NAVAL POSTGRADUATE SCHOOL

Monterey, California

THESIS

ONE-YEAR UDP: A COST/BENEFIT ANALYSIS OF A PROPOSED ALTERNATIVE TO THE MARINE CORPS' UNIT DEPLOYMENT PROGRAM FOR FIGHTER AVIATION

by

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December 1988

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Unclassified

SECURITY CLASSIFICATION OF THIS PAGE

REPORT DOCUMENTATION PAGE

1a. REPORT SECURITY CLASSIFICATION: UNCLASSIFIED	1b. RESTRICTIVE MARKINGS
2a. SECURITY CLASSIFICATION AUTHORITY: Multiple Sources	3. DISTRIBUTION/AVAILABILITY OF REPORT: Approved for public release; distribution unlimited
2b. DECLASSIFICATION/DOWNGRADING SCHEDULE: (OADR)	
4. PERFORMING ORGANIZATION REPORT NUMBER(S)	5. MONITORING ORGANIZATION REPORT NUMBER(S)
6a. NAME OF PERFORMING ORGANIZATION: Naval Postgraduate School; 6b. OFFICE SYMBOL (If applicable): 54	7a. NAME OF MONITORING ORGANIZATION: Naval Postgraduate School
6c. ADDRESS (City, State, and ZIP Code): Monterey, CA 93943-5000	7b. ADDRESS (City, State, and ZIP Code): Monterey, CA 93943-5000
8a. NAME OF FUNDING/SPONSORING ORGANIZATION; 8b. OFFICE SYMBOL (If applicable)	9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER
8c. ADDRESS (City, State, and ZIP Code)	10. SOURCE OF FUNDING NUMBERS: PROGRAM ELEMENT NO. / PROJECT NO. / TASK NO / WORK UNIT ACCESSION NO.

11. TITLE (Include Security Classification)
ONE-YEAR UDP: A COST/BENEFIT ANALYSIS OF A PROPOSED ALTERNATIVE TO THE MARINE CORPS UNIT DEPLOYMENT PROGRAM FOR FIGHTER AVIATION

12. PERSONAL AUTHOR(S) Hacker, Earl W

13a. TYPE OF REPORT	13b. TIME COVERED	14. DATE OF REPORT (Year, Month, Day)	15. PAGE COUNT
Master's Thesis	FROM ____ TO ____	December 1988	114

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

17. COSATI CODES			
FIELD	GROUP	SUB-GROUP	18. SUBJECT TERMS (Continue on reverse if necessary and identify by block number)
			Unit Deployment, UDP, Marine Aviation, Transportation Cost, Aircraft Readiness, Aircrew Training, Personnel Retention, Theses. (SDW)

19. ABSTRACT (Continue on reverse if necessary and identify by block number)

The author examines the incremental costs and benefits associated with a change from six-month unit deployments to one-year unit deployments. The analysis is based primarily on five fighter squadrons participating in the Marine Corps' Unit Deployment Program and takes in the period July 1976 to October 1988. Regression analysis is used to project transportation cost savings of $4 million in real terms from FY 1989 through FY 1993. With a change to a one-year Unit Deployment Deployment Program, fighter squadrons should experience net increases in aircraft readiness, aircrew training readiness, and personnel retention. Keywords:

20. DISTRIBUTION/AVAILABILITY OF ABSTRACT: ☒ UNCLASSIFIED/UNLIMITED ☐ SAME AS RPT ☐ DTIC USERS	21. ABSTRACT SECURITY CLASSIFICATION: Unclassified
22a. NAME OF RESPONSIBLE INDIVIDUAL: Henderson, David R.	22b. TELEPHONE (Include Area Code): (408) 646-2524; 22c. OFFICE SYMBOL: 54Ht

DD FORM 1473, 84 MAR — 83 APR edition may be used until exhausted. All other editions are obsolete.

SECURITY CLASSIFICATION OF THIS PAGE

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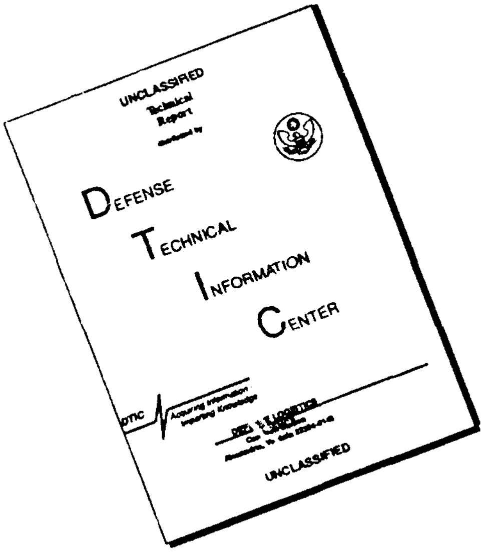

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One-Year UDP: A Cost/Benefit Analysis of a Proposed Alternative to the Marine Corps' Unit Deployment Program for Fighter Aviation

by

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Submitted in partial fulfillment of the requirements for the degree of

MASTER OF SCIENCE IN MANAGEMENT

from the

NAVAL POSTGRADUATE SCHOOL
December 1988

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ABSTRACT

The author examines the incremental costs and benefits associated with a change from six-month unit deployments to one-year unit deployments. The analysis is based primarily on five fighter squadrons participating in the Marine Corps' Unit Deployment Program and takes in the period July 1976 to October 1988. Regression analysis is used to project transportation cost savings of $4 million in real terms from FY 1989 through FY 1993. With a change to a one-year Unit Deployment Program, fighter squadrons should experience net increases in aircraft readiness, aircrew training readiness, and personnel retention.

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I. INTRODUCTION

A. PURPOSE

The purpose of this thesis is to determine if the Marine Corps' Unit Deployment Program (UDP) for fighter aviation should be changed from six-month deployment evolutions to one-year evolutions. The emphasis is on possible cost reductions and the impacts that a change in deployment time length will have on aircraft readiness, aircrew training readiness, and personnel retention.

The beginning of this decade witnessed a giant leap in military capability and readiness. Higher budgets voted by Congress allowed the military to expand following the slowdown experienced after the end of the Vietnam Conflict. Between 1970 and 1975, the defense budget, adjusted for inflation, declined by 22 percent. During the post-Vietnam period, from 1976 to 1980, the real defense budget grew by an average of two percent per year. Real spending for procurement and for operations and maintenance actually increased four percent annually due to a six percent decline in personnel levels. [Ref. 1] During the Reagan defense build-up from 1981 to 1986, the real dollar growth for outlays averaged approximately eight percent per year [Ref. 2]. Large increases in budgets over a short time period resulted in some inefficiency in the creation and maintenance of our current force level. Consequently, Congress and the press have been voracious in their attacks on military fraud, waste, and abuse.

Today's environment is one of an austere budget in comparison to the early 1980s. After experiencing decreases in real budget authority of 3.3 percent in fiscal year (FY) 1987 and 2.9 percent in FY 1988, the Defense Department's real budget was cut $32.5 billion relative to current services for FY 1989. This cut represents a 0.7 percent real decline in budget authority. [Ref. 3] Budget cutbacks have forced the military to scale back weapon system purchases resulting in more costly systems. Many systems have been cancelled outright. The challenge for the Department of Defense is to maintain the military capabilities and readiness gained during the early eighties. Our military services must voluntarily seek out inefficiency and reduce costs wherever it can. Where in the past we have sought to maximize our capabilities, regardless of cost, we must now balance our capabilities with their cost.

B. OBJECTIVE

The objective of this thesis is to examine the marginal costs and benefits associated with changing from Western Pacific (WestPac) deployments of six months duration to deployments of one-year. The author hopes this study will provide the impetus for Headquarters, United States Marine Corps (HQMC) to re-examine UDP for fighter aviation. The possibility exists for expanding potential cost savings to other fixed wing aircraft communities without sacrificing capability, readiness, or morale.

C. SCOPE, LIMITATIONS, AND ASSUMPTIONS

This study focuses on U.S. Marine Corps fighter squadrons participating in UDP from FY 1977 through FY 1988. Since the emphasis of this thesis is on potential cost savings, the cost of transporting personnel to and from WestPac is analyzed for the two alternatives and forecasts are projected through 1993. No attempt is made to place dollar values on the positive or negative benefits to aircraft readiness, aircrew training readiness, or personnel retention. They are considered either positive or negative with no emphasis on magnitude.

This thesis is not severely limited or constrained by lack of data. Although actual cost figures for transportation are not available, the indexes on which the actual costs were based are available from the Military Airlift Command (MAC). Detailed records are maintained for aircraft maintenance, aircrew training, and personnel reenlistments. These records are used as the basis for examining possible benefits accrued by changing WestPac tour lengths.

This thesis does not consider the possible effects of a one-year deployment program on personnel assignment policy or on deployment allowances. Since most enlistments are for four-year terms, the impact on first term enlistees may not be significant. Personnel deploying to MCAS Iwakuni, Japan receive a daily per diem allowance. Personnel assigned there as a permanent change of station (PCS) receive a cost of living allowance (COLA) based on geographic location, rank, and time-in-service. Whether personnel deploying for one year would receive a per diem allowance or be paid COLA should be considered in any follow-on analyses.

The Joint Federal Travel Regulations limit the period of temporary deployment to six-months. This limitation does not apply to personnel deployed afloat. Approval of temporary duty for periods in excess of six months must be obtained from the service secretary. [Ref. 4] For UDP to change to one-year evolutions, new legislation for exemption, similar to the duty afloat provisi[illegible] may be required. The overall legality and methods of approving the extended UDP are not explored in this thesis.

D. SUMMARY OF FINDINGS

Regression models have been developed to estimate future transportation costs. Based on these models, an undiscounted sum of approximately $4 million (1988 dollars) can be saved over the next five years if UDP changes to one-year deployments. Analysis of maintenance data, aircrew training records, and reenlistment rates indicates that if squadrons deploy for one year vice six months, neither readiness nor morale will suffer, and may even improve.

II. BACKGROUND

The Marine Corps maintains two fighter squadrons at MCAS Iwakuni, Japan to provide anti-air warfare and close air support for U.S. forces stationed in WestPac. One of the squadrons is provided by Marine Aircraft Group - 31 (MAG-31), MCAS Beaufort, SC on a six-month rotational basis. The other squadron is provided by MAG-11, MCAS El Toro, CA on the same basis. When MAG-24, MCAS Kaneohe Bay, HI completes transition to the F/A-18 Hornet, it will assume MAG-24's responsibility for maintaining one squadron. While stationed at Iwakuni, both fighter squadrons report to the Commanding Officer, MAG-12, 1st Marine Aircraft Wing.

Prior to the Vietnam Conflict, fighter squadrons rotated to WestPac for 12 to 15 months. These units were stabilized several months before transplacement. Approximately one half of the assigned personnel were first term Marines. With the advent of the Vietnam Conflict, unit rotation dissappeared. The large numbers of fighter squadrons and the number of replacements involved forced the Marine Corp to send personnel to WestPac on individual orders. The orders were issued as PCS and covered approximately 13 months.

In the fall of 1975, the Commandant of the Marine Corps, General Louis Wilson, became concerned with the overall lack of unit readiness due to personnel deficiencies. Of eight battalions assigned to the 2nd Marine Division, one was rated P-1 (> 90% manned), one P-2 (> 80% manned), one P-3 (> 70% manned), and 5 P-4 (< 70% manned). The Commandant wanted high, uniform readiness. There were several means of solving this readiness problem: (1) by reducing transient man-years associated with PCS moves and the resulting leave, (2) by increasing the pool of personnel available for deployment, and (3) by controlling personnel assignment from HQMC. [Ref. 5]

In addition to personnel assignment problems, the Commandant wanted to lessen the hardships of unaccompanied one-year tours (without dependents), increase the unit cohesiveness, increase the leader-to-led time, and decrease total PCS costs. A study in 1974 indicated that only one of three Marines completed his/her entire enlistment contract. The length of unaccompanied overseas tours was cited as one of the reasons. Since personnel remain with their WestPac units only a maximum of 13 months, units fail to develop identities and cohesiveness suffers. In 1976, the average contact between unit leaders/supervisors and their subordinates was an unacceptable 16 to 17 months. And finally, a reduction in PCS cost was necessitated by a 1974 initiative of the Assistant Secretary of Defense for Manpower and Reserve Affairs to reduce the number of PCS moves. [Ref. 6]

The Commandant approved UDP in late 1976. In June 1977, VMFA-251 began the Marine Corps' UDP by deploying to Iwakuni for 12 months. They replaced a permanent squadron, VMFA-115 which returned to Beaufort. One year later VMFA-251 would be replaced by VMFA-122, also on a one-year tour. The initial one-year UDP was necessitated by a change in aircraft models taking place in Beaufort. Problems were developed in the reconfiguring of engines from the GE-J79-10A to the -10B model. [Ref. 7] VMFA-235 deployed from Hawaii in October 1977, three months after VMFA-251 began its WestPac committment. VMFA-235 also replaced a permanent squadron, VMFA-232, which redeployed to Hawaii. The squadrons rotating from Hawaii were all on six-month tours. A complete chronology of WestPac deployments for fighter squadrons is provided in Appendix A.

Support for the program has been overwhelming, even for the initial one-year deployments. The Commanding Officer of the first deployment believes that his squadron morale did not suffer from serving along side the six-month squadrons. [Ref. 8]. Since the implementation of UDP, the Marine Corps has realized several significant benefits: (1) stabilization in tactical units for up to three years, enhancing continuity and increasing the leader-to-led association, (2) support for standardization and interoperability of the interchangeable parts of a Marine Air/Ground Task Force, (3) support of the maritime prepositioning concept for deploying to pre-staged equipment, and (4) improvement of family stability through reduction of PCS moves. [Ref. 9]

As of FY 1987, almost 13,000 PCS moves are being saved annually. The net effect on the budget is an annual savings of approximately $5 million. The Marine Corps is also realizing savings in transient man-years of over 1,000 in FY

1987. This equates to a savings of $30 million. Although great savings have been accrued since 1977, the Marine Corps is expanding UDP to include tank companies, amphibious tractor companies, and artillery batteries. By the end of FY 1990 over 10,000 PCS billets in WestPac will have been converted to temporary additional duty billets. [Ref. 10]

III. METHODOLOGY

A. GENERAL

The field of economics can be described as either normative or positive. "Positive economics describes, explains, and predicts actual economic phenomena and is devoid of value judgment." The goodness or badness of different states is not considered. "Normative economics, on the other hand, explicitly introduces value judgments or norms." [Ref. 11] The relative desirability of different states is considered.

A vehicle for comparing or considering two or more different states is a cost-benefit analysis (CBA). It is "an estimation and evaluation of net benefits associated with alternatives for achieving defined public goals" [Ref. 12]. CBA works well in the area of normative economics since the decision to implement or change a project leads from one state to another, and the desire is to determine which state is the best alternative.

B. CRITERIA

The process of choosing the best alternative requires a judgment based on specific criteria and an analysis of the alternatives according to the criteria. In developing the criteria, many preferences should be taken into account. In the case of this particular study, we must, at a minimum, consider individual preferences since they will affect retention and readiness for Marine fighter aviation. Four popular criteria should be considered: (1) unanimity, (2) Pareto superiority, (3) majority rule, and (4) potential Pareto superiority. According to Sassone and Shaffer, the first three can easily be discounted. The fourth, potential Pareto superiority, is applicable to this case and lends itself well to CBA. A project is determined superior if those who gain from the project can compensate those who lose so that no one is worse off for the project being accepted. Essentially, it says that this criterion chooses the alternative with the greatest net benefits. [Ref. 13]

C. PROBLEM DEFINITION

Due to huge government deficits, the Marine Corps' external environment can be characterized as one of budget austerity. It is incumbent upon us to hold down costs while attempting to maintain our present capabilities. Consequently, the null hypothesis for the CBA can be stated as:

deploying fighter squadrons to Japan on a six-month rotational basis is the least cost approach to providing the anti-air warfare assets necessary to fulfill the mission of MAG-12.

In testing the null hypothesis, only one alternative will be analyzed: deployment on a one-year rotational basis.

In analyzing the costs and benefits of the two programs, care will be taken to minimize the probability of a type I error, rejecting the null hypothesis when it is true, while considering a type II error, rejecting a null hypothesis when it is false.

D. ANALYSIS DESIGN

Analysis will be centered around transportation costs. Only those costs which are different for the two programs will be analyzed. The applicable transportation costs consist of those for: (1) advanced party personnel, (2) main body personnel, (3) rear party personnel, and (4) equipment. An appropriate cost deflator will be used to ensure proper comparisons are made.

Three other areas deserve analysis. They include aircraft readiness, aircrew training readiness, and personnel retention. These areas are difficult to quantify in monetary terms and can be considered incommensurables in the decision-making process. Acceptance or rejection of the null hypothesis cannot be made based on transportation costs alone. Inclusion of the incommensurables in the CBA requires subjective weighting, making any absolute decision suspect. To preclude the problem of subjectivity in comparing the two programs, the hypothesis will be rejected only if the costs are less for the alternative and the other areas mentioned for consideration have an equal or positive impact. In other words, a change in programs will not be recommended if the consequence of that change could be a reduction in personnel retention, a decrease in aircraft readiness, or a decrease in aircrew training readiness.

IV. DATA

A. TRANSPORTATION COSTS

Difficulty was encountered in obtaining transportation costs for UDP. Headquarters, U.S. Marine Corps (HQMC), Fleet Marine Force (FMFLant), Atlantic, and Fleet Marine Force, Pacific (FMFPac) were queried for historical costs. Neither the Aviation, the Manpower, nor the Logistics Branches at HQMC held worthwhile data. Neither the Comptroller Branch nor the Logistics Branches of FMFLant or FMFPac maintained UDP cost data past two prior years. Because transportation data is aggregated when computerized by the Comptrollers, breakdowns by date or unit were unavailable. However, cost data for the past two years was obtained from the Mobility Section of the Logistics Branch at FMFLant. Marine Aircraft Group - 31 and several of the deploying squadrons were checked for data; the results were negative.

The Military Airlift Command (MAC), Scott Air Force Base was checked for the detailed, historical cost data required for this analysis. Historical costs were not available, but the Comptroller (Code ACIB), maintains pricing data for determining the actual costs charged to transportation users. CAT B rates are used to determine costs for contracting commercial Special Airlift Missions (SAAM). These rates existed from FY 1979 through FY 1988 and are used in the main body transportation analysis. CAT Y rates are used to charge for individual travel on MAC scheduled commercial airline flights between the U.S. and overseas bases. Rates were obtained for flights originating from Los Angeles, St. Louis, and Honolulu with service to Tokyo, Japan and return. Rates covered CY 1983 through CY 1989. Equipment transportation costs are determined from C-141 flying hour rates. These tariffs were available from FY 1982 through FY 1989.

B. AIRCRAFT READINESS

Aircraft data was requested from the Navy Maintenance Support Office Department, Naval Sea Logistics Command, Mechanicburg, PA. This is the depository of all Navy and Marine Corps aircraft statistical data. The eight requested reports cover one year each and are broken down by aircraft type, squadron, and month. The data is summarized for type commander (Commander Naval Air, Atlantic or Commander Naval Air, Pacific), force commander for Marine F-4S aircraft (FMFLant or FMFPac), and all Navy and Marine F-4S aircraft. The data covers 1 January 1981 to 31 July 1988 and is classified confidential. The standardization and normalization process used in Chapter 6 allows the data to be presented in an unclassified format. 1981 was picked as the beginning of the analysis since prior years involved a changeover from the F-4J to the F-4S aircraft for the squadrons involved in UDP. During the changeover period, squadrons flew and reported on two types of aircraft. Deployments involving the F/A-18 were not included since they began in 1987 and sufficient historical data does not exist. Analysis was limited to three units from MCAS Kaneohe Bay, HI and three units from MCAS Beaufort, SC since they were the only fighter squadrons involved in UDP during this time period.

These reports contain a wealth of summary data. Each annual report includes a listing of all major aircraft status codes and the subdivisions of each code. No data is available for approximately 33 percent of the time covered. Late or inaccurate submissions by units are not included in NAMSO's data base, and squadrons are not notified of problems so that corrections or additions can be made.

C. AIRCREW TRAINING READINESS

Data was requested from the Aviation Analysis Branch (ASA) of HQMC. ASA maintains the data base for all data on Marine Aviation flight readiness. Due to the immense amount of data available, the analysis is restricted to five squadrons participating in UDP and covers 1 July 1977 to 30 June 1980. This includes two squadrons from MCAS Beaufort which deployed to MCAS Iwakuni for one year and three squadrons from MCAS Kaneohe Bay which deployed for six-month increments. Approximately 51,000 records have been manually inspected for this analysis.

Aircrew training readiness is inputed to the system through the Flight Readiness Evaluation Data System (FREDS), MAVMC Form 10958. This form includes data concerning the aircraft, the pilot, and the radar intercept officer (RIO). One form is generally filed for each flight. Information from the form is then keypunched on two computer cards (for pilot and RIO) for system input. Each record has 115 characters. Included in the data are such items as aircraft bureau number, julian date[1] , departure time, organization and equipment codes, arrival and departure location codes, flight purpose code, flight time, aircrew social security numbers, number of landings and instrument approaches, crew mission codes, and training codes.

D. PERSONNEL RETENTION

Data for analysis of personnel retention was obtained from the master files at HQMC. Reenlistment rates were requested for twelve tactical F-4 squadrons. These rates begin on 1 July 1977 and end 30 June 1980. Time periods of 91 days and 182 days were considered for analysis. The quarterly breaks included too many sparsely populated cells to be useful, so semi-annual breaks were chosen. The data fields include the number of personnel eligible for reenlistment, number ineligible for reenlistment, number reenlisting, and the reenlistment rate. The reenlistment rate is found by dividing the number reenlisting by the number eligible for reenlistment.

The data covers all enlisted personnel in the squadron. Officers are not included in the data. Aircrew have six years of obligated service upon graduation from flight training and normally hold a reserve status. Officers must be augmented into the regular Marine Corps if they are to

[1] Julian date is a four digit number. The first number rerepresents the last number of the current year. The next three numbers represent the day of the year according to the Julian calendar (1-365).

remain beyond the initial obligated service. Enlisted personnel serve varying terms of enlistment and then must reenlist to remain on active duty. Those ineligible for reenlistment include personnel retiring after 20 years of service as well as those personnel not qualified for reenlistment.

The all-squadron reenlistment rates are subdivided into grade and time-in-service. For grade subdivisions, Staff Noncommissioned Officers (SNCO, E6-E9) and junior enlisted (sargeants and below) were chosen. SNCOs are generally considered career-oriented and are segregated from more junior enlisted personnel, since SNCO reenlistment rates are considerably higher. Time-in-service is broken down in two increments: one to five years and over five years. Because the one to five year category captures all first term enlistments, a lesser increment is not considered appropriate. A larger increment will begin to approximate the grade breakdowns for SNCOs and junior enlisted personnel.

V. TRANSPORTATION COST ANALYSIS

By changing UDP from a six-month rotation to a one-year rotation, the Marine Corps can reduce transportation costs. Under the present program, squadron aircraft are flown to Iwakuni, Japan on every other evolution. For example, VMFA-312 deployed to Japan in June of 1985 replacing VMFA-333. VMFA-312 flew their F-4S aircraft from MCAS, Beaufort, SC to Japan. Most of the enlisted personnel in the squadron were transported by Special Assignment Airlift Mission (SAAM) scheduled by MAC. A selected number of maintenance personnel provide logistical support for squadron aircraft along the route of flight. Personnel preceed the F-4S aircraft in a Marine Corps C-9 transport aircraft and provide aircraft recovery, refueling, and maintenance at the next stopping point. The C-9 will take off prior to the next launch and again preceed the F-4s. A minimum number of personnel will remain behind, launch the F-4s, and provide maintenance if any aircraft are forced to abort. These maintenance personnel will follow the F-4s in a Marine Corps C-130 cargo aircraft. After VMFA-312's arrival, VMFA-333 aircrew flew out their aircraft, and the enlisted personnel boarded the SAAM flight and logistical aircraft and returned to Beaufort. Six months later VMFA-312 was replaced by

VMFA-451. In a cost savings effort, squadron aircraft are rotated every other deployment. This simplified the entire evolution. VMFA-451 personnel were flown over by SAAM (Main Body), and VMFA-312 personnel returned via the same SAAM. Advanced parties of 35 personnel preceeded the unit deployments and were responsible for acceptance inspections on the other squadron's aircraft.

Changing to one-year deployments would save the transportation costs associated with the second deployment evolution highlighted in the example. Appendix A depicts a chronology of fighter squadron deployments to MCAS Iwakuni, Japan. Periods marked by a # identify deployments that did not involve the TransPac of aircraft. Three squadrons from both Beaufort and Kaneohe Bay are involved in UDP rotation. Each unit will, therefore alternate deploying with and without their aircraft. In the previous example, VMFA-312 would deploy again in Janauary 1987 without its assigned aircraft.

Minitab Statistical Software has been used to provide regression models for predicting transportation costs between US based squadrons and MCAS, Iwakuni. Appendix B depicts transportation cost rates for main body, advanced party, and equipment transportation provided by or contracted through MAC [Ref. 14].

A. MAIN BODY

An equation for forecasting main body transportation costs is obtained with Civilian Air Transport rates for dedicated contracted aircraft (CAT B) as the dependent variable. These are the rates MAC pays its commercial airline contractors and are based on round trip schedules. The CAT B rates are first deflated and changed to constant 1988 dollars with the use of Implicit Gross National Product Price Deflators, Appendix C [Ref. 15]. Deflators exist through the second quarter of calendar year 1988. The rates for the remainder of 1988 and 1989 are estimated based on a four quarter moving average with 0.5 percent added to account for an apparent increase in inflation this year. Although the estimates are rough, an 1.0 percent increase or decrease in the estimate for 1988 and 1989 (constant 1988 dollars) causes only a $5,000 difference in the projected Marine Corps cost savings for UDP main body transport over the next five years. The CAT B rate is cents per available passenger seat per statute route mile.

CAT B rates are regressed using fuel prices as the predictor. The regression covers the period 1982 through 1988. Appendix D shows kerosene type jet fuel prices as a yearly average from fiscal year 1982 through 1988 [Ref. 16]. These prices are for plant and gas operator sales to end users which are made directly to the ultimate consumer including bulk customers such as agriculture and the military, as well as residential and commercial customers.

The regression line depicted in Table 5.1 was developed using the least squares method. The line expresses the average relationship between the independent and dependent variables (fuel price and rate). The least squares method attempts to find a straight line which is close to all the data points and minimizes the distances between individual points and the line. The plot of CAT B RATE versus FUEL PRICE shows a upward sloping trend between 1982 and 1988.

In order to use a regression line for forecasting, one must make several assumptions: (1) a linear relationship exists between the dependent and independent variables; (2) the errors between actual observations and forecast values based on the regression line are normally distributed; (3) the expected errors sum to zero; (4) the variance of errors along the regression line is constant; and (5) error terms are independent of previous or subsequent errors.

The upward sloping plot of CAT B RATE over FUEL PRICE can be fitted with a straight line to satisfy the first assumption. To determine if the regression equation is a good fit for the actual data points, one must analyze the standard error of the estimate, the coefficient of correlation, and the coefficient of determination. The standard error of the estimate tells roughly within what distance of the estimate the true value can be expected to lie. The standard error of the estimate (s) is 0.1338.

TABLE 5.1

MAIN BODY TRANSPORTATION REGRESSION ANALYSIS

The regression equation is:

CAT B RATE = 4.2 + 0.0204(FUEL PRICE)

Predictor	Coef	Stdev	t-ratio	p
Constant	4.1967	0.1785	23.52	0.000
FUEL PRICE	0.020449	0.002117	9.66	0.000

s = 0.1338 R-sq = 94.9% R-sq(adj) = 93.9%

Analysis of Variance

Source	DF	SS	MS	F	p
Regression	1	1.6700	1.6700	93.27	0.000
Error	5	0.0895	0.0179		
Total	6	1.7595			

Durbin-Watson statistic = 2.00

This is relatively small compared to the estimates and indicates a good fit. For example, at a 1986 fuel price of 56.29 cents (constant 1988 dollars), the calculated CAT B RATE is 5.35 cents per passenger per available seat. Adding the standard error of the estimate gives a price of 5.4838 which is greater than the actual price of 5.4332. At the estimated price, the standard error is only 2.5 percent of the price.

A correlation coefficient (r) of 1.0 indicates perfect correlation between variables but is intuitively difficult to relate to the regression equation. Its square, the coefficient of determination (r-sq) is more useful and describes how much of the variability in the observed dependent variable is due to variation in the independent variable. In this case, the r-sq means that 94.9% of the variation in rates is due to variations in fuel price (from one year to the next).

The t-ratio can be used to test the significance of the independent variables and of the constant. For a 95% confidence level and six total degrees of freedom (DF), the critical t-value is 2.447. The absolute values of the indicated t-ratios of 23.52 and 9.66 are substantially higher than the critical value, implying a good fit.

The F-ratio provides another excellent means of determining the goodness of fit. Where there is only one independent variable, the F-ratio is the square of the t-ratio. For a 95% confidence level, one DF for the regression, and five DFs for the error, the critical F-value is 6.61. The F-ratio of 93.27 is significantly greater than the critical value and a good fit exists.

A plot of the residual errors against normal scores for the data (Minitab NSCORE routine) provides a check for normality. The NSCORE routine transforms the residual errors into standard normal distribution values which are useful in determining whether the residual errors approximate a normal distribution. The results approximate a straight line; therefore, normality can be assumed. The correlation between the error terms and the normal scores is 0.972 and exceeds the critical value of approxomately 0.9 for a .05 level of significance. A plot of CAT B RATE versus FUEL PRICE with the superimposed regression equation indicates that constant variance exists. A plot of the errors versus time shows that the errors have no pattern and are random.

Autocorrelation is a problem most often encountered in time series analysis, but it can pose a problem for regression using independent variables other than time. Autocorrelation can be caused by "stickiness" in reducing costs or the relationship of time periods to previous time periods. Each period's cost, therefore, can be partly dependent on the prior period's cost. Determination is made by checking error terms of each period for systematic relationships. A method of measuring autocorrelation is through the Durbin-Watson Statistic (D-W). With absolutely no correlation between errors, the value will equal 2.0. Perfect positive correlation is indicated by a D-W of 0.0, and perfect negative correlation is indicated by a D-W of 4.0. The critical test value depends on the number of explanatory variables and the number of observations serving as the basis of the regression equation. With one independent variable (FUEL PRICE) and six observations, the upper limit of the critical value is less than 1.36. Because the D-W for the regression equation is 2.00, there is no autocorrelation.

Initial regression analysis included data from fiscal years 1980 and 1981. The initial data plot of CAT B RATE versus FUEL PRICE showed an abrupt decrease in the slope. A time series plot presented the possibility that the trend line may have changed course in 1980 and 1981. Further investigation revealed that steep increases in crude oil prices during this time caused the price of jet fuel to double. This increase in variable costs was largely absorbed by the commercial contractors, thereby distorting the normal historical relationship between fuel prices and transportation rates. The R-sq for the regression was approximately 46%, showing a poor fit for the regression line. A low D-W indicated autocorrelation was present. As a consequence, data from 1980 and 1981 were not used in developing the regression equation and trend line.

Before continuing the analysis, more assumptions must be made. The first assumption is that the Marine Corps will continue to use DC-10 aircraft to transport main body personnel as they have over the last several years. This aircraft is a good size for aviation units, providing adequate seating and capability for extra baggage without requiring more servicing stops between Beaufort, SC and

Iwakuni, JA. The second assumption is that terminal fees and other miscellaneous airline costs, none of which are included in the CAT B RATE, will not become significant and can, therefore, be excluded from the analysis. Third, the analysis assumes that the present flight routes will remain the same.

The next step in forecasting costs for main body transportation requires estimating future jet fuel prices. Table 5.2 are estimates provided by the Energy Information Administration, Department of Energy. To be usable, the prices per million BTU are converted to cents per gallon using an average of 5.67 million BTU per barrel for kerosene type jet fuel and 42 gallons per barrel. [Ref. 17]

TABLE 5.2

PROJECTED JET FUEL PRICES 1989 - 1993

Year	Price/million BTU (dollars)	Price/gal (cents)
1989	4.63	60.7
1990	4.68	61.4
1991	4.73	62.1
1992	4.77	62.6
1993	4.95	64.9

The conversion factor is $0.135 million BTU per gallon.

The DC-10 cost for each evolution, home base - overseas - home base, can now be easily computed. For the DC-10 configuration under present MAC contracts, 354 seats are available and will be paid for whether used or not. MAC uses great circle mileage, rather than International Air Transport Association (IATA) mileage charts, to figure charges under CAT B contracts. Table 5.3 depicts the routing and the one way distance for commercial contracts.

TABLE 5.3

SPECIAL AIRLIFT MISSION ROUTING (DC-10)

Beaufort Squadrons

Route: MCAS Beaufort, SC - Anchorage Int'l Airport - Yokoda AFB, Japan - MCAS Iwakuni, Japan - Yokoda AFB, Japan - Anchorage Int'l Airport - MCAS Beaufort, SC

Distance: 14,896 statute miles (one way)

El Toro Squadrons

Route: MCAS El Toro, CA - Anchorage Int'l Airport - Yokoda AFB, Japan - MCAS Iwakuni, Japan - Yokoda AFB, Japan - Anchorage Int'l Airport - MCAS El Toro, CA

Distance: 12,534 statute miles (one way)

Hawaii Squadrons

Route: Hickam AFB, HI - Yokoda AFB, Japan - MCAS Iwakuni, Japan - Yokoda AFB, Japan - Hickam AFB, HI

Distance: 8,596 statute miles (one way)

Forecasts are developed for the next five years using the regression equation, CAT B RATE = 4.2 + 0.0204(PROJECTED FUEL PRICE), and are presented in Table 5.4. This is the amount MAC pays the commercial carrier per passenger seat available. The amount that MAC charges its military customers through the Industrial Fund (tariff) has an additional ten percent surcharge added. The costs are projected by applying the following equation:

Projected Cost = Tariff X Statute Miles X Available Seats.

Appendix E provides a forecast of the fighter squadrons to be involved in UDP over the next five years [Ref. 18]. This can vary and depends on the desires of the Commanding Generals, Fleet Marine Forces, Pacific (FMFPac) and Fleet Marine Forces, Atlantic (FMFLant). As listed, the squadrons exchange aircraft during January and October.The possible cost savings can be determined by matching the results shown in Table 5.4 with the unit deployments which do not involve the TransPac of squadron aircraft (Appendix E).

TABLE 5.4

PROJECTED DC-10 SAAM COSTS FOR UDP
(Constant 1988 Dollars)

Year	CAT B	Tariff	Beaufort	El Toro	Kaneohe Bay
1989	5.44	5.98	$315,336	$265,335	$181,970
1990	5.45	6.00	$316,391	$266,222	$182,579
1991	5.47	6.01	$316,918	$266,666	$182,883
1992	5.48	6.02	$317,446	$267,110	$183,188
1993	5.52	6.08	$320,610	$269.772	$185,013

CAT B and Tariff units of measure are cents per mile per seat available.

For example, in 1989, only a Beaufort and an El Toro squadron will participate in UDP. In 1991, the deploying squadrons from El Toro will be replaced by Kaneohe Bay squadrons. Table 5.5 provides a breakdown of these possible cost savings. If UDP is changed to a one-year deployment, the savings for main body transport over the next five years could exceed $2,600,000. If the projected cost savings are discounted at five percent based on the time value of money, the total savings will be $2,321,256. At a ten percent discount rate, the savings will be $2,040,781.

TABLE 5.5

PROJECTED MAIN BODY TRANSPORTATION COST SAVINGS FOR UDP
FY 1989 - FY 1993
(Constant 1988 Dollars)

FY	Beaufort	El Toro	Kaneohe Bay	Total
1989	$315,336	$265,335		$ 580,671
1990	$316,391	$266,222		$ 582,613
1991	$316,918		$182,883	$ 499,801
1992	$317,446		$183,188	$ 500,634
1993	$320,610		$185,013	$ 505,623

Total Undiscounted Cost Savings...........$2,669,342

TOTAL DISCOUNTED COST SAVINGS:

5% Discount Rate	10% Discount Rate
$2,321,256	$2,040,781

B. EQUIPMENT

All squadrons deploy with a certain amount of equipment which enables them to fulfill their missions. The majority of the equipment consists of maintenance tools and support gear. Since transportation of this equipment is expensive, much of it is left in place and transferred to the arriving unit. However, there still remains a considerable amount of equipment that cannot be easily transferred. F-4 squadrons were authorized transportation, via MAC C-141, of up to 55,000 pounds from home base to Iwakuni, Japan and return. The F/A-18 community has lower support requirements and deploys with approximately 50,000 pounds of equipment.

The tariff flying hour rates (FHR) from Appendix B are used to determine a regression equation, depicted in Table 5.6, for forecasting future equipment transportation costs. The independent variable or predictor is the price of kerosene-type jet fuel, listed in Appendix D. Both TARIFF and FUEL PRICE are deflated to constant 1988 dollars using the GNP Implicit Price Deflators from Appendix C.

The plot of FHR TARIFF versus FUEL PRICE shows an increasing upward sloping trend which can be fitted with a straight line. Initial efforts at regression show a need to transform the data for a better fit. Transforming the horizontal or vertical scales can straighten the plots and provide linear equivalents of a curvilinear function. Analysis of the shape of the original data led to the conclusion that transformations--logarithmic, exponential, and power--were desirable. The first involves transforming the FUEL PRICE axis to a logarithmic scale; the second involves transforming the CAT B RATE axis; and the third

TABLE 5.6

EQUIPMENT TRANSPORTATION REGRESSION ANALYSIS

The regression equation equation is:

$$\text{FHR TARIFF} = (31.9 + 0.316(\text{FUEL PRICE}))^2$$

Predictor	Coef	Stdev	t-ratio	p
Constant	31.880	3.152	10.11	0.000
FUEL PRICE	0.31602	0.03662	8.63	0.000

s = 2.303 R-sq = 93.7% R-sq(adj) = 92.5%

Analysis of Variance

Source	DF	SS	MS	F	p
Regression	1	395.16	395.16	74.48	0.000
Error	5	26.53	5.31		
Total	6	421.68			

Durbin-Watson statistic = 2.43

involves transforming both axes. Other transformations include transforming to reciprocal or square root scales vice logarithmic. The reciprocal is required when the trend requires more bending to form a straight line than what logarithmic transformation can provide. The square root is used when less bending is required. The equation, Square

Root Y = a + bx, is similar to a logarthimic equation, appears to be the best fit, and is supported by the following analysis.

The true value of C-141 FHR TARIFF should lie within \$5.30 (the square of the standard estimate of 2.303) of the estimate. This small possible error indicates a good fit. For example, at an actual FHR TARIFF of \$655, the possible error equates to less than one percent of the actual FHR TARIFF. Almost 94 percent of the variation in C-141 FHR TARIFF is due to variations in FUEL PRICE as evidenced by an r-sq value of 93.7%. For a 95% confidence level and six total degrees of freedom, the critical t-value is 2.447. The absolute values of the indicated t-ratios of 10.11 and 8.63 are significantly higher than the critical value, implying a good fit. The critical value for the F-ratio is 6.61 and is much lower than the 74.48 for the regression equation. Again, this implies a good fit.

The residual error plot versus normal scores approximates a straight line and normality of the errors is assumed. The correlation coefficient between the two is 0.935 and exceeds the critical value of 0.9 for a 0.05 level of significance. The plot of the transformed dependent variable and the independent variable indicates that constant variance exists. A plot of the errors versus C-141 FHR TARIFF shows that the errors have no pattern and are independent of the variables. A times series plot of the residuals shows no apparent trends of the errors over time.

Autocorrelation does not exist. The D-W coefficient for the regression is 2.43, implying that any autocorrelation would be negative. The critical value lower limit at the 0.05 level of significance is greater than 2.64 and significantly higher than the computed value for the regression equation.

Estimates for C-141 FHR TARIFF, as listed in Table 5.7, are projected for 1989 to 1993, based on the regression equation and the jet fuel prices forecasted in Table 5.2. These tariffs are multiplied by the average C-141 flight hours between U.S. military bases (Beaufort, El Toro, and Kaneohe Bay) and Iwakuni, Japan to determine equipment transportation costs. Actual cost figures for C-141 transportation for 1988 and 1989 are depicted in Appendix F. These figures each cover one deployment evolution, to Iwakuni and return. The actual cost figures were divided by the actual C-141 FHR Tariffs for these two years to determine the flying hours between the home bases and Iwakuni. The flying hours are for round trip flights, are averaged, and are used to forecast the cost of C-141 transportation for 1989 to 1993 as depicted in Table 5.7.

The potential cost savings for transporting equipment to Iwakuni, Japan under a one-year UDP can be determined by matching the results of Table 5.7 with those deployments which do not involve the TransPac of aircraft, marked by a #

in Appendix E. Table 5.8 shows a breakdown of the possible cost savings. These savings could amount to almost $1,000,000 over the next five years.

TABLE 5.7

PROJECTED EQUIPMENT TRANSPORTATION COSTS FOR UDP
(Constant 1988 Dollars)

Year	C-141 FHR Tariff	Beaufort	El Toro	Kaneohe Bay
1989	2,607	$109,103	$85,145	$78,497
1990	2,630	$110,066	$85,896	$79,189
1991	2,653	$111,028	$86,647	$79,882
1992	2,669	$111,698	$87,170	$80,364
1993	2,745	$114,878	$89,652	$82,652

For the projected savings to be valid, three assumptions must hold. First, the average flight hour figures developed in Appendix F must remain constant. The number of flight hours required for equipment deployment will fluctuate based on the winds at flight level. For example, a 12,935 nautical mile flight from Beaufort to Iwakuni and return will take approximately 27 hours at an average airspeed of 480 nautical miles per hour. This is an overly simplistic example and does not include the extra time required due to slower airspeeds for takeoff, for climb to cruising altitude, for enroute descent, and for landing. At an average airspeed of 450 nautical miles per hour, this same trip will take two hours longer than at a speed of 480. The second assumption is that the equipment requirements for deploying F/A-18 units will remain at approximately 25 short tons and not outgrow the lift capability of a C-141 in weight or cube (space).

TABLE 5.8

PROJECTED EQUIPMENT TRANSPORTATION COST SAVINGS FOR UDP
FY 1989 - FY 1993
(Constant 1988 Dollars)

FY	Beaufort	El Toro	Kaneohe Bay	Total
1989	$109,103	$85,145		$194,248
1990	$110,066	$85,896		$195,962
1991	$111,028		$79,882	910
1992	$111,698		$80,364	$192,062
1993	$114,878		$84,652	$199,530

Total Undiscounted Cost Savings.............$972,712

5% Discount Rate	10% Discount Rate
$842,004	$737,048

The third assumption is that there will be no change in trends for components of C-141 FHR TARIFFS other than jet fuel prices. For 1989, the Tariff of $2,507 was determined by MAC based on the following inputs: (1) fixed costs of $923 which includes $118 for civilian pay, $474 for depot maintenance, $200 for supply, and $136 for miscellaneous costs; (2) variable costs of $1,287 based on flight hours which includes $1,196 for fuel, $23 for depot maintenance, $26 for supply, and $42 for temporary duty payment to aircrew; and (3) a premium of $292 [Ref. 19]. Since fuel accounts for less than 50 percent of the total Tariff, any large changes in labor, supply, or maintenance costs could induce errors in forecasts over the next five years. Historical figures, other than fuel inputs, were not available for running a multiple regression analysis.

C. ADVANCED PARTY

F-4 squadrons were authorized 35 personnel on advanced parties for deployments involving the transfer of aircraft between squadrons. These parties consisted mainly of maintenance personnel to perform aircraft acceptance and transfer inspections, aircrews for acceptance flights, and logistics and administrative personnel. F/A-18 squadrons are now limited to 30 personnel since fewer aircrew and maintenance personnel are required for transfer and acceptance.

CAT Y airline rates and kerosene type jet fuel are used to forecast advanced party transportation costs. The CAT Y Rates are user tariffs that MAC charges military services for transporting individual personnel one way between U.S. civilian airports and overseas civilian airports. MAC contracts annually with civilian carriers to provide regularly scheduled flights and pays them by the flight rather than the seat, thus absorbing the risk of unfilled flights. The seats are then made available to military and DOD personnel at rates (CAT Y) sufficient to cover MAC's overhead costs, allowing for an average number of unfilled seats, and to provide some "profit." The independent variable for the analysis is the price of jet fuel which appears in Appendix D. Prior to regression, the CAT Y rates and fuel prices are converted to constant 1988 dollars using the Implicit GNP Price Deflators, Appendix C.

Three CAT Y rates are listed in Appendix B and cover transportation from St. Louis, MO, Los Angeles, CA, and Honolulu, HI to Narita International Airport, Tokyo, Japan. These rates cover personnel deploying from Beaufort, SC, El Toro, CA, and Kaneohe Bay, HI respectively. Additional costs are incurred by Beaufort squadrons for commercial transportation to St. Louis. From Narita Airport, the common mode of transportation to MCAS Iwakuni, Japan is by train. Historical rates are not available so a train transportation cost of 9600 yen one-way, effective on 22 October 1988, is used for analysis [Ref. 20]. The conversion rate from yen to dollars has flucuated drastically over the past several years. This analysis uses the October 22, 1988 rate of 127 yen to the dollar and 9600 yen to forecast charges for the next five years. This rounds to $76.00 per person for one-way transportation. This cost is small compared to the overall transportation costs. For 30 individuals, this totals to $2,280.

The following analyses are based on three assumptions. First, the Marine Corps will continue to use CAT Y flights to transport advanced parties to and from WestPac. Second, Beaufort personnel will continue to use commercial flights from Savannah, GA to St. Louis, MO and then board a CAT Y flight to Japan. Third, personnel will continue to use train transportation from Tokyo to Iwakuni.

One must realize that the figures developed in this section are only estimates of possible cost savings. For example, advanced parties have deployed directly to Korea due to runway repairs at Iwakuni and have returned to the U.S. from the Phillippines since their units were deployed there just prior to completing a UDP evolution. Any such changes will result in deviations from the projected cost savings.

1. MCAS Beaufort to MCAS Iwakuni

The CAT Y RATE, Appendix B, is regressed using FUEL PRICE as the predictor. The plot of CAT Y RATE versus FUEL PRICE shows an upward sloping trend which does not require transformation prior to performing regression analysis. The power equation, $Y = a + bx$ provides a good fit. The results of the regression are depicted in Table 5.9.

Analysis of the goodness of fit follows that applied in the previous section on transportation costs.

TABLE 5.9

ADVANCED PARTY TRANSPORTATION REGRESSION ANALYSIS
ST. LOUIS, MO - TOYKO, JAPAN

The regression equation equation is:

CAT Y RATE = 316 + 4.45 X FUEL PRICE

Predictor	Coef	Stdev	t-ratio	p
Constant	316.01	62.91	5.02	0.007
FUEL PRICE	4.4501	0.7911	5.63	0.005

s = 39.58 R-sq = 88.8% R-sq(adj) = 86.0%

Analysis of Variance

Source	DF	SS	MS	F	p
Regression	1	49565	49565	31.64	0.005
Error	4	6265	1566		
Total	5	55830			

Durbin-Watson statistic = 2.33

The standard error of the estimate, 39.58, is acceptable and indicates a good fit. 88.8% of the variation in rates is due to the independent variable, FUEL PRICE. The critical t-ratio is 2.57 with a 95% confidence interval and five total degrees of freedom. The absolute value of the regression t-ratios of 5.02 and 5.63 are higher and imply a good fit. The F-ratio, 31.64, exceeds the critical value of 7.71 for a 95% confidence interval, one DF for the regression, and four DFs for the error.

A plot of residual errors against normal scores approximates a straight line; therefore, normality can be assumed. Correlation between the error terms and the normal scores is 0.974 and exceeds the critical value of 0.9 for a .05 level of significance. A plot of CAT Y RATE versus FUEL PRICE with the superimposed regression line indicates that constant variance exists. The error plots show no pattern, and they are considered independent of the variables as required for least squares, best fit analysis.

Table 5.10 provides estimated costs over the next five years as determined by the regression formula, Table 5.9. CAT Y RATES from St. Louis to Tokyo are based on projected jet fuel prices listed in Appendix D.

TABLE 5.10

PROJECTED ADVANCED PARTY TRANSPORTATION COSTS
MCAS BEAUFORT - MCAS IWAKUNI
(Constant 1988 Dollars)

Year	1989	1990	1991	1992	1993
Savannah - St. Louis	170	170	170	170	170
St. Louis - Tokyo	586	589	592	595	605
Tokyo - Iwakuni	76	76	76	76	76
Cost Per Individual	832	835	838	841	851
Total Cost (30 People)	24,960	25,050	25,140	25,230	25,530

Beaufort squadron's advanced party personnel use commercial airline transportation to reach St. Louis for their CAT Y flight to Narita International Airport, Tokyo, Japan. Historical airline charges are not available between the closest civilian airport to Beaufort (Savannah, GA) and St. Louis; consequently, a November 1, 1988 rate of $170, one-way, is used in this analysis. The total cost of transporting one advanced party from Savannah to St. Louis is $5,100.

2. MCAS El Toro - MCAS Iwakuni

The plot of CAT Y RATE, Appendix B, versus FUEL PRICE, Appendix D shows a trend which slopes upward at a decreasing rate. Analysis of data plots indicates that transformation of the dependent variable, FUEL PRICE, is required prior to performing regression. The equation, Y = a + b* 1/x, provides a good fit. The results of the regression are depicted in Table 5.11.

The standard error of the estimate compares favorably to the estimates, indicating a good fit. 95.9% of the variation in CAT Y RATE is due to the independent variable 1/FUEL PRICE. The critical t-ratio is 2.57 and is less than the absolute values of the regression t-ratios for the predictors, 21.76 and -9.63. The F-ratio is 92.67 and exceeds the critical value of 7.71.

TABLE 5.11

ADVANCED PARTY TRANSPORTATION REGRESSION ANALYSIS
LOS ANGELES, CA - TOYKO, JAPAN

The regression equation equation is:

CAT Y RATE = 893 + 27194 (1/FUEL PRICE)

Predictor	Coef	Stdev	t-ratio	p
Constant	892.95	41.04	21.76	0.000
1/FUEL PRICE	-27194	2825	-9.63	0.001

s = 26.44 R-sq = 95.9% R-sq(adj) = 94.8%

Analysis of Variance

Source	DF	SS	MS	F	p
Regression	1	64756	64756	92.67	0.001
Error	4	2795	699		
Total	5	67551			

Durbin-Watson statistic = 1.86

A plot of residual errors over normal scores approximates a straight line, implying normality. Correlation between the error terms and the normal score is 0.941 and is greater than the critical value of 0.9. Constant variance exists between the regression results and the actual p s. The errors appear random, implying independence and satisfies the requirements of regression.

Table 5.12 provides estimated costs over the next five years. The regression equation from TABLE 5.11 and the projected jet fuel prices listed in Appendix D were used to project CAT Y RATES from Los Angeles to Tokyo.

TABLE 5.12

PROJECTED ADVANCED PARTY TRANSPORTATION COSTS
MCAS EL TORO - MCAS IWAKUNI
(Constant 1988 Dollars)

Year	1989	1990	1991	1992	1993
Los Angeles - Tokyo	445	450	455	459	474
Tokyo - Iwakuni	76	76	76	76	76
Cost Per Individual	521	526	531	535	550
Total Cost(30 People)	15,630	15,780	15,930	16,050	16,500

3. MCAS Kaneohe Bay - MCAS Iwakuni

The plot of CAT Y RATE, Appendix B, versus FUEL PRICE, Appendix D shows an upward sloping trend. The plot approximates a straight line indicating transformationof variables is not required. The equation, Y = a + b * X is appropriate. Regression analysis, Table 5.13, shows an almost perfect fit.

A very small standard error of the estimate, 2.761, indicates a good fit of the regression line. 99.4 % of the variance in CAT Y RATE is due to the independent variable, FUEL PRICE. The t-ratios of 53.56 and 26.41 are significantly greater than the critical ratio of 2.57. An F-ratio of 697.4 exceeds the critical value of 7.71. Both ratios imply a good fit.

TABLE 5.13

ADVANCED PARTY TRANSPORTATION REGRESSION ANALYSIS
HONOLULU, HI - TOYKO, JAPAN

The regression equation equation is:

CAT Y RATE = 235 + 1.46 (FUEL PRICE)

Predictor	Coef	Stdev	t-ratio	p
Constant	235.005	4.388	53.56	0.000
FUEL PRICE	1.45734	0.05518	26.41	0.000

s = 2.761 R-sq = 99.4% R-sq(adj) = 99.3%

Analysis of Variance

Source	DF	SS	MS	F	p
Regression	1	5315.5	5315.5	697.4	0.000
Error	4	30.5	7.6		
Total	5	5346.0			

Durbin-Watson statistic = 2.01

A plot of residual errors against normal scores shows a straight line and normality is assumed. Correlation between the two is extremely high at 0.97 and exceeds the critical value of 0.9. Very little variance exists so it is assumed to be constant. No pattern is depicted in the error plot and they are considered independent of the variables.

Projected jet fuel prices from Appendix D are used to project CAT Y rates. Table 5.14 provides a summary of projected transportation costs between Honolulu and Iwakuni.

TABLE 5.14

PROJECTED ADVANCED PARTY TRANSPORTATION COSTS
MCAS KANEOHE BAY - MCAS IWAKUNI
(Constant 1988 Dollars)

Year	1989	1990	1991	1992	1993
Honolulu - Tokyo	323	324	326	326	330
Tokyo - Iwakuni	76	76	76	75	76
Cost Per Individual	399	400	402	402	406
Total Cost(30 People)	11.970	12,000	12,060	12,060	12,180

4. Aggregate Costs

Table 5.15 depicts projected overall transportation cost savings for UDP advanced parties. These costs are determined by crossing the advanced party costs from Tables 5.10, 5.12, and 5.14 with the UDP deployment projections from Appendix E.

D. TRANSPORTATION COST SUMMARY

Table 5.16 is a recap of all the projected transportation costs for UDP. The figures are summed from Table 5.5, 5.8, and 5.15. By changing fighter squadron UDP from a series of six-month deployments to one-year deployments, the Marine Corps has the potential to save over four million dollars (constant 1988 dollars).

TABLE 5.15

PROJECTED UDP ADVANCED PARTY TRANSPORTATION COST SAVINGS
FY 1989 - FY 1993
(Constant 1988 Dollars)

FY	Beaufort	El Toro	Kaneohe Bay	Total
1989	$49,920	$31,260		$ 81,180
1990	$50,100	$31,560		$ 81,660
1991	$50,280		$24,120	$ 74,400
1992	$50,460		$24,120	$ 74,580
1993	$51,060		$24,360	$ 75,420

Total Undiscounted Cost Savings.............$387,240

5% Discount Rate	10% Discount Rate
$336,103	$294,954

TABLE 5.16

PROJECTED UDP TRANSPORTATION COST SAVINGS
FY 1989 - FY 1993
(Constant 1988 Dollars)

FY	Beaufort	El Toro	Kaneohe Bay	Total
1989	$474,359	$381,740		$ 856,099
1990	$476,557	$383,678		$ 860,235
1991	$478,226		$286,885	$ 765,111
1992	$479,604		$287,672	$ 767,276
1993	$486,548		$294,025	$ 780,573

Total Undiscounted Cost Savings.............$4,029,294

5% Discount Rate	10% Discount Rate
$3,499,362	$3,072,783

VI. BENEFIT ANALYSIS

A. AIRCRAFT READINESS

One of the underlying reasons for beginning UDP was to increase unit readiness. Aircraft readiness is a function of overall unit readiness. Whether or not aircraft readiness has increased since UDP began is beyond the scope of this thesis. What is considered is whether a change in the current six-month deployment concept to a one-year evolution will sacrifice aircraft readiness. There is no sure method of quantifying readiness between the two alternatives, but an analysis of the present program will provide an indication whether to accept or reject the alternative based on aircraft readiness.

The author's personal experience in UDP as a squadron maintenance officer and as an executive officer leads to the conclusion that the maintenance effort will be about average until just prior to deployment (two weeks or so). During the deployment period, aircraft readiness will be higher than the readiness normally maintained in the squadron. Following the deployment, there will be a let down in readiness due to leave periods and due to a relaxing of operational tempo and maintenance requirements.

Aircraft readiness is difficult to measure accurately. Readiness is a judgment call rather than simply a quantitative measurement. For example, when an baseball player says he is "ready" to play, his feeling comes from within and is made up of many variables. Certainly past performance is one. How many hits did he have in the last week? How many errors? Readiness in this case also depends on the amount of recent rest and nutrition, the baseball player's attitude, the state of his equipment, and any problems relating to injuries. Since this judgment makes readiness difficult to standardize, it must be broken down and explained by performance measurements. Measurements of readiness and the importance an individual places on each measure varies with experience level and background. We could look at the slugging percentage, the number of home runs or runs batted in rather than the baseball player's batting average. How do we weigh hits versus errors?

In addition "gaming" becomes a problem. Gaming is the ability to manipulate the measurement to support or reach a particular goal. If a baseball player gets paid for having a lot of home runs, he can do several things to try to inflate that figure. Not taking walks or accepting many stikeouts as a result of swinging for the fence are two examples.

The same problems occur in trying to measure aircraft readiness. Many different measures of readiness have been used to rate fighter squadrons. Flight hours, sorties, Mission Capable (MC) rates, Full Mission Capable (FMC) rates, and aircraft utilization rates are but a few. Appendix G provides an explanation a various readiness terminologies used in this section [Ref. 21]. Many variables are not easily quantified, so they are not used.

Maintenance training is difficult to quantify, but it is an important ingredient in readiness. An aircraft may be signed off as FMC, but it may not be properly repaired because of lack of experience and poor supervision.

Aircraft readiness measures are subject to gaming by those involved. Aircraft readiness is used by all echelons as an unofficial report card on maintenance officers and on squadron, group, wing, and force commanders. Flight hours can be increased by adding three external fuel tanks and flying maximum endurance airspeed. Of course, aircrew training suffers. By flying at high airspeeds and using high-speed refueling pits, a squadron can increase the number of sorties it flys in a given time period. Aircrew training may not suffer but maintenance of the aircraft probably will. MC, FMC, PMC, etc. are computed from squadron documents and are difficult to check for accuracy or authenticity. Squadrons often fly aircraft away from home base on weekends to generate flight time without forcing the Maintenance Department to work. If the aircraft return during non-working hours, the discrepancies written on the aircraft are often post-dated to the time Maintenance returns to work. This makes FMC, MC, and PMC look artificially higher.

Many different measures of aircraft readiness were considered for analysis. Not Mission Capable, Maintenance (NMCM) was chosen. NMCM is that percentage of Equipment In Service (EIS) hours in which an aircraft is Not Mission Capable (NMC) due to unscheduled maintenance requirements.

EIS is computed by multiplying the number of aircraft assigned to the squadron and in a reportable status by the number of hours in a month.

The reason for choosing NMCM was to limit the gaming possibilities and to isolate the measure to maintenance at the squadron level. NMC status, basically, is assigned to aircraft that are unable to fly without endangering the aircraft or aircrew. An NMC aircraft can't be used to perform any mission. This is one status that maintenance personnel and aircrew refuse to compromise and is, therefore, subject to less gaming. No statistic is worth intentionally risking man or machine. NMC is determined by maintenance and supply requirements. NMCM, as a subdivision of NMC, isolates supply from the aircraft status and is a good indicator of aircraft readiness due to squadron maintenance efforts.

The NMCM rates analyzed were recorded for six squadrons based at Kaneohe Bay, HI and Beaufort, SC, and cover the period 1 January 1981 to 31 July 1988. NMCM varies considerably between squadrons and between time periods. Each squadron commander or aircraft maintenance officer places different emphasis on how high a MNCM rate he is willing to tolerate. Maintenance personnel sometimes work long hours to keep squadron aircraft in a high state of readiness. Maintenance officers are notorious for trying to place the onus on supply when aircraft are non-flyable. The number and quality of maintenance personnel are key factors in NMCM percentages, vary between squadrons, and are dependent on transfers in and out of the units.

Due to the variance among squadrons and over time, the NMCM percentages are standardized. First, the mean and the standard deviation are computed for each calendar year. Then, the mean is subtracted from the monthly NMCM percentage, and the result is divided by the standard deviation. This figure measures the NMCM percentage distance from the mean as a number of standard deviations and is often called a z-score. Approximately 68 percent of the value in a normal population lie within one standard deviation of the mean, approximately 95 percent lie within two standard deviations, and approxomately 99.7 percent lie within three standard deviations.

Standardization is based on the assumption of normality. Twelve of the 48 populations have been checked for approximate normality. The results indicate that the assumption of normality is reasonable. Three empirical rules are used as the check for normality. The probability that a single observation falls within plus or minus one standard deviation of the mean should be 68 percent. Another way to say this is that 68 percent of all the observations should be within one standard deviation. The standard deviation of the number falling inside this interval is equal to the square root of the number times the probability times one minus the probability. This equals 0.47 times the square root of the number of observations. To be within three standard deviations means to be within 1.47 times the square root of the number. The rule of thumb is that if the number in the interval differs from .68n by more than 1.41(sqr n), the assumption of normality is suspect. The last two checks are similar and deal with two standard deviation intervals and three standard deviation intervals. For example, VMFA-312 averaged an NMCM of 23.1 percent in 1981 with a standard deviation of 5.5. Ten observations occurred during the year. Seven of these observations are within one standard deviation. So, for normality to hold, the following checks apply:

1 StDev: $7 - 0.680(10) \leq 1.41(\text{sqrt}10)$
$0.20 \leq 4.46$

2 StDev: $10 - 0.950(10) \leq 0.65(\text{sqrt}10)$
$0.50 \leq 2.07$

3 StDev: $10 - 0.997(10) \leq 0.16(\text{sqrt}10)$
$0.03 \leq 0.52$

The next procedure in the analysis involves normalization of the data. The years are converted to time period intervals. January 1981 is time period one and July 1988 is time period 90. The data for the six squadrons is lagged so that deployment begins in time period 16 for all squadrons. This eases the process of analyzing any trends that might be caused by deployment. VMFA-312 deployed in January 1981. The idea is to match all the other squadron deployments in a vertical alignment to make analysis simpler. VMFA-312 is lagged fifteen periods. VMFA-212 deployed in April 1981 so their data is lagged twelve time periods. VMFA-451 is next with a nine period lag followed by VMFA-232 (six month lag), VMFA-333 (three month lag) and VMFA-235 (no lag). This places all squadrons deploying for six periods beginning at time periods 16, 34, 52, 70, and

88. However, one problem still remains. The five resulting deployment intervals are mixed; in each interval, three squadrons transfer aircraft and three squadrons fly their aircraft from home base to MCAS Iwakuni. Experience leads the author to believe that maintenance efforts might not be equally weighted. That is to say that maintenance tends to slide on aircraft that are being transferred while the maintenance effort is more consistent on aircraft that are being kept. As a result, three squadrons were lagged from time period 16 to time period 34 which finally matches all six squadron's deployment cycles. The results of the standardization and normalization process appear in Table 6.1. The six month deployment is bracketed top and bottom by bold characters.

No pattern is apparent in the magnitude of the z-scores. The distribution of values greater than plus or minus one standard deviation appears random. However, if one looks merely at how each period fares in relation to the norm, a pattern emerges. Any z-score in Table 6.1 with a minus sign portrays better than average aircraft readiness, and z-scores without a sign portray worse than average performance. In the three months preceeding UDP, better than average NMCM occurs for 51 percent of the periods for which data is available. A breakdown by period is presented in Table 6.2. During the squadron deployment, better than average NMCM occurs 67.4 percent of the periods. For the three months following deployment, better than average NMCM occurs 34.9 percent of the periods.

TABLE 6.1

F-4 NOT MISSION CAPAPABLE MAINTENANCE RATES (Normalized and Standardized)

DEPLOYMENT PERIOD 1; NO AIRCRAFT TRANSFER

	13	14	15	16	17	18	19	20	21	22	23	24
VMFA-312												
VMFA-333												
VMFA-451							0.2	-1.1	0.9	0.8		
VMFA-235	-0.1	-0.7	-0.9	-0.3	-0.3	-0.9	-0.8	-0.6	0.4	2.0	1.8	0.4
VMFA-212	0.4	0.3	0.0						-2.5	-0.3	0.2	0.1
VMFA-232												1.1

DEPLOYMENT PERIOD 2; AIRCRAFT TRANSFER

	31	32	33	34	35	36	37	38	39	40	41	42
VMFA-312			-1.4		-0.7	1.0	-1.1	0.4		-0.7	0.7	-0.3
VMFA-333				0.7	-1.2	-1.0		-0.6			-0.7	1.5
VMFA-451	1.1	-0.3	1.1	2.2	0.7	-1.2		-0.1	-0.2	-0.3	0.6	-0.9
VMFA-235	0.9	-0.1	-2.5	-0.8		0.0	0.5	2.3		-0.3		-0.4
VMFA-212	-0.8	0.8	-1.2	-0.4	-1.4	0.0	2.0	0.9	-0.2	-0.5	-0.3	-0.9
VMFA-232	0.8		-0.5	-1.9	-1.3	1.5		-0.5	0.3	0.8	1.5	0.7

DEPLOYMENT PERIOD 3; NO AIRCRAFT TRANSFER

	49	50	51	52	53	54	55	56	57	58	59	60
VMFA-312	-2.0	0.5		-0.1		0.7		1.1	2.0	0.1	-1.0	-1.1
VMFA-333	0.1	0.5		-0.1	0.3			-2.8		-0.8	-0.2	2.4
VMFA-451	0.1	-0.8	-1.3	0.3		-0.3		0.1		1.5	-0.2	1.0
VMFA-235		0.2	[illegible]	[illegible]	-0.6	-1.1	-1.5	0.0	0.6	0.4	1.7	
VMFA-212	-0.1	-1.0	-0.2	0.0	-1.0		0.0	-0.5	-0.2		0.3	2.6
VMFA-232	-2.0	1.9	0.5	-0.6	-0.2	1.1	0.6	-0.3	-0.7	0.3	-0.3	1.4

DEPLOYMENT PERIOD 4; AIRCRAFT TRANSFER

	67	68	69	70	71	72	73	74	75	76	77	78
VMFA-312		-0.3		-0.2	0.2	-1.4	0.0	-0.4	-0.3	-0.1	0.0	2.4
VMFA-333	-1.7	0.5	0.7		-1.3	0.0	0.1	0.6	-2.4	0.4	0.5	0.9
VMFA-451	-1.0	1.2	-0.7		0.9			0.4	-0.2			-1.4
VMFA-235		0.7	0.6	2.1	-0.6	-0.8					0.0	
VMFA-212	0.2	0.3	-0.1	-1.1	-1.1	-1.3	-1.3	-0.6	-0.7	0.8	0.5	1.4
VMFA-232	0.1	-0.1	-0.2	-1.4	-0.2	-0.2						

DEPLOYMENT PERIOD 5; NO AIRCRAFT TRANSFER

	85	86	87	88	89	90	91	92	93	94	95	96
VMFA-312	0.4	0.2	-0.6	1.3	-0.6	0.7		0.1	1.5	2.0	0.5	0.2
VMFA-333	0.7	-0.6	-0.6	-1.3	-0.5	-0.3	-1.2	-0.5			0.0	
VMFA-451												
VMFA-235	0.9	-0.1	-0.5	-1.9	-0.5	-1.5						
VMFA-212	1.5	1.2	0.6	-0.1	-1.2	0.1	-0.5		-1.1		-1.1	1.0
VMFA-232	-0.5	-0.8	-0.2	-0.1	0.0	0.6	-0.7	0.0	0.5		2.7	1.8

These results confirm the author's experience but cannot be considered conclusive. The number of gaps in the data, the few squadrons involved in UDP, and the compressed time frame present the possibility of reaching conclusions that are untrue. However, in the absence of better data to judge the benefits that accrue to aircraft readiness, this analysis does serve to reinforce the author's judgment.

TABLE 6.2

PERCENT OF MONTHS IN WHICH MAINTENANCE (MEASURED BY NMCM) IS ABOVE AVERAGE FOR ALL SQUADRONS
(January 1981 - July 1988)

	3 Mos Prior	6 Mo Deployment	6 Mos After
Deployment 1	50.0%	70.0%	12.5%
Deployment 2	58.0%	57.0%	63.0%
Deployment 3	47.0%	62.0%	36.0%
Deployment 4	47.0%	77.0%	36.0%
Deployment 5	53.0%	71.0%	25.0%
Average	51.0%	67.4%	34.9%

Note: Average is computed for each time segment (eg. for 3 months prior over all squadrons, etc.).

How does changing from two six-month deployments to a one-year evolution affect aircraft readiness? In comparing the two alternatives, one is concerned with total time. Under both alternatives, squadrons will deploy for a total of 12 months. According to Table 6.2, eight of those months should have better than average NMCM percentages, assuming that the maintenance effort will be as consistent for a 12 month deployment as it is for two 6 month deployments. If we consider NMCM over specified periods prior to and after deployment, we will have to consider twice as many months for six-month UDP as we would for one-year UDP. Changing to one-year UDP will have no effect on NMCM for the three-month periods prior to deployment, if NMCM is above the average for half of the time and below for the remainder. According to Table 6.2, two-thirds of the months following UDP will have worse than average NMCM. Since half as many deployments will take place under one-year UDP, the number of months that NMCM is below the norm should decrease. Six-month UDP squadrons should have eight worse than average months subsequent to deployment, and one-year UDP squadrons should have only four worse than average months. Therefore, by selecting the alternative UDP, the fighter community should see an overall decrease in NMCM percentage and an increase in aircraft readiness.

B. AIRCREW TRAINING READINESS

Aircrew training readiness is another important component of overall unit readiness. UDP was envisioned to provide unit continuity, thereby, enabling commanders to organize and control their training evolutions more effectively. The result hoped for is increased readiness. Whether or not this goal has been achieved in the fighter community is not the purpose of this discussion. Again, consideration is given to whether a change in the unit deployment program will effect aircrew training readiness.

Aircrew training readiness depends on many factors. Some of the more important factors include the number and material condition of squadron aircraft, the number of sorties flown during a typical month, the number of aircrew assigned to the squadron, the previous experience level of the aircrew, aircrew time in service, the quality of lectures provided the aircrew, the expertise of the squadron's aircrew training section, and the emphasis that the various echelons of command place on aircrew training.

The Marine Corps' Training and Readiness Manual (T&R) provides guidelines for the conduct of training for aviation communities. The T&R provides a specific syllabus for each community. This syllabus is divided into four categories: combat capable, combat ready, combat qualified, and full-combat qualified. Each syllabus flight requirement in the T&R has a combat readiness percentage (CRP) assigned. The categories are made up of different types of sorties. The F-4 community will fly instrument, intercept, bombing, low level navigation, and air combat manuvering sorties, among others. The difference between categories lies in the degree of expertise required to complete each sortie. As aircrew progress through the syllabus, their CRP increases. When they complete the first portion of the syllabus, which equates to a CRP of 60 percent, they are considered combat capable. Seventy percent is required for combat ready, 85 percent for combat qualified, and 100 percent for full-combat qualified. [Ref. 22]

CRP measures total proficiency for each aircrewman. Proficiency is a measure of achievement of a specific skill by an individual. The need to perform aviation skills with a degree of frequency is required to maintain a minimum level of proficiency. This means that certain sorties specified in the T&R syllabus must be reflown within a specified time period; if not, CRP decreases. When aicrew refly a syllabus sortie, they are credited with a refresher sortie. Refresher sorties may be flown as often as desired. For example, instrument navigation flight 104 may be flown on five successive days or during five successive months. The aircrew will be credited for one syllabus completion and four refresher sorties. Only the syllabus completion will update the aircrew's CRPs. If the refly requirement is every three months, the aircrew will not lose the CRP corresponding to INST 104 until the first day of the fourth month following the last refresher sortie.

CRP is maintained for all aircrew assigned to fly with the squadron. The CRPs for all aircrew are averaged every month and used as an input for overall squadron readiness. Historical files on squadron CRP are not maintained, as a general rule, past one year. There is also no Marine Corps requirement to maintain aircrew historical CRPs; only a current monthly CRP is required. As a consequence, CRP cannot be used as a measure of aircrew training readiness for the two alternatives being analyzed for UDP. The only information available on a long term basis is the number of sorties flown by each aircrew.

Each sortie is recorded on a FREDS as indicated in Chapter IV. The FREDS list the crew mission and training code for each flight. The training code corresponds to a T&R syllabus sortie and is used to update CRPs. Mission codes are divided into seven categories which equate to syllabus completions/incompletions, refresher sorties, evaluation flights, instructor training, test and ferry flights, logistics and operations support, and administrative support.

The two alternative programs are analyzed by comparing the aircrew training accomplished by two squadrons involved in UDP for a one-year period to three squadrons participating in UDP for six-month increments. Since historical CRPs are not available, mission codes are used as a measure of aircrew training readiness for this analysis. The aircrew training mission codes for the five squadrons involved in UDP between October 1977 and July 1980 have been divided into four groups of mission codes: syllabus completions, refreshers, others, and syllabus incompletions. The results of the data search are recapped in Appendix H. The four groups of mission codes are displayed on a monthly basis. WestPac deployment time periods are highlighted along with unit deployments to MCAS Yuma, AZ. Yuma is included since it is a major training resource center; the number of sorties flown and the training accomplished there are considerably higher. Since each sortie requires a pilot and a RIO, the number of sorties can be determined from the mission code totals (mission code totals divided by two).

Aircrew receive valuable training every time they fly, whether they gain a syllabus completion, a refresher, or a logistics support flight. Even a flight for which a syllabus incompletion is recorded provides some training for the aircrew. However, the amount of training received for a syllabus completion does not equate to the amount of training accomplished on a logistics support flight. As a consequence, the mission code categories are weighted to provide a better indication of overall training accomplished. Multiple syllabus completions on individual flights are not considered in the analysis since they are not broken out by mission code. Based on the experience of the author as an instructor in the training squadron for Marine F-4 aircrew (VMFAT-101), as a graduate of the Navy Fighter Weapons School (TOPGUN), as the Aircrew Training Officer in a tactical squadron, and as an instructor in Marine Aviation Weapons and Tactics Squadron - One (MAWTS-1), the following weights indicated in Table 6.3 are assigned to mission codes.

The aircrew mission code totals in Appendix H are multiplied by the weights assigned in Table 6.3 to obtain weighted totals. The results are presented in Appendix I.

For comparison purposes between one-year UDP and six-month UDP, the totals in Appendix I are converted to a percent difference from the mean. The results are shown in Table 6.4. The mean applies to the 32 or 33 month periods for each squadron. An attempt to develop an aggregated mean for the squadron as a whole is not made due to differences in aircraft availability between units and due to the possibilities for gaming the results of training.

TABLE 6.3

AIRCREW MISSION WEIGHTING

Syllabus Completions	7
Syllabus Incompletions	1
Refresher Sorties	4
Other	2

Note: Other includes evaluation, instructor training, test and ferry, logistics and operations, and administrative codes.

Gaming is quite easy to accomplish. Aircrew log their own training on FREDS and often take completions without performing all the requirements. Training officers have also been known to adopt the policy: "fly what you want, log what you need." Some squadrons place more emphasis on syllabus completions than on refreshers. They can make the syllabus completions high by allowing currency for a particular syllabus flight to lapse and then quickly scheduling that syllabus requirement for a flight. One of the squadrons analyzed has a 16-month period when the average number of refresher sorties recorded in any month was less than three.

Some aircrew training officers are reluctant to allow incompletions to be recorded. During a 12-month period, one of the squadrons went nine months without a single

TABLE 6.4

WEIGHTED AIRCREW MISSION CODE TOTALS AS A PERCENT DIFFERENCE FROM THE MEAN OCTOBER 1977 - JUNE 1980

Periods

	1	2	3	4	5	6	7	8	9
VMFA-251	-14	-50	4	-7	1	43	33	13	-30
VMFA-122	-14	-18	-13	-15	-13	9	108	-20	-31
VMFA-235	-11	16	-20	2	-4	-31	-32	8	-13
VMFA-212	84	75	-35	-23	-41	-18	-30	19	-15
VMFA-232	-68	-33	-37	-26	-28	11	44	132	-10

	10	11	12	13	14	15	16	17	18
VMFA-251	-31	-20	3	-5	-24	-7	-8	27	-10
VMFA-122	-27	34	29	0	54	35	31	0	64
VMFA-235	14	16	87	104	8	10	7	12	-12
VMFA-212	22	-56	0	-47	-19	-11	12	-4	-15
VMFA-232	8	-47	-46	4	49	-15	-5	12	-24

	19	20	21	22	23	24	25	26	27
VMFA-251	156	-20	11	-5	-40	-20	16	-18	-27
VMFA-122	59	19	-31	-14	-38	-25	-10	59	-16
VMFA-235	6	2	22	6	7	10	-14	-34	-31
VMFA-212	-5	3	-38	-5	20	-16	-5	32	14
VMFA-232	0	7	5	-18	-15	1	5	177	11

	28	29	30	31	32	33
VMFA-251	-13	15	15	45	-24	
VMFA-122	-22	-66	-41	-53	-34	
VMFA-235	-58	-54	-31	-1	13	-4
VMFA-212	52	63	-2	-18	20	-12
VMFA-232	-28	-43	-46	-44	70	0

NOTES:
1. Periods are one month long.
2. Bold characters indicate UDP periods.
3. Bold and underlined characters indicate squadron deployed to MCAS Yuma, AZ during the period.
4. The means are based on 32 months for VMFA-251 and VMFA-122 and 33 months for VMFA-235, VMFA-212, and VMFA-232.
5. See Appendix H and Appendix I for further breakdowns. Refresher sorties were flown each month.

incomplete sortie. Deciding what constitutes a support flight or a ferry flight is often difficult. Most squadrons attempt to log syllabus completions or refreshers vice support codes. For example, if the MAG tasked the squadron to fly documents from Iwakuni to Okinawa, a squadron might log a refresher sortie for instrument/navigation instead of logging a logistics support flight. One squadron evidently was over tasked with outside requirements or did not place the emphasis on matching syllabus requirements with the other missions. Their average was almost three times the norm for support missions.

There are many ways to analyze the results depicted in Table 6.4. The basic method used is to compare the results of the two one-year deployment squadrons (VMFA-251 and VMFA-122 (Beaufort)) to the six-month squadrons (Hawaii). The training accomplished by the Beaufort squadrons is better than their averages for 68 percent of their UDP time. For the Hawaii squadrons, the figure is 59 percent. This leads the author to believe that one-year UDP might be better for aircrew training than six-month UDP.

Another way to look at the differences between alternative programs appears in Table 6.5. The average weighted totals for UDP and non-deployed months are found by adding all the mission code totals for periods in which the squadrons were deployed to WestPac and non-deployed periods, respectively (Appendix I). The indices are determined by dividing these totals by the over-all averages shown in Appendix I. For Beaufort (one-year UDP), the 113 percent index means that the squadrons accomplish 13 percent more training monthly than their average over deployed and non-deployed periods (excluding Yuma deployments). The other numbers have similar intrepretations. Table 6.5 shows, therefore, that the one-year UDP squadrons accomplish more of their training while deployed to WestPac than the six-month UDP units on their deployments (113% vice 106%). This, again, supports the author's judgement that one-year UDP is better than six-month UDP from the standpoint of aircrew training.

TABLE 6.5

AIRCREW TRAINING COMPARISONS

	Beaufort	Hawaii
Average Weighted Totals	1457	1826
UDP Periods:		
Average Weighted Deployed	1650	1933
Index (Percent of Total)	113%	106%
Non-deployed Periods:		
Average Weighted Non-deployed	1216	1580
Index (Percent of Total)	83%	87%

The fact that the results in the previous two paragraphs indicate aircrew training is better for one-year deployments than six-month deployments does not necessarily imply that the same would be true for future deployments. The F-4 has been replaced by the F/A-18. The training syllabus for the F/A-18 is different, the aircraft readiness is higher, and there are fewer total aircrew (one seat vice two seat). However, additional benefits may be accrued from a one-year UDP. When one analyzes the data mission code by mission code, these additional benefits become apparent. First, acceptance inspection flights are required for deployments in which aircraft are transferred. On the average, this requires two flights per aircraft (24 sorties) before the squadron is satisfied with the material condition of the newly accepted aircraft. Second, shortly after arrival at Iwakuni, aircrew are subjected to local area familiarization (FAM) flights. Each aircrewman is required to fly two of these on the average (average of 32 per squadron per deployment). A one-year UDP, by reducing the number of deployments, should cut in half the number of FAM flights.

Lastly, slow changes in circadian rhythm[2] are a problem for aircrew who fly non-stop directly to Iwakuni. For Hawaii aircrew, two days of standdown is required before the daily flight schedule may begin. For Beaufort squadrons, the required time is five days. These requirements were developed to overcome aircrew safety problems that can occur from lack of rest and stress due to jet lag. When Beaufort squadrons fly their aircraft to WestPac, the evolution takes as much as one week. The body adapts gradually to time zone changes while enroute, and there is no standdown requirement upon arrival. Generally, two days of welcome aboard lectures take place after arrival. Beaufort squadrons could

[2] Regular metabolic, glandular, and sleep patterns associated with the 24 hour cycles of the Earth's rotation.

fly three additional days during their deployments. For a conservative flight schedule of twelve sorties per day, this equates to 36 additional sorties.

Overall, changing to a one-year UDP can increase the aircrew training capabilities for the involved squadrons. The one-year deployments may accomplish more training while in WestPac as a percentage of overall training. As many as 138 additional sorties can be flown each year if the requirements for area FAM, aircraft acceptance inspection, and standdown time are no longer required. At the least, it appears that aircrew training readiness will not suffer if UDP is changed from the current six-month periods to a one-year evolution.

C. PERSONNEL RETENTION

One of the primary reasons for adopting the six-month UDP was to increase individual and unit morale. Morale is a mental, emotional, and spiritual state. Webster's Dictionary defines it as a "moral or mental condition with respect to courage, discipline, confidence, enthusiasm, willingness tc endure hardship, etc. within a group, in relation to a group, or within an individual." Morale depends on the command climate set by leadership and the feeling of well-being experienced by each individual. This well-being is made up of many factors, with family being one of the most important.

According to a study on overseas dependents conducted by the Army:

> A deployment experience of six months' duration will enhance morale by providing new and unique training opportunities, new surroundings and training areas, a

feeling of cohesiveness based on a shared common experience, the opportunity to travel in distant lands, and the overall feeling of mission accomplishment. During the separation there was a shift in attitudes on the part of wives regarding the Army. Prior to the deployment the majority of wives reported very positive attitudes.... During the deployment there was a general shift in these attitudes from positive to neutral. ...following the deployment, officers' and NCOs' wives' attitudes shifted from positive to neutral; however, the wives of junior enlisted (E5 and below) shifted from positive to negative.

The Marine Corps switched to UDP to decrease the length of continuous family separation (not the total amount) and to gain unit cohesiveness, both of which should have increased morale. As someone who has experienced WestPac deployment prior to and during UDP, this author's opinion is that morale has increased. How would a change to one-year unit deployments affect morale? Having recently experienced two six-month deployments, first as the Aircraft Maintenance Officer and then as the Executive Officer, this author feels that morale might improve with a change in programs but would certainly not decrease.

Investigation of FREDS data from FY 1977 through FY 1979 revealed no appreciable difference in the total deployed time between one-year UDP squadrons and six-month UDP squadrons. Each of the five units investigated spent approximately 39 percent of its time deployed. The normal tour length in fighter squadrons is three years. During this normal tour, personnel can expect to spend one year overseas. If personnel remain in squadrons longer than three years, they become susceptible to more than two unit deployments under the current program. Almost 50 percent of the Staff Non-commissioned Officers (SNCO) in the author's former unit completed three unit deployments to WestPac. One master sargeant completed four tours to WestPac. Under a one-year UDP, the prospect of spending more than one year in WestPac should be less than under the six-month UDP.

To analyze morale more objectively, one needs a method to measure it. This is difficult, to say the least. Indicators of morale might include divorce rates, family service center counselling, substance abuse, and retention. Of these, the easiest to measure is retention. For this analysis, retention is assumed to be, and is used, as an indicator of morale. If morale is low, retention should be lower than normal and visa versa. Although there is certainly a positive correlation between retention and morale, other independent variables affect retention and can skew the measurements. One excellent example is the economy. As the economy suffers and jobs become harder to find, the reenlistment rates in the military services increase. Personnel may also be enticed into reenlistment to provide financial security if the family is suffering debt problems.

Retention figures can be broken down in many ways over several different periods. The analysis of retention and reenlistment figures does not consider officers. They do not reenlist; they are augmented to, or extended on, active duty as reservists. Only enlisted personnel are considered in the analysis of retention. A difficult question is how to look at the reenlistment data. One can consider all personnel or break reenlistment down by grade or time-in-service or both.

The normal break for grade is between E5 (Sgt) and E6 (Staff Sgt). Once a person becomes a Staff Sargeant, he/she is consider career-oriented. Promotion to Staff Sargeant normally occurs sometime after the sixth year, depending on military occupational specialty (MOS). A look at reenlistment rates for E5 and below may not be as good an indicator of morale as other categories. The majority of these personnel are on their first enlistment. Determination not to reenlist may have nothing to do with morale. A lot of personnel in this category are in for a chance to "see the world" and have no intention of reenlisting. Others have little alternative. Family problems, financial hardships, a lackluster economy, and outside job scarcity may induce personnel to reenlist even when their morale is low. Such cases could lead to discipline problems or substance abuse.

Reenlistment rates at the E6 to E9 (SNCO) level may be a better indicator of morale than for E1 to E5. SNCOs have several years invested in the Marine Corps and have made their career decisions. The closer they get to the twenty year retirement mark, the more likely they are to remain on active duty. Low morale may be something they can weather for a few months or years in order to finish their twenty years. If the renlistment rates for SNCOs go down, morale is probably poor and is likely to be the primary factor in a low reenlistment rate.

Breaking down reenlistment rates by time-in-service is more subjective than by grade. Individuals reenlist for different time periods and are promoted based on grade openings in their MOS. The decision to remain past the first or second reenlistment is essentially a career decision and is based on the individual's likelihood of promotion to staff sargeant. Promotion is based on the needs of each occupational field. For example, an electrician may have six years in grade as an E5 when selected for E6; whereas, an ordnanceman could be selected for E6 with only four years as an E5. Would a good break occur at five years or six years? There is no clear answer.

The difficulty of establishing a break based on time-in-service and the fact that SNCO reenlistment rates are higher than the rate for all enlistees leads the author to conclude that reenlistment rates for SNCOs is the best retention indicator of morale. This analysis includes the overall squadron reenlistment rates and SNCO reenlistment rates so that the reader can compare the two.

For personnel to deploy under UDP, they must be able to complete the deployment and have at least ten days remaining on their enlistment contract when they return. Consequently, the potential exists for personnel to say they will not reenlist and to be transferred to a non-deploying unit, only to "change" their mind after their old unit deploys. However, personnel other than first term Marines are not considered eligible for reenlistment if they choose to leave the squadron based on expiration of enlistment.

HQMC's goal is to stabilize units 60 days prior to deployment. If an individual's enlistment contract expires during the deployment period, he/she is transferred early and does not count adversely toward the squadron's reenlistment rate. This causes the squadron's rate to look better than it should. To provide a truer picture of retention, the reenlistment rates analyzed in this section reflect all the personnel who were eligible but who did not reenlist in order to deploy.

This section compares the retention rates of squadrons deploying for six months to the rates of those deploying for one year. The analysis looks at: (1) five different squadrons, (2) from two different air groups, (3) deploying to WestPac at different times, (4) for different tour lengths. This makes the analysis particularly difficult to structure since retention rates vary between units, geographic location, and time. Table 6.6 provides examples of differing retention rates covering periods in which squadrons were not deployed to WestPac. The comparison rates were chosen at random among the first three squadrons deploying to WestPac under UDP and reflect all enlisted personnel.

The next question that must be answered prior to analysis is how do we compare retention for six-month UDP to one-year UDP? Do we compare them by individual squadrons or groups, over separate periods or a block of periods? Aggregrating the numbers into two groups (one-year and six-month) makes the numbers larger and the retention rates more significant. Unfortunately for this analysis, the one-year deploying units are from one location, MCAS Beaufort, and

TABLE 6.6

RETENTION RATE COMPARISON

Between Squadrons, Same Locale:

		Eligible	Reenlisting	Rate
Hawaii, 4th Qtr 1978				
	VMFA-235	19	0	0%
	VMFA-212	21	3	14%

Between Squadrons, Different Locale:

		Eligible	Reenlisting	Rate
3rd Qtr FY 1977				
Hawaii	VMFA-235	16	4	25%
Beaufort	VMFA-251	11	4	36%

Between Squadrons, Different Locale, Long Time Period:

		Eligible	Reenlisting	Rate
21 Month Time Period				
Hawaii	VMFA-212	139	12	9%
Beaufort	VMFA-251	124	18	15%

Different Time Periods, Different Deployment Lengths:

		FY 1977	FY 1978	FY 1979
VMFA-235	Eligible	44	72	103
	Reenlisting	6	8	13
	Rate	14%	12%	13%
	Months Deployed	0	6	6
VMFA-251				
	Eligible	44	49	92
	Reenlisting	6	9	10
	Rate	11%	18%	11%
	Months Deployed	0	12	0

NOTE: VMFA-251 time period covers 2nd Qtr FY thru 1st Qtr for the next FY.

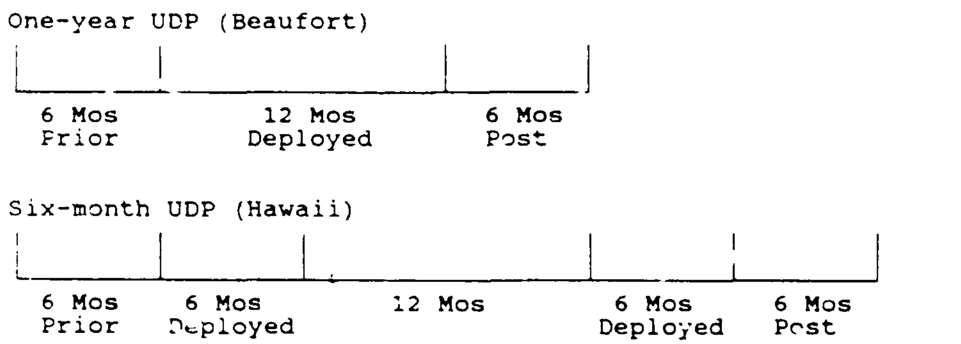
the six-month units are from another location, MCAS Kaneohe Bay. It is possible that the two groupings will reflect retention rate differences due to location as well as length of UDP. However, an indication of the rate difference due to location cannot be determined since none of the Beaufort squadrons were assigned six-month UDP during this time period. Certainly, comparisons can be made between Hawaii and Beaufort at a later date since one-year UDP ceased in 1980; however, these comparisons would be over time periods different from the one being investigated so the comparison would be inconclusive. To complete this analysis, an assumption must be made that there is no significant difference in retention due solely to the fact that the squadrons are home-based at two different locations.

Any comparison of retention between the two programs needs to consider the element of time. One way to compare alternatives is to normalize the data by leading or lagging, so that all the squadrons begin deployment in the same time period. The data would then be event-centered rather than time-centered. This creates a problem in that the retention rates being compared have occurred in two different periods and the rates are not independent of time. The two groups can be matched on a periodic basis. The problem incurred here is that the groups consist of units that are deployed, units preparing to deploy, and units finished with deployment. Comparing the retention rate of deploying Beaufort units to deploying Hawaii units in any particular time period does not guarantee that any difference in retention rates is due to differing deployment time lengths.

Perhaps the best method for comparison is to pick a block of time periods which would have equal amounts of deployed time, predeployed time, and post deployed time for each group. This is difficult since the comparison includes two different cycles and unequal groupings (two squadrons versus three squadrons). Figure 6.1 depicts the difference in time frame required to include one year of deployment for squadrons under the two alternatives.

FIGURE 6.1

DEPLOYMENT TIME HORIZON



To include one year of deployed time for Beaufort and Hawaii squadrons, the time horizons must cover 24 months and 36 months, respectively. If all five squadrons are included in a comparison, the time horizon for Hawaii must extend for 48 months to cover the three participating squadrons; whereas it will require only 36 months to cover the two Beaufort squadrons. The time horizons can be matched by adding 12 months of the Beaufort squadrons retention figures to the covered 24 months. This places a different complexion on the analysis. The behavior of the Beaufort squadrons' personnel should be significantly different, since they are no longer involved in UDP past the 24th month. VMFA-251 will have 30 months of retention rates which are subsequent to its 12 month deployment and VMFA-122 will have 12 months. This compares to 18, 12, and 6 months for the Hawaii squadrons, VMFA-235, VMFA-212, and VMFA-232.

The question still remains, how to block the data without biasing one or more of the squadrons' data. The best choice may be to close down the block, as much as possible, so that behavior changes are limited. Comparison of the aggregates between Beaufort and Hawaii may even out or at least provide an indication of retention trends. In this case an assumption is made that the analysis will not be significantly biased by shortening the time horizons and comparing unequally divided blocks of data.

Appendix J contains the number of individuals eligible for reenlistment, the number of those eligible who chose to reenlist, and the resulting reenlistment rates. The data in Appendix J covers the five squadrons that participated in UDP during the first few years of the program. The figures are for 21 months and are broken down quarterly. Two different starting dates were considered, July 1977 and October 1977. The range considered includes 18 months to 27 months. Table 6.7 depicts the effort to determine an appropriate time horizon for analysis. The desire to limit the analysis time period and to even out the deployed periods, the periods prior to deployment, and the periods following deployment, make the time horizon of October 1977 through June 1979 the best alternative.

TABLE 6.7

TIME HORIZON ANALYSIS

Begining Month:	----- July 1977 ---				--- October 1977 --			
Ending Month:	12/78	3/79	6/79	9/79	3/79	6/79	9/79	12/79
MAG-31 (Beaufort)								
Total Months	36	42	48	54	36	42	48	54
Months Deployed	18	21	24	24	18	21	24	24
Percent	50%	50%	50%	44%	50%	50%	50%	44%
Prior to Deployment	12	12	12	12	9	9	9	9
Percent	33%	29%	25%	22%	25%	21%	19%	17%
After Deployment	6	9	12	18	9	12	15	21
Percent	17%	21%	25%	33%	25%	29%	31%	39%
MAG-24 (Hawaii)								
Total Months	54	63	72	81	54	63	72	81
Months Deployed	15	18	21	24	18	21	24	27
Percent	28%	29%	29%	30%	33%	33%	33%	33%
Prior to Deployment	27	27	27	27	18	18	18	18
Percent	50%	43%	38%	33%	33%	29%	25%	22%
After Deployment	12	18	24	30	18	24	30	36
Percent	22%	29%	33%	37%	33%	38%	42%	44%

When all enlisted personnel are considered, the deploying squadrons of MAG-31 had an overall retention rate of 25 percent, which was over three times the rate of MAG-24 squadrons. When E6 to E9 are considered, MAG-31 UDP squadrons had a 38 percent retention rate compared to a 18 percent rate for MAG-24. This is a large difference among SNCOs! In short, whether measured by overall retention or by retention of SNCOs, retention for one-year deployment would appear to be much better than for six-month deployment. This author is familiar with the Commanding Officers of the Hawaii squadrons during the time period undergoing analysis, and believes it is unlikely that command climate and location are the only factors in explaining the difference between retention rates. But, the fact that variables such as home base and deployment time period cannot be totally isolated for the comparison between one-year and six-month deployments limits the author's confidence in the results of Appendix J, which are summarized in Table 6.8.

TABLE 6.8

RETENTION RATE SUMMARY
OCTOBER 1977 - JUNE 1979

	MAG-31 (Deploying)	MAG-24
All Enlisted Personnel		
Eligible	236	426
Reenlisted	58	34
Rate	25%	8%
E1 - E6		
Eligible	48	68
Reenlisted	18	12
Rate	38%	18%

A conclusion cannot be made that one-year deploying squadrons will always have better retention rates than six-month deploying squadrons, ceteris paribus. However, the magnitude of differences in retention rates between Beaufort deploying squadrons and Hawaii squadrons supports the author's belief that changing UDP to one-year evolutions will not adversely affect personnel retention in the fighter community.

VII. SUMMARY, CONCLUSION, AND RECOMMENDATIONS

A. SUMMARY AND CONCLUSION

There is no question in this author's mind that the Marine Corps' Unit Deployment Program is the answer to staffing WestPac and reducing PCS costs. Through the implementation of UDP, the Marine Corps has reduced the number of PCS billets by over 10,000. This has translated into millions of dollars in cost savings. However, in the face of future, possibly austere budgets, we need to search for more savings.

This thesis proposes an alternative to the present UDP of six-month deployments. Prior to the Vietnam Conflict, a one-year unit transplacement program provided the necessary units for WestPac duty. It is time to reconsider this program. A one-year UDP can save the Marine Corps over $4 million in undiscounted, real terms between FY 1989 and FY 1993. These savings can be gained without adversely affecting aircraft readiness, aircrew training readiness, or personnel retention.

A change to one-year UDP could have a positive affect on aircraft readiness. With its implemtation, the number of deployments would be cut in half. Past NMCM figures indicate that squadrons' aircraft readiness is lower than average in four of the six months following UDP. Reducing the total number of months following UDP should decrease NMCM and increase aircraft readiness.

A change to one-year UDP could have a positive effect on aircrew training readiness. Flight readiness data for the first 31 months of UDP was analyzed. It shows that the two one-year UDP squadrons' average monthly training while deployed to WestPac was 13 percent higher than their average for the 31 month period. The corresponding figure for the six-month UDP squadrons is six percent. In comparing training accomplished during non-deployed time (excludes Yuma deployments), the six-month UDP squadrons monthly average was 87 percent of their 31 month average. For the one-year UDP squadrons, the figure is 83 percent. It appears, from this data, that aircrew training readiness will show a small increase, in the long run, if one-year UDP is adopted.

Personnel retention is an important variable in the fighter community's readiness. It is considered very carefully in this thesis. Reenlistments rates for all enlisted personnel and reenlistment rates for SNCOs are analyzed, and a comparison is made between the present six-month UDP and the proposed one-year UDP. The results appear significant. The all-enlisted rate for the two one-year squadrons was three times the rate for the three six-month squadrons. When SNCO reenlistment rates are considered, the retention rate for the one-year squadrons was twice the rate for the six-month squadrons. Although other causation factors exist that cannot be totally isolated for the analysis, the magnitudes of the differences lead this author to believe that a one-year UDP will have a net positive affect on the fighter community's all-enlisted and SNCO retention rates.

B. RECOMMENDATIONS

The author recommends that the Marine Corps seriously consider a one-year Unit Deployment Program. Cost savings for transportation is a foregone conclusion; the amount may be disputed. Based on the evidence presented here, aircraft readiness or aircrew training are unlikely to suffer from a change to one-year deployments. If they do suffer, leadership and creativity can overcome any accrued negative benefits. The one area in which we should not take chances concerns our most valuable resource--people. Morale, both individual and unit, is vitally important to the Marine Corps. Morale certainly matters for retention. If a one-year deployment evolution is considered, the Marine Corps should expand the analysis of personnel retention. Other possibilities for measuring the potential effects of one-year UDP on morale should be investigated. The most obvious is a formal survey of the fighter community or possibly the entire fixed wing community. Although another WestPac tour is several years away, this author would prefer one-year UDP to six-month UDP.

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APPENDIX A

FIGHTER SQUADRON DEPLOYMENT CHRONOLOGY FOR WESTPAC

	DATES	SQDN	A/C	HOME BASE
	Jun 77 - Jun 78	VMFA-251	F-4J	Beaufort, SC
	Oct 77 - Apr 78	VMFA-235	F-4J	Kaneohe Bay, HI
	Apr 78 - Oct 78	VMFA-212	F-4J	Kaneohe Bay, HI
#	Jun 78 - Jun 79	VMFA-122	F-4J	Beaufort, SC
	Oct 78 - Apr 79	VMFA-232	F-4J	Kaneohe Bay, HI
	Apr 79 - Oct 79	VMFA-235	F-4J	Kaneohe Bay, HI
	Jun 79 - Jan 80	VMFA-312	F-4S	Beaufort, SC
	Oct 79 - Apr 80	VMFA-212	F-4J	Kaneohe Bay, HI
#	Jan 80 - Jun 80	VMFA-451	F-4S	Beaufort, SC
#	Apr 80 - Oct 80	VMFA-232	F-4J	Kaneohe Bay, HI
	Jun 80 - Jan 81	VMFA-333	F-4S	Beaufort, SC
#	Oct 80 - Apr 81	VMFA-235	F-4S	Kaneohe Bay, HI
#	Jan 81 - Jun 81	VMFA-312	F-4S	Beaufort, SC
	Apr 81 - Oct 81	VMFA-212	F-4S	Kaneohe Bay, HI
	Jun 81 - Jan 82	VMFA-451	F-4S	Beaufort, SC
#	Oct 81 - Apr 82	VMFA-232	F-4S	Kaneohe Bay, HI
#	Jan 82 - Jun 82	VMFA-333	F-4S	Beaufort, SC
	Apr 82 - Oct 82	VMFA-235	F-4S	Kaneohe Bay, HI
	Jun 82 - Jan 83	VMFA-312	F-4S	Beaufort, SC
#	Oct 82 - Apr 83	VMFA-212	F-4S	Kaneohe Bay, HI
#	Jan 83 - Jun 83	VMFA-451	F-4S	Beaufort, SC
	Apr 83 - Oct 83	VMFA-232	F-4S	Kaneohe Bay, HI
	Jun 83 - Jan 84	VMFA-333	F-4S	Beaufort, SC
#	Oct 83 - Apr 84	VMFA-235	F-4S	Kaneohe Bay, HI
#	Jan 84 - Jun 84	VMFA-312	F-4S	Beaufort, SC
	Apr 84 - Oct 84	VMFA-212	F-4S	Kaneohe Bay, HI
	Jun 84 - Jan 85	VMFA-451	F-4S	Beaufort, SC
#	Oct 84 - Apr 85	VMFA-232	F-4S	Kaneohe Bay, HI
#	Jan 85 - Jun 85	VMFA-333	F-4S	Beaufort, SC
	Apr 85 - Oct 85	VMFA-235	F-4S	Kaneohe Bay, HI
	Jun 85 - Jan 86	VMFA-312	F-4S	Beaufort, SC
#	Oct 85 - Apr 86	VMFA-212	F-4S	Kaneohe Bay, HI
#	Jan 86 - Jun 86	VMFA-451	F-4S	Beaufort, SC
	Apr 86 - Oct 86	VMFA-232	F-4S	Kaneohe Bay, HI
	Jun 86 - Jan 87	VMFA-333	F-4S	Beaufort, SC
#	Oct 86 - Apr 87	VMFA-235	F-4S	Kaneohe Bay, HI
#	Jan 87 - Jun 87	VMFA-312	F-4S	Beaufort, SC
	Apr 87 - Oct 87	VMFA-212	F-4S	Kaneohe Bay, HI
	Jun 87 - Jan 88	VMFA-115	F/A-18	Beaufort, SC
#	Oct 87 - Apr 88	VMFA-232	F-4S	Kaneohe Bay, HI
#	Jan 88 - Jun 88	VMFA-122	F/A-18	Beaufort, SC
	Apr 88 - Oct 88	VMFA-531	F/A-18	El Toro, CA
	Jun 88 - Jan 89	VMFA-251	F/A-18	Beaufort, SC
#	Oct 88 - Apr 89	VMFA-323	F/A-18	El Toro, CA

Squadrons did not TransPac aircraft; instead aircraft were exchanged.

APPENDIX B

MILITARY AIRLIFT COMMAND
COMMERCIAL AND MILITARY TRANSPORTATION RATES

Year	CAT B RATE (CY)	C-141 FHR Tariff (FY)
1989		2,507
1988	05.310	2,247
1987	05.169	2,602
1986	05.106	2,520
1985	05.279	3.119
1984	05.344	3.208
1983	05.527	3,806
1982	05.488	4,118
1981	04.986	
1980	03.732	

	CAT Y Tariffs (FY)		
Year	St. Louis	Los Angeles	Honolulu
1989	532	392	330
1987	500	355	313
1986	579	382	304
1985	579	472	313
1984	655	534	329
1983	663	540	333
1982	668	544	335

Notes: 1. CAT B RATES are cents per passenger per seat available for DC-10 commercial aircraft.
2. C-141 FHR Tariffs are dollars per flying hour.
3. CAT Y Tariffs are dollars per one-way passenger.
4. Blanks indicate rates were not available.

APPENDIX C

IMPLICIT PRICE DEFLATORS
GROSS NATIONAL PRODUCT

Year		Quarterly		Calendar Year	Fiscal Year
1989					* 124.2
1988	*	4th	122.9	* 121.2	
	*	3rd	121.9		120.2
		2nd	120.6		
		1st	119.4		
1987		4th	118.9	117.7	
		3rd	118.2		116.8
		2nd	117.3		
		1st	116.3		
1986		4th	115.3	113.9	
		3rd	114.7		113.2
		2nd	113.4		
		1st	112.4		
1985		4th	112.2	110.9	
		3rd	111.3		110.2
		2nd	110.6		
		1st	109.7		
1984		4th	109.0	107.7	
		3rd	108.7		107.1
		2nd	107.3		
		1st	106.8		
1983		4th	105.7	104.1	
		3rd	104.6		103.1
		2nd	103.6		
		1st	102.6		
1982		4th	101.7	100.0	
		3rd	100.6		99.0
		2nd	99.7		
		1st	98.4		
1981		4th	97.3	94.3	
		3rd	95.3		92.3
		2nd	93.1		
		1st	91.6		
1980		4th	89.3	86.0	
		3rd	86.9		
		2nd	85.1		
		1st	82.9		

* Denotes forecast by author

APPENDIX D

REFINER AND GAS PLANT OPERATOR PRICES OF KEROSENE TYPE JET FUEL TO END USERS (Cents per Gallon)

Year	Then Yr $	CY88 Constant $	FY88 Constant $
1988	52.7	52.7	54.8
1987	54.3	55.9	51.6
1986	52.9	56.3	66.5
1985	79.6	87.0	87.5
1984	84.2	94.8	95.5
1983	87.8	102.2	105.3
1982	96.3	116.7	119.2
1981	102.4	131.6	
1980	86.8	122.3	

Notes:

1. Sales to end users are those made directly to the ultimate consumer such as agriculture and the military, as well as residential and commercial customers.

2. Geographic coverage is the 50 states and the District of Columbia.

3. Prices prior to January 1983 are Energy Information Administration estimates.

4. Fiscal Year 1981 and 1980 prices in constant 1988 dollars were not computed since they are not required for regression.

APPENDIX E

1989 - 1993 FORECAST SCHEDULE FOR FIGHTER SQUADRON DEPLOYMENT TO WESTPAC

	DATES	SQDN	A/C	HOME BASE
#	Jan 89 - Jun 89	VMFA-333	F/A-18	Beaufort, SC
	Apr 89 - Oct 89	VMFA-314	F/A-18	El Toro, CA
	Jun 89 - Jan 90	TBD	F/A-18	Beaufort, SC
#	Oct 89 - Apr 90	VMFA-531	F/A-18	El Toro, CA
#	Jan 90 - Jun 90	TBD	F/A-18	Beaufort, SC
	Apr 90 - Oct 90	VMFA-323	F/A-18	El Toro, CA
	Jun 90 - Jan 91	TBD	F/A-18	Beaufort, SC
#	Oct 90 - Apr 91	VMFA-314	F/A-18	El Toro, CA
#	Jan 91 - Jun 91	TBD	F/A-18	Beaufort, SC
	Apr 91 - Oct 91	VMFA-212	F/A-18	Kaneohe Bay, HI
	Jun 91 - Jan 92	TBD	F/A-18	Beaufort, SC
#	Oct 91 - Apr 92	TBD	F/A-18	Kaneohe Bay, HI
#	Jan 92 - Jun 92	TBD	F/A-18	Beaufort, SC
	Apr 92 - Oct 92	TBD	F/A-18	Kaneohe Bay, HI
	Jun 92 - Jan 93	TBD	F/A-18	Beaufort, SC
#	Oct 92 - Apr 93	TBD	F/A-18	Kaneohe Bay, HI
#	Jan 93 - Jun 93	TBD	F/A-18	Beaufort, SC
	Apr 93 - Oct 93	TBD	F/A-18	Kaneohe Bay, HI
	Jun 93 - Jan 94	TBD	F/A-18	Beaufort, SC
#	Oct 93 - Apr 94	TBD	F/A-18	Kaneohe Bay, HI

Squadrons do not TransPac aircraft; instead aircraft are exchanged.

NOTE: UDP responsibility should revert from the 3rd Marine Aircraft Wing to the 1st Marine Brigade in April 1991. Marine Corps transition to the F/A-18 should be completed by this time. TransPac normally occurs during spring and summer due to potentially adverse weather conditions in the winter.

APPENDIX F

EQUIPMENT TRANSPORTATION COSTS VIA C-141
(Then Year Dollars)

Years	FHR Tariff	Beaufort	El Toro	Kaneohe Bay
1988	$2,247	$ 93,512	$72,972	$67,358
1989	$2,507	$105,412	$82,298	$75,802
Flight Hours				
1988		41.62	32.48	29.98
1989		42.05	32.83	30.24
Average		41.85	32.66	30.11

Notes: 1. Flight hour figures were not converted to hours and minutes since this was not necessary for further computations.
2. Flight hours are for round trip evolutions.

APPENDIX G

AIRCRAFT READINESS MEASURES

1. Flight Hours. These are measured as the total time an aircraft is in actual flight, takeoff to landing.

2. Sorties. These are the number of individual aircraft flights.

3. Aircraft Utilization. This measure is determined by dividing the number of monthly flight hours by the average number of aircraft assigned to the unit during the month.

4. Aircraft Status Codes. Squadrons must account for the status of all aircraft twenty-four hours a day, every day it is in service to the squadron. A thirty-day month would have 720 Equipment In Service (EIS) hours for each aircraft. The following description is an over simplification of the Maintenance Data System (MDS) and omits several categories which do not add to the discussion.

a. Mission Capable (MC). MC is that percentage of EIS hours that an aircraft is mechanically capable of performing at least one of its assigned missions. For example, even if the radar was not operational, the aircraft could still perform a manual bombing mission.

(1) Full Mission Capable (FMC). FMC is that percentage of EIS hours in which an aircraft is mechanically capable of performing all of its assigned missions (all systems fully operational).

(2) Partial Mission Capable (PMC). PMC is that percentage of EIS hours in which an aircraft is mechanically

capable of performing only some of its assigned missions.

(a) Partial Mission Capable Maintenance (PMCM). PMCM is that percentage of EIS hours in which an aircraft is PMC and maintenance is either being performed or could be performed and no supply parts are on order.

(b) Partial Mission Capable Supply (PMCS). PMCS is that percentage of EIS hours in which an aircraft is PMC and replacements parts needed to place the aircraft in a FMC status have been ordered but not received. Once parts are received the aircraft would be placed in a PMCM status until the parts are installed an the functioning checked.

b. Not Mission Capable (NMC). NMC is that percentage of EIS hours in which an aircraft is incapable of performing any of its assigned missions. Safety is the key ingredient. For example, aircraft are not allowed to fly without certain instruments or with leaks in the hydraulics system.

(1) Not Mission Capable Maintenance (NMCM). NMCM is that percentaga of EIS hours in which an aircraft is NMC due to unscheduled maintenance.

(2) Not Mission Capable Supply (NMCS). NMCS is that percentage of EIS hours in which an aircraft is NMC due to parts on order.

The following formulas exist based on the previous definitions.

MC = FMC + PMC   NMC = NMCM + NMCS

100% = MC + NMC   PMC = PMCM + PMCS

APPENDIX H

AIRCREW MISSION CODE TOTALS
OCTOBER 1977 - JUNE 1980

VMFA-251	Periods								
	*	*	*	*	*	*	*	*	*
	1	2	3	4	5	6	7	8	9
Completion	114	55	136	110	129	126	149	107	79
Refresher	84	63	102	106	111	257	194	193	95
Other	18	16	30	30	20	22	15	20	26
Incompletion	18	36	46	42	66	55	40	56	28
Total	234	170	314	288	326	460	398	376	228

	10	11	12	13	14	15	16	17	18
Completion	82	90	121	111	74	79	77	129	85
Refresher	92	114	137	131	126	173	183	193	149
Other	4	14	15	12	12	28	10	48	16
Incompletion	30	10	29	0	0	0	0	0	0
Total	208	228	302	254	212	280	270	370	250

	Y 19	20	21	22	23	24	25	26	27
Completion	441	74	108	96	63	72	107	64	47
Refresher	95	140	194	160	95	130	211	168	127
Other	50	4	6	10	4	44	22	14	16
Incompletion	8	0	0	2	14	4	0	24	24
Total	594	218	308	268	176	250	340	270	214

	28	29	30	Y 31	32	AVG
Completion	97	111	153	184	91	111
Refresher	121	199	117	156	86	141
Other	18	22	40	60	41	22
Incompletion	40	26	14	30	36	21
Total	276	358	324	430	254	295

NOTES:
1. Periods are one month.
2. Asterisks indicate UDP during the period.
3. A 'Y' indicates deployed to MCAS Yuma, AZ.
4. July 1978 is excluded from the totals. Only 17 sorties were flown due to delay in rotation and acceptance of new aircraft.

VMFA-122 Periods

	1	2	3	4	5	6	Y 7	8	9
Completion	122	131	123	135	110	132	380	121	111
Refresher	96	66	81	63	118	151	108	77	54
Other	8	17	42	16	18	29	16	12	17
Incompletion	42	16	26	34	34	20	62	24	30
Total	268	230	272	248	280	332	244	234	212

	* 10	* 11	* 12	* 13	* 14	* 15	* 16	* 17	* 18
Completion	92	201	163	148	271	154	154	68	135
Refresher	106	145	187	66	85	223	218	246	365
Other	6	8	20	98	30	26	6	14	16
Incompletion	30	62	86	42	60	55	68	70	37
Total	234	416	456	354	446	458	446	398	553

	* 19	* 20	* 21	22	23	24	25	Y 26	27
Completion	184	75	56	114	56	61	90	295	105
Refresher	264	297	147	111	123	153	146	75	119
Other	12	18	21	24	19	40	70	6	18
Incompletion	36	40	36	46	50	34	36	42	86
Total	496	430	260	295	248	288	342	418	328

	28	29	30	31	32	AVG
Completion	90	35	55	35	91	128
Refresher	127	65	121	105	81	137
Other	11	2	8	20	13	21
Incompletion	32	28	58	30	20	43
Total	260	130	242	190	205	329

NOTES:

1. Periods are one month.
2. Asterisks indicate UDP during the period.
3. A 'Y' indicates deployed to MCAS Yuma, AZ.
4. July 1979 is excluded from the totals. Only 30 sorties were flown due to delay in rotation and acceptance of new aircraft.

VMFA-235

Periods

	*	*	*	*	*	*			
	1	2	3	4	5	6	7	8	9
Completion	152	172	129	165	137	73	120	224	142
Refresher	56	160	93	111	154	88	38	38	110
Other	80	36	18	32	7	120	68	36	14
Incompletion	42	28	40	54	32	59	18	28	6
Total	330	396	280	362	330	340	244	326	272

				Y	Y				*
	10	11	12	13	14	15	16	17	18
Completion	218	242	410	454	231	250	234	240	153
Refresher	88	50	52	50	22	16	30	41	59
Other	12	22	22	18	44	10	18	12	64
Incompletion	22	12	22	16	18	12	10	19	38
Total	340	326	506	538	315	288	292	312	314

	*	*	*	*	*				
	19	20	21	22	23	24	25	26	27
Completion	154	192	247	177	185	176	155	138	155
Refresher	160	76	74	131	92	140	63	18	3
Other	16	18	10	8	64	20	46	26	24
Incompletion	30	38	11	10	14	10	0	12	12
Total	360	324	342	326	[illegible]	346	266	194	194

	28	29	30	31	32	33	AVG
Completion	54	96	148	230	260	200	191
Refresher	59	4	5	2	5	40	64
Other	39	44	47	18	25	26	32
Incompletion	22	6	6	10	10	8	20
Total	174	150	206	260	300	274	307

NOTES:

1. Periods are one month.
2. Asterisks indicate UDP during the period.
3. A 'Y' indicates deployed to MCAS Yuma, AZ.

VMFA-212 Periods

	Y 1	Y 2	3	4	5	6	* 7	* 8	* 9
Completion	469	472	190	219	156	221	195	341	237
Refresher	154	120	10	11	20	24	26	45	31
Other	45	10	6	28	42	48	27	12	4
Incompletion	24	24	24	32	12	43	44	38	72
Total	692	626	230	290	230	336	292	436	376

	* 10	* 11	* 12	13	14	15	16	17	18
Completion	352	130	289	129	242	263	342	283	256
Refresher	42	10	33	54	16	5	6	15	2
Other	12	4	10	17	2	34	10	18	16
Incompletion	32	36	42	20	42	44	42	24	48
Total	438	180	374	220	302	346	400	340	322

	19	20	21	22	23	24	* 25	* 26	* 27
Completion	289	311	186	282	364	254	270	404	350
Refresher	2	3	2	4	2	2	2	2	2
Other	15	14	14	40	26	26	96	18	12
Incompletion	42	32	26	16	20	12	12	20	4
Total	348	360	228	342	412	294	380	444	368

	* 28	* 29	* 30	31	32	33	AVG
Completion	468	504	300	250	370	265	293
Refresher	4	2	0	0	0	0	20
Other	4	10	18	22	16	37	23
Incompletion	32	10	2	0	8	4	27
Total	508	526	320	272	394	306	363

NOTES:
1. Periods are one month.
2. Asterisks indicate UDP during the period.
3. A 'Y' indicates deployed to MCAS Yuma, AZ.

VMFA-232

Periods

	1	2	3	4	5	6	Y 7	Y 8	9
Completion	17	126	94	134	129	180	235	464	163
Refresher	36	32	51	38	22	103	142	96	5[illegible]
Other	104	18	50	19	63	21	36	28	36
Incompletion	9	34	19	71	24	28	37	46	44
Total	166	210	214	262	238	332	450	634	300

	10	11	12	* 13	* 14	* 15	* 16	* 17	* 18
Completion	185	80	64	110	252	104	109	148	111
Refresher	69	46	56	168	86	85	100	58	24
Other	66	46	88	102	129	139	171	256	151
Incompletion	40	60	8	42	27	38	52	8	12
Total	360	232	216	422	494	366	432	470	298

	19	20	21	22	23	24	25	Y 26	Y 27
Completion	144	193	190	118	132	181	207	540	218
Refresher	122	51	68	100	50	73	42	141	54
Other	40	64	38	40	110	26	35	41	16
Incompletion	40	40	14	6	16	10	12	26	8
Total	346	348	310	264	308	290	296	748	296

	28	29	30	* 31	* 32	* 33	AVG
Completion	141	59	66	49	269	143	162
Refresher	29	120	80	83	190	127	79
Other	16	8	40	104	34	44	66
Incompletion	10	17	2	16	31	10	26
Total	196	204	188	252	524	324	333

NOTES:
1. Periods are one month.
2. Asterisks indicate UDP during the period.
3. A 'Y' indicates deployed to MCAS Yuma, AZ.

APPENDIX I

AIRCREW MISSION CODE TOTALS, WEIGHTED
OCTOBER 1977 - JUNE 1980

VMFA-251	Periods								
	* 1	* 2	* 3	* 4	* 5	* 6	* 7	* 8	* 9
Completion	798	385	952	770	903	882	1043	749	553
Refresher	336	252	408	424	444	1028	776	772	380
Other	36	32	60	60	40	44	30	40	52
Incompletion	42	28	40	54	32	59	18	28	6
Total	1212	697	1460	1308	1419	2013	1867	1589	991

	10	11	12	13	14	15	16	17	18
Completion	574	630	847	777	518	553	539	903	595
Refresher	368	456	548	524	504	692	732	772	596
Other	8	28	30	24	24	56	20	96	32
Incompletion	22	12	22	16	18	12	10	19	38
Total	972	1126	1447	1341	1064	1313	1301	1790	1261

	Y 19	20	21	22	23	24	25	26	27
Completion	3087	518	756	672	441	504	749	448	329
Refresher	380	560	776	640	380	520	844	672	508
Other	100	8	12	20	8	88	44	28	32
Incompletion	30	38	11	10	14	10	0	12	12
Total	3597	1124	1555	1342	843	1122	1637	1160	881

	28	29	30	Y 31	32	AVG
Completion	679	777	1071	1288	637	777
Refresher	484	796	468	624	344	564
Other	36	44	80	120	82	44
Incompletion	22	6	6	10	10	21
Total	1221	1623	1625	2042	1073	1407

NOTES:
1. Periods are one month.
2. Asterisks indicate UDP during the period.
3. A 'Y' indicates deployed to MCAS Yuma, AZ.
4. Weights are as follows: Completion (X7), Refresher (X4), Other (X2), Incompletion (X1).
5. July 1978 is excluded from the totals. Only 17 sorties were flown due to delay in rotation and acceptance of new aircraft.

VMFA-122 Periods

	1	2	3	4	5	6	Y 7	8	9
Completion	854	917	861	945	770	924	2660	847	777
Refresher	384	264	324	252	472	604	432	308	216
Other	16	34	84	32	36	58	32	24	34
Incompletion	42	28	40	54	32	59	18	28	6
Total	1296	1243	1309	1283	1310	1645	3142	1207	1033

	* 10	* 11	* 12	* 13	* 14	* 15	* 16	* 17	* 18
Completion	644	1407	1141	1036	1897	1078	1078	476	945
Refresher	424	580	748	264	340	892	872	984	1460
Other	12	16	40	196	60	52	12	28	32
Incompletion	22	12	22	16	18	12	10	19	38
Total	1102	2015	1951	1512	2315	2034	1972	1507	2475

	* 19	* 20	* 21	22	23	24	25	Y 26	27
Completion	1288	525	392	798	392	427	630	2065	735
Refresher	1056	1189	588	444	492	612	584	300	476
Other	24	36	42	48	38	80	140	12	36
Incompletion	30	38	11	10	14	10	0	12	12
Total	2398	1787	1033	1300	936	1129	1354	2389	1259

	28	29	30	31	32	AVG
Completion	630	245	385	245	637	896
Refresher	508	260	484	420	324	548
Other	22	4	16	40	26	42
Incompletion	22	6	6	10	10	21
Total	1182	515	891	715	997	1507

NOTES:

1. Periods are one month.
2. Asterisks indicate UDP during the period.
3. A 'Y' indicates deployed to MCAS Yuma, AZ.
4. Weights are as follows: Completion (X7), Refresher (X4), Other (X2), Incompletion (X1).
5. July 1979 is excluded from the totals. Only 30 sorties were flown due to delay in rotation and acceptance of new aircraft.

VMFA-235

Periods	* 1	* 2	* 3	* 4	* 5	* 6	7	8	9
Completion	1064	1204	903	1155	959	511	840	1586	994
Refresher	224	640	372	444	616	352	152	152	440
Other	160	72	26	64	14	240	136	72	28
Incompletion	42	28	40	54	32	59	18	28	6
Total	1490	1944	1351	1717	1621	1162	1146	1820	1468
	10	11	12	Y 13	Y 14	15	16	17	* 18
Completion	526	1694	2870	3178	1617	1750	1638	1680	1071
Refresher	352	200	208	200	88	64	120	184	236
Other	24	44	44	36	88	20	36	24	128
Incompletion	22	12	22	16	18	12	10	19	38
Total	1924	1950	3144	3430	1811	1846	1804	1887	1473
	* 19	* 20	* 21	* 22	* 23	24	25	26	27
Completion	1078	1344	1729	1239	1295	1232	1099	966	1085
Refresher	640	304	296	524	368	560	252	72	12
Other	32	36	20	16	128	40	92	52	48
Incompletion	30	38	11	10	14	10	0	12	12
Total	1780	1722	2056	1789	1805	1842	1443	1102	1157
	28	29	30	31	32	33	AVG		
Completion	378	672	1036	1610	1820	1400	1337		
Refresher	236	16	20	8	20	160	256		
Other	78	88	94	36	50	52	64		
Incompletion	22	6	6	10	10	8	20		
Total	714	782	1156	1664	1900	1620	1682		

NOTES:

1. Periods are one month.
2. Asterisks indicate UDP during the period.
3. A 'Y' indicates deployed to MCAS Yuma, AZ.
4. Weights are as follows: Completion (X7), Refresher (X4), Other (X2), Incompletion (X1).

VMFA-212 Periods

	Y 1	Y 2	3	4	5	6	* 7	* 8	* 9
Completion	3283	3304	1330	1533	1092	1547	1365	2387	1659
Refresher	616	480	40	44	80	96	104	180	124
Other	90	20	12	56	84	96	54	24	72
Incompletion	42	28	40	54	32	59	18	28	6
Total	4031	3832	1422	1687	1288	1798	1541	2619	1861

	* 10	* 11	* 12	13	14	15	16	17	18
Completion	2464	910	2023	903	1694	1841	2394	1981	1792
Refresher	168	40	132	216	64	20	24	60	8
Other	24	8	20	34	4	68	20	36	32
Incompletion	22	12	22	16	18	12	10	19	38
Total	2678	970	2197	1169	1780	1941	2448	2096	1870

	19	20	21	22	23	24	* 25	* 26	* 27
Completion	2023	2177	1302	1974	2548	1778	1890	2828	2450
Refresher	8	12	8	16	8	8	8	8	8
Other	30	28	28	80	52	52	192	36	24
Incompletion	30	38	11	10	14	10	0	12	12
Total	2091	2255	1349	2080	2622	1848	2090	2884	2494

	* 28	* 29	* 30	31	32	33	AVG
Completion	3276	3528	2100	1750	2590	1855	2051
Refresher	16	8	0	0	0	0	80
Other	8	20	36	44	32	74	46
Incompletion	22	6	6	10	10	8	20
Total	3322	3562	2142	1804	2632	1937	2192

NOTES:
1. Periods are one month.
2. Asterisks indicate UDP during the period.
3. A 'Y' indicates deployed to MCAS Yuma, AZ.
4. Weights are as follows: Completion (X7), Refresher (X4), Other (X2), Incompletion (X1).

VMFA-232 Periods

							Y	Y	
	1	2	3	4	5	6	7	8	9
Completion	119	882	658	938	903	1260	1645	3248	1141
Refresher	144	128	204	152	88	412	568	384	228
Other	208	36	100	38	126	42	72	56	72
Incompletion	42	28	40	54	32	59	18	28	6
Total	513	1074	1002	1182	1149	1773	2303	3716	1447

				*	*	*	*	*	*
	10	11	12	13	14	15	16	17	18
Completion	1295	560	448	770	1764	728	763	1036	777
Refresher	276	184	224	672	344	340	400	232	96
Other	132	92	176	204	258	278	342	512	302
Incompletion	22	12	22	16	18	12	10	19	38
Total	1725	848	870	1662	2384	1358	1515	1799	1213

								Y	Y
	19	20	21	22	23	24	25	26	27
Completion	1008	1351	1330	826	924	1267	1449	3780	1526
Refresher	488	204	272	400	200	292	168	564	216
Other	80	128	76	80	220	52	70	82	32
Incompletion	30	38	11	10	14	10	0	12	12
Total	1606	1721	1689	1316	1358	1621	1687	4438	1786

				*	*	*	
	28	29	30	31	32	33	AVG
Completion	987	413	462	343	1883	1001	1134
Refresher	116	480	320	332	760	508	316
Other	32	16	80	208	68	88	132
Incompletion	22	6	6	10	10	8	20
Total	1157	915	868	893	2721	1605	1603

NOTES:
1. Periods are one month.
2. Asterisks indicate UDP during the period.
3. A 'Y' indicates deployed to MCAS Yuma, AZ.
4. Weights are as follows: Completion (X7), Refresher (X4), Other (X2), Incompletion (X1).

APPENDIX J

SQUADRON RETENTION RATES
OCTOBER 1977 through JUNE 1979

ALL ENLISTED PERSONNEL:

	Periods 1	2	3	4	5	6	7	Total
VMFA-251								
Eligible	9	8	15	17	26	20	29	124
Reenlisted	2	0	6	0	2	3	5	18
Rate	22%	0%	40%	0%	8%	15%	17%	15%
VMFA-122								
Eligible	12	10	8	20	13	23	26	112
Reenlisted	4	4	1	6	4	10	11	40
Rate	33%	40%	13%	30%	31%	43%	42%	36%
MAG-31 (Deploying)								
Eligible	21	18	23	37	39	43	55	236
Reenlisted	6	4	7	6	6	13	16	58
Rate	29%	22%	30%	16%	15%	30%	36%	25%
VMFA-235								
Eligible	10	5	18	39	19	23	26	140
Reenlisted	1	0	3	4	0	3	3	14
Rate	10%	0%	17%	10%	0%	13%	12%	10%
VMFA-212								
Eligible	15	11	11	21	21	25	35	139
Reenlisted	0	1	0	3	4	2	2	12
Rate	0%	9%	0%	14%	19%	8%	8%	9%
VMFA-232								
Eligible	15	17	18	40	12	18	27	147
Reenlisted	1	1	0	0	2	0	4	8
Rate	7%	6%	0%	0%	17%	0%	15%	5%
MAG-24								
Eligible	40	33	47	100	52	66	88	426
Reenlisted	2	2	3	7	6	5	9	34
Rate	5%	6%	6%	7%	12%	8%	10%	8%

Notes:
1. Each period covers three months.
2. Bold figures are for quarters in which the unit was deployed to WestPac.

E6 to E9 (SNCO):

	Periods 1	2	3	4	5	6	7	Total
VMFA-251								
Eligible	3	0	4	2	6	6	8	29
Reenlisted	1	0	2	0	1	3	5	12
Rate	33%	0%	50%	0%	17%	50%	63%	41%
VMFA-122								
Eligible	3	2	2	1	4	4	3	19
Reenlisted	1	1	1	0	3	0	0	6
Rate	33%	50%	50%	0%	75%	0%	0%	32%
MAG-31 (Deploying)								
Eligible	6	2	6	3	10	10	11	48
Reenlisted	2	1	3	0	4	3	5	18
Rate	33%	50%	50%	0%	40%	30%	36%	38%
VMFA-235								
Eligible	0	2	3	4	1	6	1	17
Reenlisted	0	0	2	0	0	1	0	3
Rate	0%	0%	67%	0%	0%	17%	0%	18%
VMFA-212								
Eligible	2	7	1	4	4	3	6	27
Renlisted	0	1	0	3	0	0	2	6
Rate	0%	14%	0%	75%	0%	0%	33%	22%
VMFA-232								
Eligible	4	2	3	5	3	4	3	24
Reenlisted	0	0	0	0	1	0	2	3
Rate	0%	0%	0%	0%	33%	0%	66%	13%
MAG-24								
Eligible	6	11	7	13	8	13	10	68
Reenlisted	0	1	2	3	1	1	4	12
Rate	0%	9%	29%	23%	13%	7%	40%	18%

Notes:
1. Each period covers three months.
2. Bold figures are for quarters in which the unit was deployed to WestPac.

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