowances 012, Basis of Issue. TA 012. Washington: HQ USAF, 1 October 1993.

-----. Vehicle Management Index File. TO 36A-1-1301. Washington: HQ USAF, 29 May 1992.

-----. Vehicle Operations Management and Use of Motor Vehicles. AFR 77-310, Volume 1. Washington: HQ USAF, 29 May 1992.

-----. Vehicle Operations Management and Use of Motor Vehicles - Vehicle Utilization Analysis. AFR 77-310, Volume 1, Air Force Materiel Command Supplement 1, Attachment 2. Wright-Patterson AFB OH: HQ AFMC, 1 July 1992.

-----. Vehicle Maintenance Management. AFR 77-310, Volume 2, Attachment 3. Washington: HQ USAF, 24 April 1987.

Dixon, Terrill E. Air Force Audit Agency. Report of Audit: Review of Base Civil Engineering Management of Selected Special Purpose, Construction and Maintenance Vehicles. Project No. 91052015. Norton AFB CA, 31 July 1992.

"Economic Projections Assuming President's Program," Budget of the United States Government, Fiscal Year 1993. Washington: Government Printing Office, 1992.

Horngren, Charles T. and George Foster. Cost Accounting: A Managerial Emphasis. Englewood Cliffs NJ: Prentice Hall, Inc., 1991.

Laughlin, William P. Vehicle Control Officer, 654 Civil Engineering Squadron, Tinker AFB OK. Telephone Interview. 29 June 1994.

O'Brian, David S. Commander, 96 Civil Engineering Group, Eglin AFB FL. Personal Interview. 16 June 1994.

Perales, Richard G. Commander, 645 Civil Engineering Maintenance Squadron, Wright Patterson AFB OH. Personal Interview. 10 June 1994.

Poindexter, G.W. "Will Service Get 19,300 to Go Early?" Air Force Times, 14 February 1994:28.

"Reports From the Major Commands," Air Force Magazine, 76, Number 5: 67 (May 1993).

"Reports From the Operating Agencies," Air Force Magazine, 76, Number 5: 87-88 (May 1993).

Springer, Herman L. Jr. Commander, 56 Transportation Squadron, Luke AFB AZ. Telephone Interview. 29 June 1994.

Tait, Robert D. Vehicle Transportation Specialist, HQ Air Force Material Command, Wright-Patterson AFB OH. Personal Interview. 3 December 1993.

Tuck, Elmer L. An Evaluation of Air Force Motor Vehicle Reporting and Management. MS Thesis, AFIT/GC-59. School of Systems and Logistics, Air Force Institute of Technology, Wright-Patterson AFB OH, 1959.

Webster's New World Dictionary (Second Edition). Cleveland: William Collins Publishers, Inc., 1979.

Welles, Michael S. Vehicle Control Officer, 653 Civil Engineering Squadron, Robins AFB GA. Personal Interview. 14 June 1994.

Vita

Captain Mark A. Karzon was born on 11 October 1958 in Pensacola, Florida. He graduated from Brimley High School in Brimley, Michigan in 1976 and attended Lake Superior State College, graduating with a Bachelor of Science in Sociology in May 1980. Upon graduation, he enlisted in the USAF and served his first tour of duty at Wurtsmith AFB, Michigan as a Personnel Specialist. He attended Air Force Officer Training School and was commissioned in June 1983. His first commissioned assignment was at Peterson AFB, Colorado as a transportation officer. Subsequent assignments took him to Thule AB, Greenland an the Chief of Transportation and to Wright Patterson AFB, Ohio where he served as a Distribution Staff Officer at Headquarters Air Force Logistics Command and as a Transportation Inspector at the Air Force Logistics Command Inspection and Safety Center. He was selected to participate in the Logistics Professional Development Program at Hill AFB, Utah prior to his entering the Graduate School of Logistics and Acquisition Management, Air Force Institute of Technology in May 1993.

Permanent Address: Rt. 1, Box 228
Brimley, MI 49715

Vita

Captain Charles E. Underwood Jr. was born in Louisville, Kentucky on 19 June 1960. Upon graduation from Floyd Central High School in New Albany, Indiana, he enlisted as an Avionics Technician in the United States Navy. He attended Southern Illinois University during his off-duty time and earned a Bachelor of Science in Industrial Technology in May 1985. He completed Air Force Officer Training School and was commissioned in the United States Air Force in April 1986. He served as an Air Weapons Control Officer and as an Air Surveillance Officer. He was Chief of Electronic Combat at the 962nd Airborne Warning and Control Squadron, Elmendorf AFB, Alaska prior to entering the Graduate School of Logistics and Acquisition Management, Air Force Institute of Technology, in May 1993.

Permanent Address: Rt. 4, Box 242
Salem, IN 42167

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 1994	Master' Thesis

4. TITLE AND SUBTITLE AN OWNERSHIP/LEASE COST COMPARISON ANALYSIS OF HEAVY EQUIPMENT MOTOR VEHICLES IN AIR FORCE MATERIEL COMMAND

5. FUNDING NUMBERS

6. AUTHOR(S)

Mark A. Karzon, USAF
Charles E. Underwood, Jr., USAF

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)

Air Force Institute of Technology, WPAFB OH 45433-6583

8. PERFORMING ORGANIZATION REPORT NUMBER

AFIT/GLM/LAL/94S-23

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)

HQ AFMC/LGT
Wright Patterson AFB OH 45433

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)*

The purpose of this thesis was to perform a ownership/lease cost comparison analysis, including the investigation of qualitative issues, of heavy equipment motor vehicles in Air Force Materiel Command (AFMC). The study examined 11 types of special purpose vehicles. Ownership cost was determined using vehicles within the categories of interest from all AFMC installations. Four AFMC installations were sampled for lease cost data and qualitative information. Once an ownership cost was determined, a comparative analysis was accomplished with lease cost information. This was done using hourly and annual cost data. Qualitative issues surrounding possible lease initiatives were addressed. Findings indicated significant cost savings would be realized if short-term, or as needed, leasing practices were adopted for low utilization vehicles. Additionally, the research found qualitative issues and mission requirements may prohibit a complete conversion to a leased special purpose fleet. The research concluded that leasing is cost effective and should be considered as a possible alternative to ownership in Air Force Materiel Command. Also, any lease initiative must include cost, utilization, and qualitative information in the decision process.

14. SUBJECT TERMS
Costs, Cost Analysis, Cost Effectiveness, Leasing, Renting, Construction Equipment, Comparison, Vehicles, Military Vehicles

15. NUMBER OF PAGES
116

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