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Achieving maximum unit Mission capability: an impact study of system availability, proficiency, cost, and OPTEMPO

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MBA PROFESSIONAL REPORT

**Achieving Maximum Unit Mission Capability:
An Impact Study of System Availability, Proficiency, Cost, and OPTEMPO**

**By: Gary J. Retzlaff, Jr. and
Roy A. DeSilva**

December 2005

**Advisors: Thom Crouch,
Keebom Kang**

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The highest level of Unit Mission Capability is the ultimate goal of any unit commander. Members of the user community, especially unit commanders, must be aware of the factors that influence their war fighting capability. Understanding these factors and their relationships, coupled with the implementation of specific strategies, can facilitate maximizing Unit Mission Capability. This is the primary focus of this project.

This report will provide aviation unit commanders and user representatives with a clear explanation and demonstration of the variables that influence a commander’s ability to improve Unit Mission Capability. The tool demonstrated in this report is the Availability, Proficiency, Cost, and Operational Tempo (OPTEMPO) model for assessing and maximizing Unit Mission Capability.

The user community must understand how competing funding requirements influences their ability to train and maintain a strong fighting force. Current DOD funding levels will decline in the near future. It will become more and more difficult to achieve the desired state of Unit Mission Capability. Users must implement strategic cost saving initiatives to preserve our war fighting capability.

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ACHIEVING MAXIMUM UNIT MISSION CAPABILITY: AN IMPACT STUDY OF SYSTEM AVAILABILITY, PROFICIENCY, COST, AND OPTEMPO

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from the

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I. INTRODUCTION

A. BACKGROUND

In 1994, the Congressional Budget Office (CBO) conducted a study that focused on the trend indicators of Unit Readiness from 1980 to 1993.[1] Unit Readiness is one of four pillars that define our military capability. The other three pillars are force structure, modernization, and sustainability. The Department of Defense (DOD) and Congress agree that the driving indicators for Unit Readiness, and ultimately, military capability, are proficiency/performance and weapon system availability.

With ever-increasing demands for budget dollars, Congress maintains an intense interest in military capability. In October 2005, the Government Accountability Office (GAO) published a report that recommended intense congressional oversight of DODs plans for addressing military capability gaps.[2] Commanders, at all levels, need tools that enable proactive examination of the variables that affect our military capability.

B. PURPOSE

Aviation unit commanders make difficult choices as they attempt to balance training and maintenance readiness. In a similar manner, aviation user representatives must make cost and reliability trade-off decisions. This report will provide aviation unit commanders and user representatives with a clear explanation and demonstration of the variables that influence a commander's ability to improve Unit Mission Capability. Users and commanders who do not understand these variables often find themselves struggling with lower than expected capability. This report introduces the user community to the Availability, Proficiency, Cost, and Operational Tempo (OPTEMPO) model for assessing Unit Mission Capability.

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[1] Congressional Budget Office, *CBO Papers: Trends in Selected Indicators of Military Readiness, 1980 through 1993* (Washington, D.C., 1994), 19.

[2] Government Accountability Office, *Report to Congressional Committees: DOD Needs to Identify and Address Gaps and Potential Risks inn Program Strategies and Funding Priorities for Selected Equipment* (Washington, D.C., 2005), 1.

C. SCOPE

The scope of this report includes an analysis of the complex relationships that exist between weapon system availability, proficiency, cost, and OPTEMPO. This analysis includes a statistical study of fluctuations in OPTEMPO and availability. However, the statistical examination of proficiency and cost are outside the scope of this report. The concepts discussed in this report apply to any weapon system, even though most of the data presented is specific to the AH-64D Longbow Apache (LBA). This report includes data constraints and assumptions where appropriate.

D. RESEARCH QUESTION

The primary research question for this study is: How does an aviation unit commander maximize Unit Mission Capability?

Listed below are the secondary Research Questions.

1. What can the user community do to increase Unit Mission Capability?
2. What terms define Unit Mission Capability?
3. How does the variability in OPTEMPO affect Unit Mission Capability?
4. How does weapon system availability affect Unit Mission Capability?
5. What external factors influence Unit Mission Capability?

E. ORGANIZATION OF STUDY

This report is organized into five chapters. Each chapter covers a specific segment of the study. The combination of these chapters provides the reader with a clear and comprehensive study addressing the primary research question. Below is a list of the individual Chapters.

- Chapter I: Introduction
- Chapter II: Availability, Proficiency, Cost, and OPTEMPO (APCO) Model
- Chapter III: APCO Model and External Factors
- Chapter IV: Accelerated Depreciation Data Study
- Chapter V: Conclusions and Recommendations

F. METHODOLOGY

Chapter II introduces the APCO model by proving definitions for the model variables and a detailed explanation of the relationships that exist between each of these variables. A step-by-step process is used to describe the foundation and assumptions used in the APCO Model. The Chapter concludes with example applications of the APCO model using the LBA and the V-22 Osprey. Information used to develop this chapter comes from literature reviews, interviews and personal experience.

Chapter III established an informed foundation for this report. Chapter III provides information pertaining to external factors that influence the APCO model. The primary factor discussed in funding. Information used to construct this chapter comes from a review of literature.

Chapter IV demonstrates the concept of accelerated depreciation. Statistical analysis is conducted using availability and OPTEMPO rate data from the Program Management Office (PMO) Apache, and Reliability and Maintainability (RAM) data obtained from the RAM Engineering and System Assessment Division, PMO Apache. This analysis is applied to the APCO model and conclusions are drawn regarding the impact of time.

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II. AVAILABILITY, PROFICIENCY, COST, AND OPTEMPO MODEL

A. CHAPTER OVERVIEW

The purpose of this chapter is to introduce, define and illustrate the utility of an Availability, Proficiency, Cost, and OPTEMPO (APCO) model. The APCO model is an equilibrium model designed to illustrate the relative impact of variables that influence total Unit Mission Capability. This chapter includes definitions for variables, as well as an orientation to the graphical model. This chapter also includes two operational capability decision support scenarios designed to illustrate the application of the APCO model.

B. APCO MODEL TERMS AND DEFINITIONS

1. Unit Mission Capability

Unit Mission Capability is the unit's ability to meet its mission requirements. This term describes the single goal of every unit commander and is synonymous with combat effectiveness. For a unit to possess a high degree of capability, it must attain the requisite level of unit proficiency and equipment availability. The variables that directly affect proficiency and availability include OPTEMPO and cost. Availability, proficiency, cost, and OPTEMPO are defined in more detail later in this chapter.

2. Availability

Availability is simply the ratio of weapon systems available for designated combat missions divided by the number of total weapon systems assigned. This ratio equates to Operational Readiness (OR) as seen in unit status reports.

$$\frac{\text{Total number of systems that are } \textit{currently Mission Capable}}{\text{Total number of systems assigned}}$$

Figure 1. Availability Formula

Key components of availability include reliability and maintainability. These components are set early in the system design process and are costly to improve. The operational availability of a system should be confirmed through robust test and evaluation during the development process.

Availability is directly dependent on the level of OPTEMPO, especially in older weapon systems. This means as OPTEMPO increases, availability will decrease as systems reach their point of required maintenance and logistical support quicker.

3. Proficiency

Proficiency is defined as a percentage of authorized crews that are qualified to perform assigned mission tasks. Crew proficiency is the basic element of unit proficiency. A crew is determined to be proficient if they have achieved the minimum level of required flight time. Formula:

$$\frac{\text{Total number of crews } \textit{qualified} \text{ to perform unit missions}}{\text{Total number of crews assigned}}$$

Figure 2. Proficiency Formula

Proficiency is also dependent on the level of OPTEMPO. Proficiency will increase as OPTEMPO increases. Conversely, proficiency degradation occurs as OPTEMPO decreases. The longer a unit operates at a less-than-minimal OPTEMPO, the longer it will take a unit to regain its required level of proficiency.

4. Cost

Cost is the measure of expenses incurred at a specified level of OPTEMPO. The total cost of achieving a desired level of Unit Mission Capability includes the costs associated with achieving minimum availability and minimum proficiency. Funding is allocated to cover these costs through the flying hour program. Other cost drivers that affect Unit Mission Capability include training simulation, reliability improvements, and other capital improvements.

Cost is interrelated with OPTEMPO, availability, and proficiency. As OPTEMPO increases to achieve a higher degree of availability or proficiency, costs also increase. The costs incurred per flight hour are often outside the span of control for a unit commander and funding for these costs are allocated annually as a flying hour program.

5. OPTEMPO

OPTEMPO is the utilization rate of the weapon system. It is the measure of flight hours per aircraft per month. OPTEMPO is the independent variable within the APCO model. It drives the other variables. With few exceptions, commanders set the OPTEMPO for their unit. Normally, the allocated flying hour program limits commanders to a maximum OPTEMPO.

OPTEMPO is a flexible variable used by commanders to balance the demands of proficiency and availability. This fact is especially true when conducting training in a resource-constrained environment. Commanders are faced with difficult trade decisions when funding does not support the accomplishment of both availability and proficiency.

6. Variable Relationships

Figure 3 below demonstrates the complex relationships that exist between the variables defined above. Unit Mission Capability is a function of proficiency, availability, and fully funded costs. If any of these variable decline below minimum levels, there will be a corresponding reduction in the unit's capability to perform designated combat operations.

Proficiency is a function of availability and OPTMEPO, while availability is a function of OPTEMPO and inherent reliability. These facts demonstrate the complexity of their relationships. Both availability and proficiency are functions of OPTMEPO. As OPTEMPO fluctuates within cost limits, as defined by the flying hour program, a decision could be made to trade availability for proficiency. This decision, consequently, has a negative impact on proficiency since availability plays a significant role in determining proficiency. It is unrealistic to expect the achievement of full Unit Mission Capability without considering these relationships.

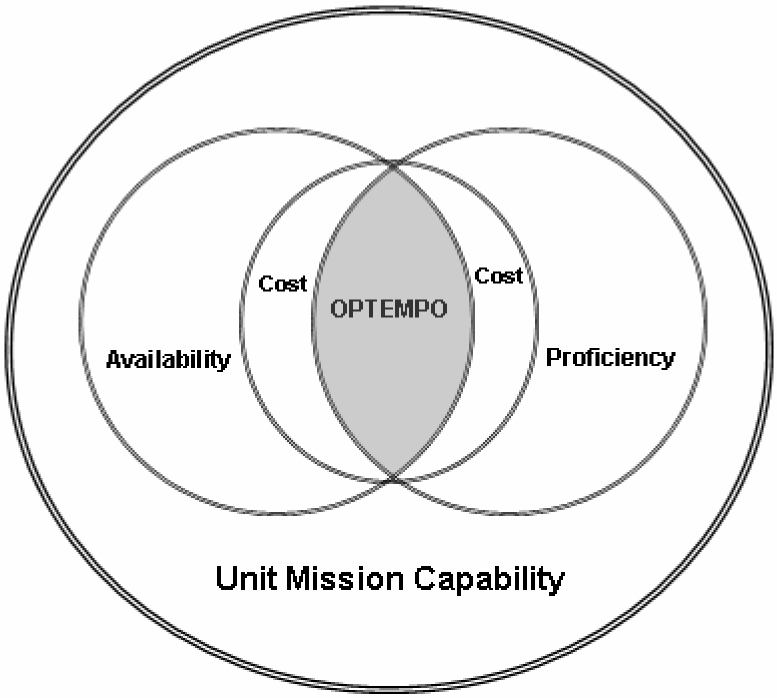

Figure 3. Unit Mission Capability Model

C. APCO MODEL ORIENTATION

Each element of the APCO model is an expression of the variables that influence a unit commander's probability of mission success. These elements, when graphed, provide a visual representation of the relative impact of each element. As mention earlier, this model design does not replicate exact numbers. However, this model will accurately depict the magnitude and direction of resulting changes. Additionally, the curves represented in the APCO model are not intended to be viewed independent of other elements. OPTEMPO and Mission Capability do not necessarily have a linear relationship. This representation is for display purposes only. The underlying premise of the APCO model dictates that OPTEMPO will seek a point of equilibrium that supports availability, proficiency, and cost.

1. APCO Model Input and Output

The APCO model input, represented on the X-axis, is OPTEMPO. OPTEMPO as an input establishes the baseline for analysis. OPTEMPO, as defined earlier, affects each of the model elements and serves as the independent variable for the model. OPTEMPO is the measure of the number of flight hours flown per assigned aircraft in a month. The starting point for the model is the LBA Block III Operational Requirements Document (ORD) input of anticipated utilization, 15 flight hours per month per airframe.[3]

The APCO model output, represented on the left side of the Y-axis, is Mission Capability. Mission Capability is met by achieving a minimum level of crew proficiency and a minimum level of availability. Successful command is often determined by a commander's ability to keep these two components in balance. Mission Capability is measured as a percentage of a unit's ability to meet assigned mission requirements. The starting point in our model is based on 75 percent. This is the Department of the Army fully mission capable rate for all aircraft.[4]

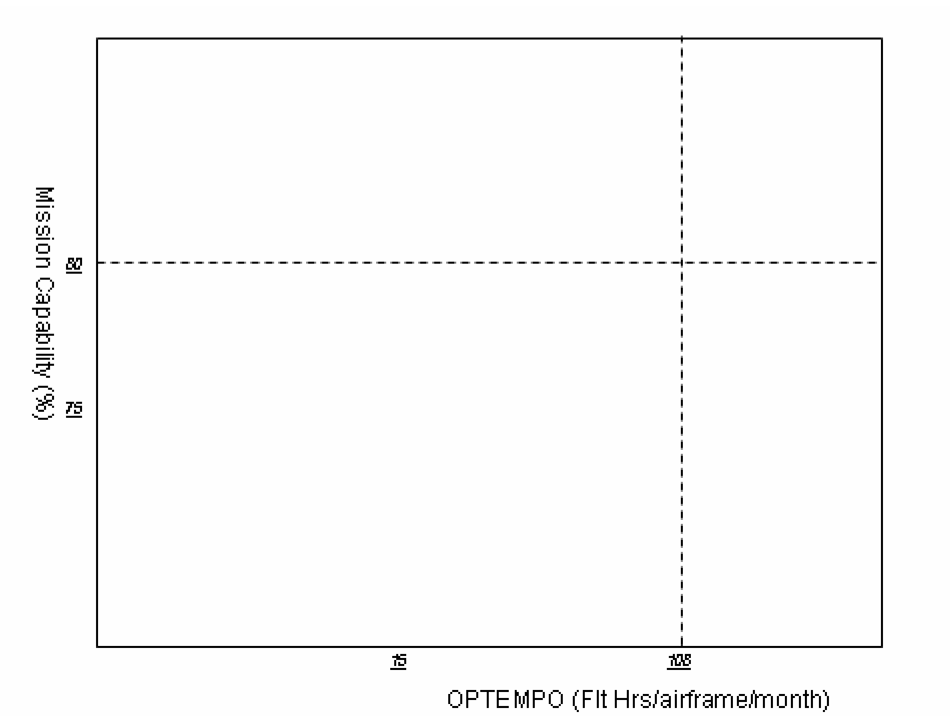

Figure 4. APCO Model Base

[3] Department of the Army, *Combat Developer Reliability and Maintainability Analysis for the Modernized Apache Longbow* (Fort Rucker, 2003), 4.

[4] Department of the Army, *Army Regulation 700-138: Army Logistics Readiness and Sustainability* (Washington D.C., 2004), 29.

2. Proficiency Curve

The proficiency curve in the APCO model represents anticipated crew performance of unit mission tasks. The curve is presented as up sloping and generally linear with an elbow at the lower and upper portions of the curve. As OPTEMPO increases, crew proficiency increases.

The lower elbow represents base level system proficiency that is achieved through institutional training. It represents the level at which operator skills will digress below entry-level training standards. This equates to 10 flight hours per month to correspond to minimum flight time requirements for aircrews.[5]

The elbow at the upper portion represents the point at which crew proficiency will degrade due to fatigue and complacency. It effectively reflects the point of diminishing returns. This equates to 160 flight hours per month. Most units' fighter-management policies restrict aircrews from performing more than eight hours of flight duty in a 24-hour period.

Lettered points are depicted along the proficiency curve to demonstrate its function. Point A indicates a point of balance where the proficiency needed to realize 75 percent Mission Capability can be achieved with an OPTEMPO of 15 hours. Point B indicates the need to increase OPTEMPO significantly in order to raise proficiency to the point of achieving 80 percent Mission Capability. Point C demonstrates the level of proficiency, and corresponding Mission Capability, that is possible at an OPTEMPO of 108 hours.

[5] Department of the Army, *TC 1-251: Aircrew Training Manual Attack Helicopter AH-64D* (Washington D.C., 2005), 2-3.

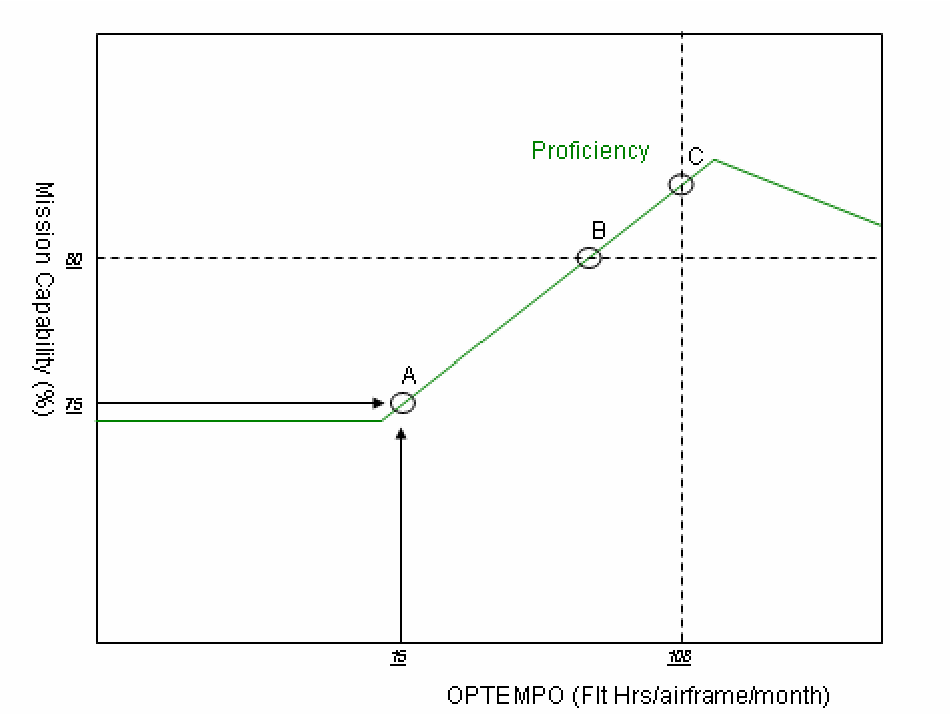

Figure 5. Proficiency Curve

3. Availability Curve

The availability curve represents mission capable aircraft at a specified level of OPTEMPO. It is presented in the APCO model as linear and down sloping. In general terms, availability will decrease as OPTEMPO increases.

Reference points are indicated along the availability curve to demonstrate the function of this curve. Point A is located at the point where 80 percent Mission Capability falls along the curve and indicates the relative OPTEMPO required to sustain this availability. In this case, the OPTEMPO is lower than the base value of 15 hours. Point B is located at the intersection of 75 percent Mission Capability and an OPTEMPO of 15 hours. This point represents the point at which availability meets the stated mission capability requirements at an OPTEMPO of 15 hours. Point C indicates a relative reduction in Mission Capability to due to a decrease in availability resulting from an increase in OPTEMPO to 108 hours.

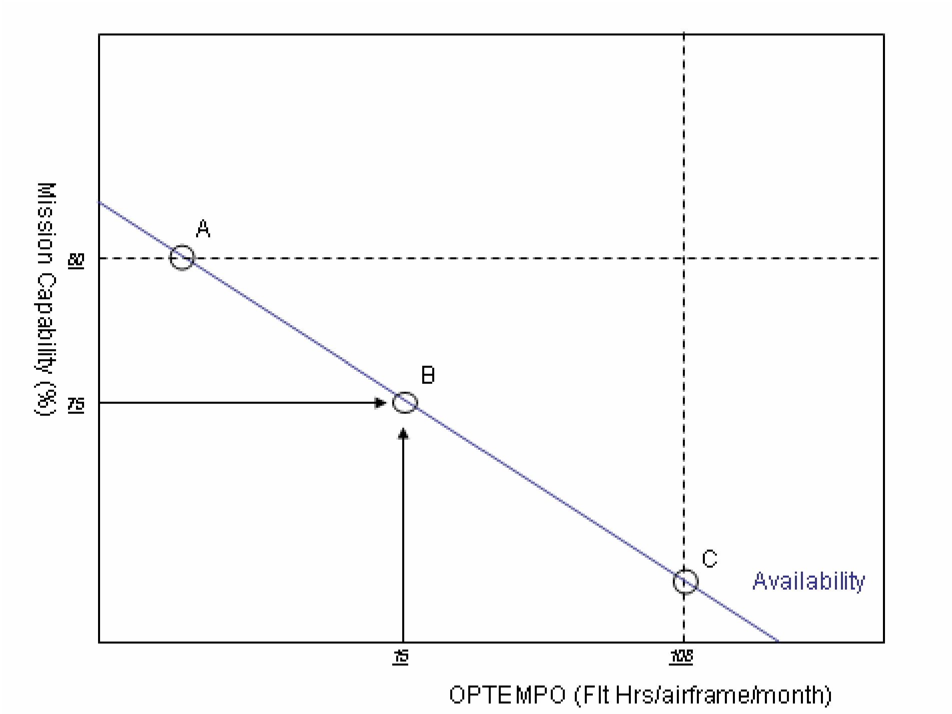

Figure 6. Availability Curve

4. Cost Curve

The cost curve used in the APCO model illustrates the per flight hour sustainment costs incurred as OPTEMPO changes. It is presented as linear in the center section and non-linear with up sloping tails. The intent of the cost curve is to indicate required funding reference points for a fluctuating OPTEMPO.

The non-linear up sloping tails represent increased costs in OPTEMPO ranges outside of normal operating levels. The lower slope is due to the fixed costs associated with calendar-based scheduled maintenance. The upper slope is caused by OPTEMPO levels in excess of design reliability characteristics or programmed logistics support.

Points are displayed along the cost curve to aid in the understanding of its function. Point A is plotted on the cost curve at the point of intersection with proficiency and availability. This indicates full funding of the costs associated with 75 percent Mission Capability and an OPTEMPO of 15 hours. An increase in the OPTEMPO to 108 hours would require an increase in funding. This is indicated by point B along the cost curve.

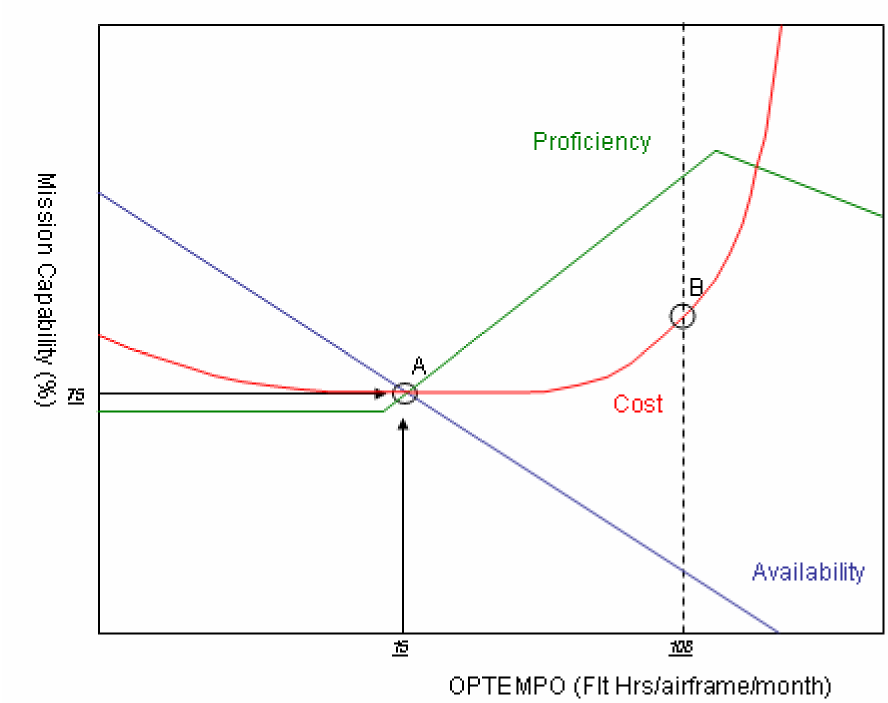

Figure 7. Cost Curve

5. Equilibrium Point

A point of equilibrium exists at the intersection of the proficiency, availability, and cost curves. This point is characterized by the fulfillment of availability goals and proficiency requirements at a given funding level. The point of equilibrium will move when the slope or relative position of the intersecting curves change. In the APCO model, the equilibrium point, depicted as a star, resides at the junction of the specified mission capability requirement (75%) and OPTEMPO (15 hours).

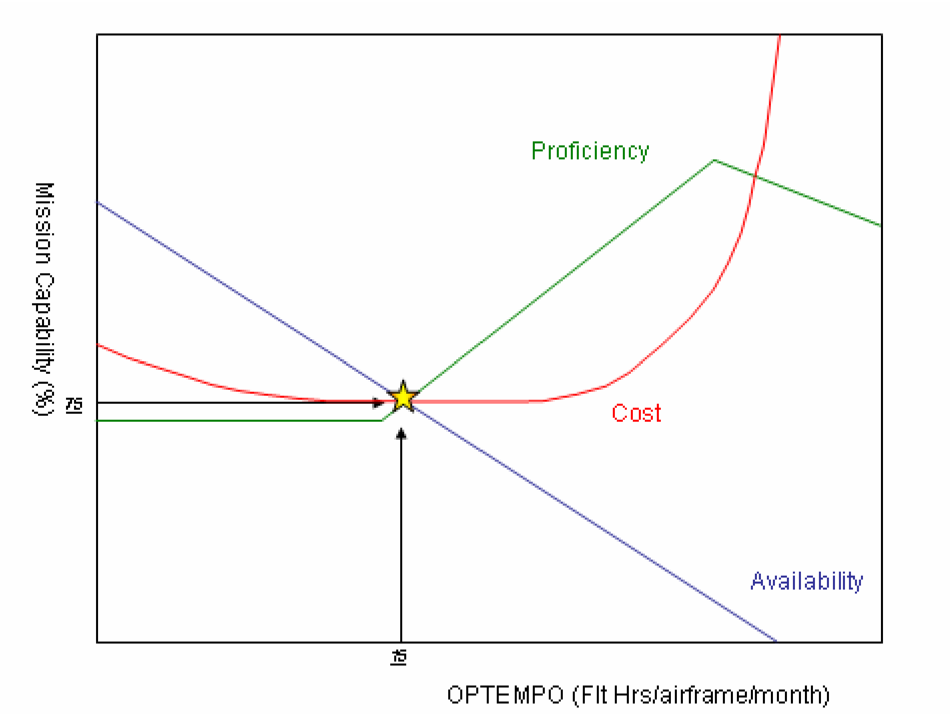

Figure 8. Equilibrium Point

As stated earlier, OPTEMPO will seek a point of equilibrium that is supported by proficiency, availability, and cost. An example of this phenomenon is depicted in figures 9 and 10 below. The APCO model scenario illustrated indicates a shift in the desired Mission Capability from 75 percent to 80 percent.

Enter the model at 80 percent Mission Capability and continue across until the proficiency curve is intersected (point A). Moving downward from this point will provide the relative increase in OPTEMPO needed to achieve 80 percent proficiency.

Additionally, point B indicates the availability curve intersection and the resultant Mission Capability. Mission Capability is significantly lower than the desired 80 percent.

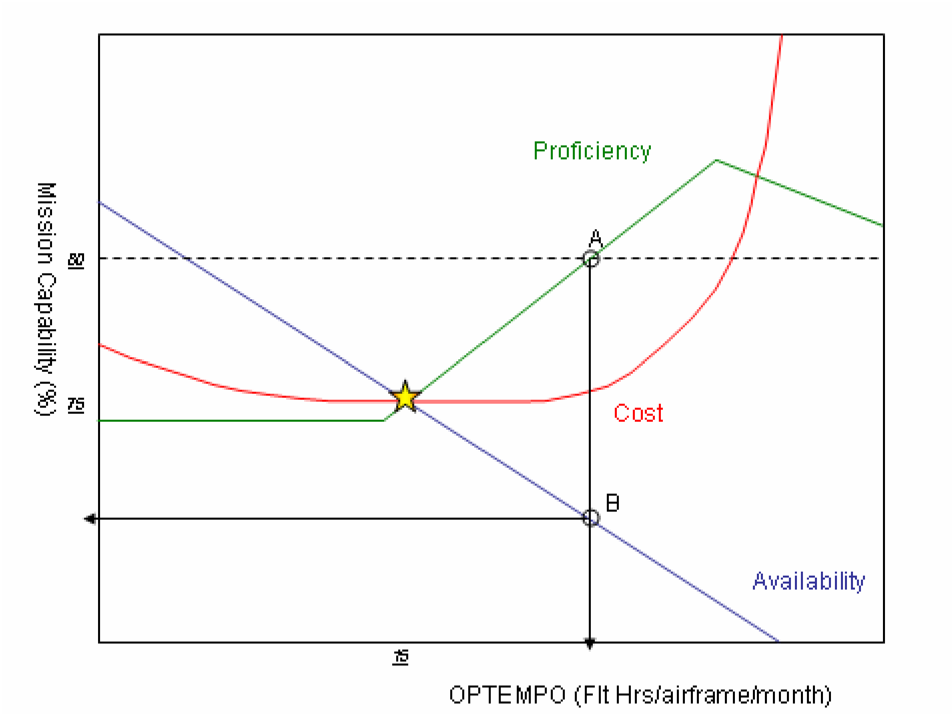

Figure 9. Mission Capability Increase

To compensate for this deficiency, unit commanders will adjust OPTEMPO to improve Mission Capability. They will make an OPTEMPO shift because funding has not increased relative to the desired Mission Capability. This reduced level of Mission Capability, as determined by availability, is unacceptable. The OPTEMPO adjustments naturally move in the direction of the equilibrium point. OPTEMPO reductions result in Mission Capability returning to the equilibrium value.

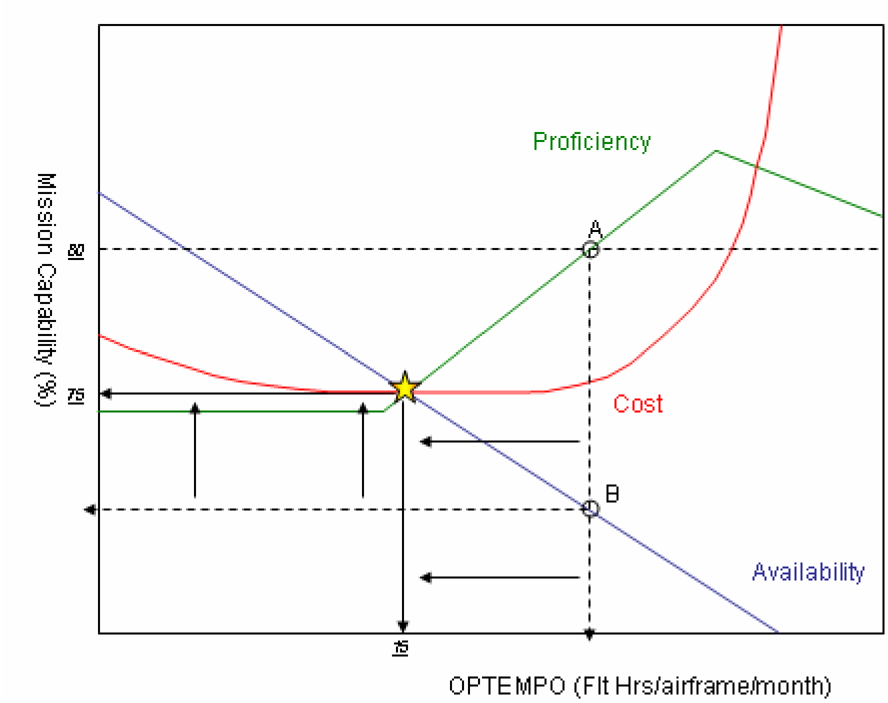

Figure 10. OPTEMPO Movement toward Equilibrium

6. Model Assumptions

The APCO model includes a number of assumptions designed to facilitate its utility. These assumptions are listed below.

1. OPTEMPO is within a unit commander's span of control.
2. This model does not depict external factors that affect Mission Capability, e.g. troop strength, mission change, and funding priorities.
3. Numbers depicted on the axis scales are for relative reference.
4. Availability is a linear function of OPTEMPO.
5. Proficiency is a linear function of OPTEMPO within the relative range.
6. Funding Requirements must support the cost associated with shifting either the proficiency curve or the availability curve.

7. Numbers used are not exact. Movement of any line or curve depicted in the APCO model is relative and only shows the trend.

8. Commanders use prudence when distributing flight hours.

D. APCO MODEL APPLICATION

Two separate and distinct applications of the APCO model are presented in this section. Each model will demonstrate the utility of the APCO model and provide the user with a valuable decision support tool. The starting point for the first model is the LBA Block III ORD Key Performance Parameter (KPP) for Mission Capability. This ORD specified an increase in Mission Capability to 80 percent.[6] The basis for the second APCO model is reliability of the V-22 Osprey. The V-22 achieved 57 percent availability during Operational Evaluation (OPEVAL).[7]

1. LBA Block III ORD Mission Capability KPP

a. Base APCO Model

The base model for this scenario has the same basic format as the previous APCO models. The dashed line drawn at 80 percent corresponds to the proposed increase in Mission Capability. This increase is relatively arbitrary since its supporting analysis used legacy mission definitions to complete the Operational Mode Summary/Mission Profile.[8]

The model indicates a significant increase in OPTEMPO with a corresponding reduction in availability. This results in a realized Mission Capability at a point substantially below the target. If the increase to 80 percent is a hard requirement, then a shift is needed in either the proficiency curve or the availability curve. Shifting these curves will cause costs to increase and a corresponding funding increase must accompany the move.

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[6] Department of the Army, *Operational Requirements Document for the Modernized Longbow, Block III, Multi-Role Helicopter* (Fort Rucker, 2004), 19.

[7] Department of the Navy, *V-22 Osprey Program Brief* (Washington D.C., 2001), 20.

[8] Department of the Army, *Combat Developer Reliability and Maintainability Analysis for the Modernized Apache Longbow* (Fort Rucker, 2003), 4.

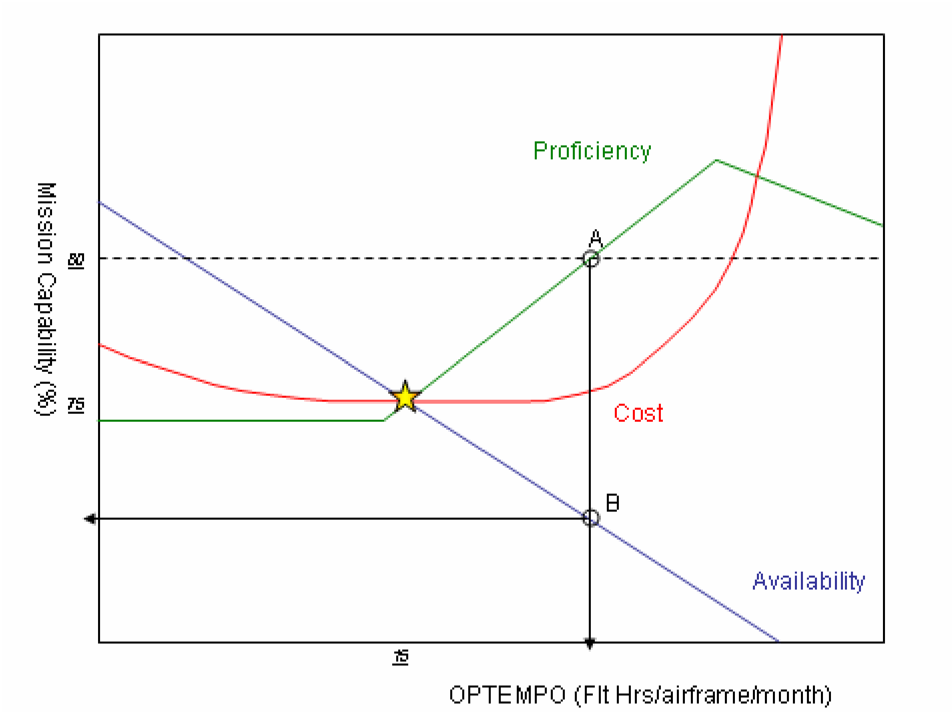

Figure 11. LBA Block III Mission Capability Base APCO Model

b. Resource Application for Availability

An application of resources is needed to shift the availability curve to the right. A required availability of 80 percent results in a sustainable OPTEMPO far less than proficiency requirements permit. The initial availability curve (dashed blue line) is set by the fielded system's reliability. A shift in this curve would require a significant investment in sustainment engineering and reliability improvement.

The availability curve must intersect the proficiency curve at the 80 percent Mission Capability line. This will permit a sustainable OPTEMPO that balances proficiency and availability. The net result is a successful attempt at achieving 80 percent Unit Mission Capability.

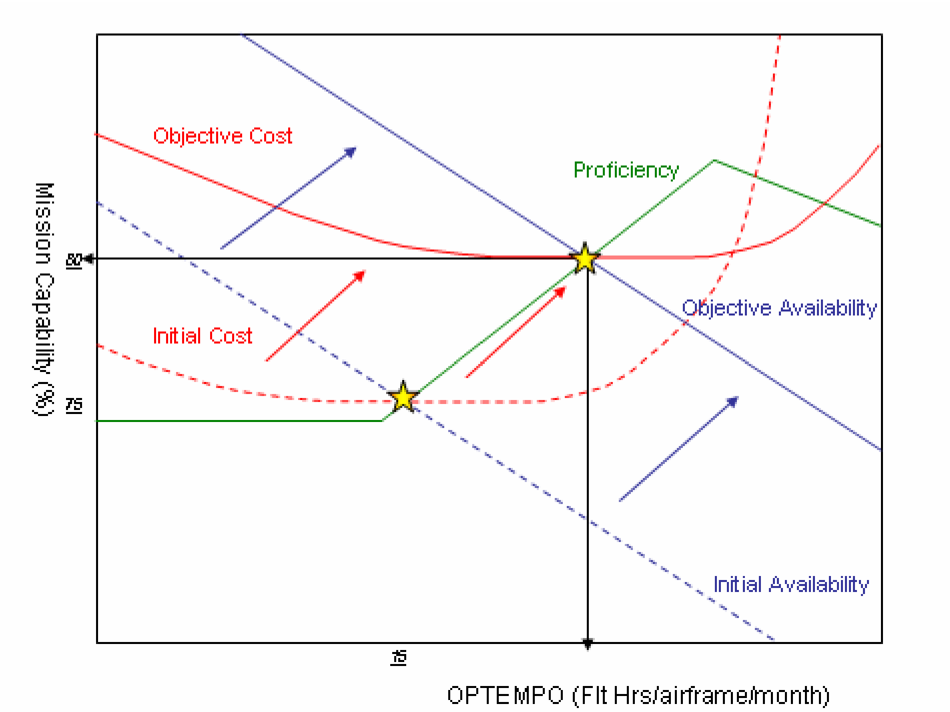

Figure 12. Resource Application for Availability

c. Resource Application for Proficiency

Another way to approach this problem is by allocating resources to shift the proficiency curve to the left. Proficiency must increase while reducing OPTEMPO to the required availability point of 80 percent. The application of non-flight training solutions causes an increase in cost. Examples of training solutions include high fidelity flight simulators, cockpit crew trainers, and other ground based training events.

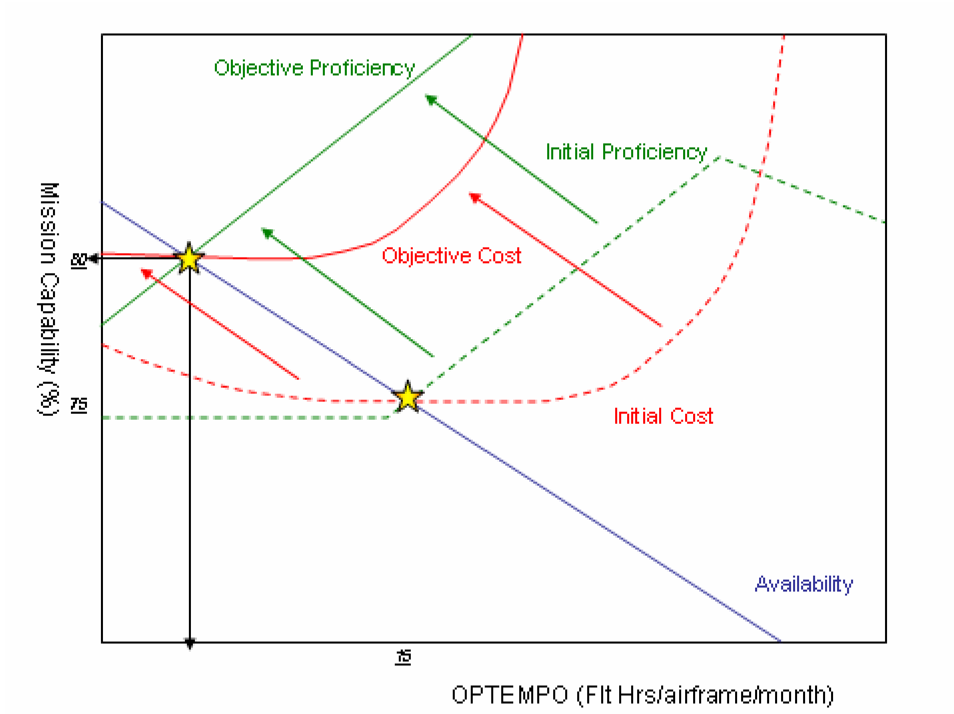

Figure 13. Resource Application for Proficiency

d. Resource Application for Availability and Proficiency

Given that availability is set early in the design of a system, achieving the total magnitude of shift required for the availability curve could be cost prohibitive. Additionally, technology may not permit a complete shift of the proficiency curve. The employment of a strategy that shifts both the availability curve and the proficiency curve could enable the successful implementation of this Mission Capability improvement. Again, this will result in a shift of the cost curve and funding must match this new requirement.

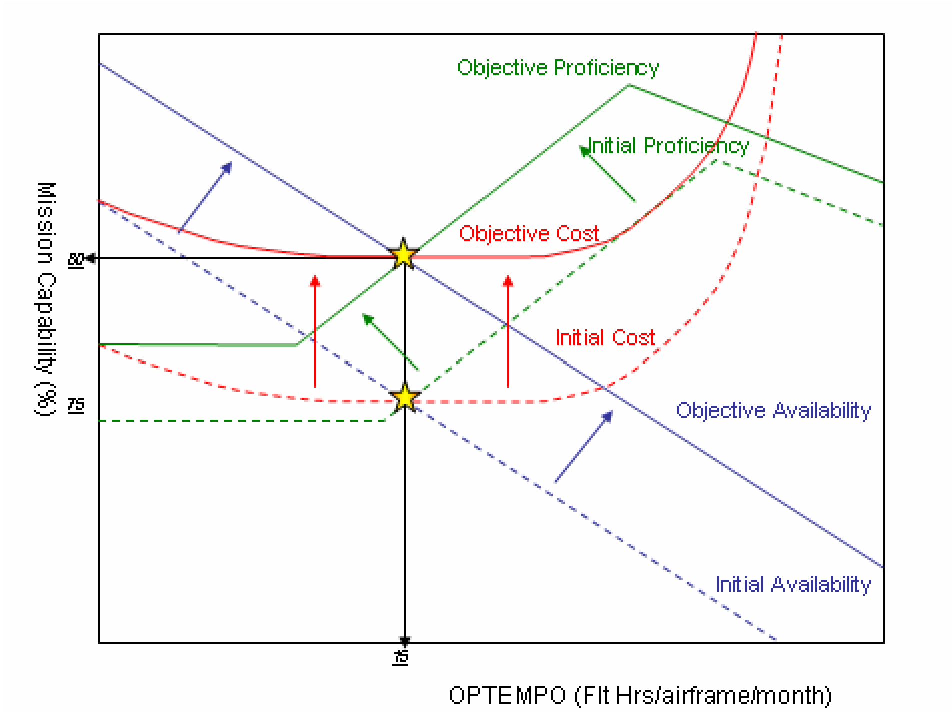

Figure 14. Resource Application for Availability and Proficiency

2. V-22 Osprey Mission Capability

a. Base APCO Model

The V-22 Osprey presents an interesting application of the APCO model. The Navy standard for system availability is 75 percent and the anticipated OPTEMPO for the V-22 is 14 hours. Using the previous APCO model as a base, figure 15 below shows the desired Unit Mission Capability for these values.

The Navy completed an OPEVAL of the V-22 in July 2000. The reliability and maintainability results from the logistics portion of the evaluation indicate an availability rate of 57 percent. The gap, 18 percent, between Navy requirements and V-22 achieved results represents a significant deficiency in Unit Mission Capability. The star on the APCO model below indicates the current capability at the intersection of the proficiency and availability curves.

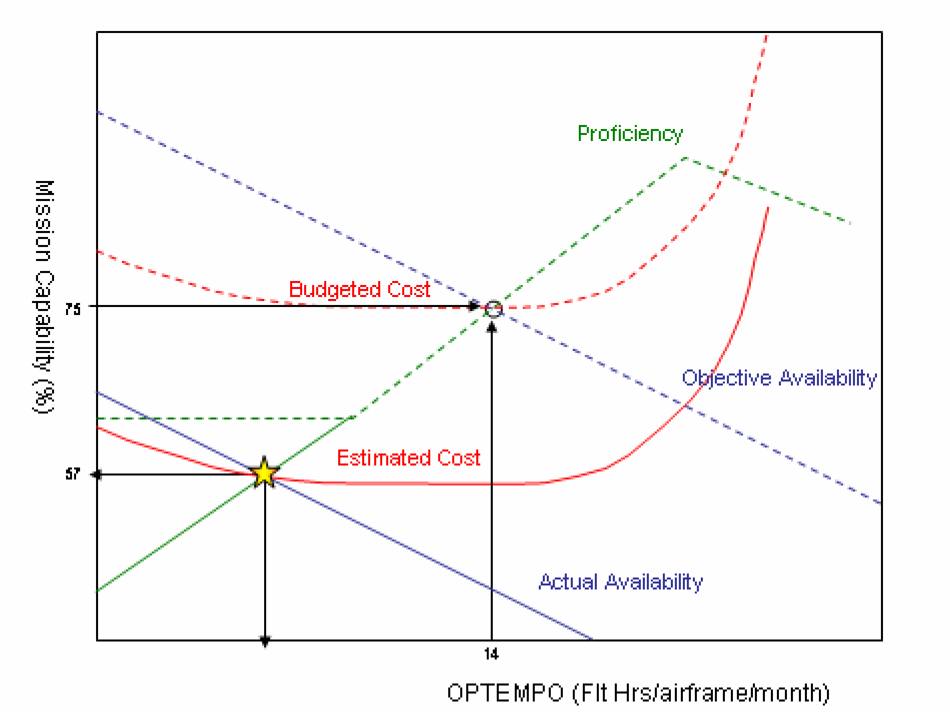

Figure 15. V-22 Mission Capability Base APCO Model

b. Resource Application for Reliability Improvements

The solution to the V-22 capability gap is an increase in funding to support the cost of reliability improvements. These reliability improvements will drive a shift in the availability curve to match Navy requirements. This curve shift also enables an OPTEMPO increase needed to support proficiency efforts. The estimate of funding needed to effect this change is $381.1M.[9] If these funds are not allocated to the program, the result will be V-22 units operating well below required Unit Mission Capability.

[9] Department of Defense, *Inspector General Audit Report: V-22 Osprey Joint Advanced Vertical Aircraft* (Arlington, 2000), 6.

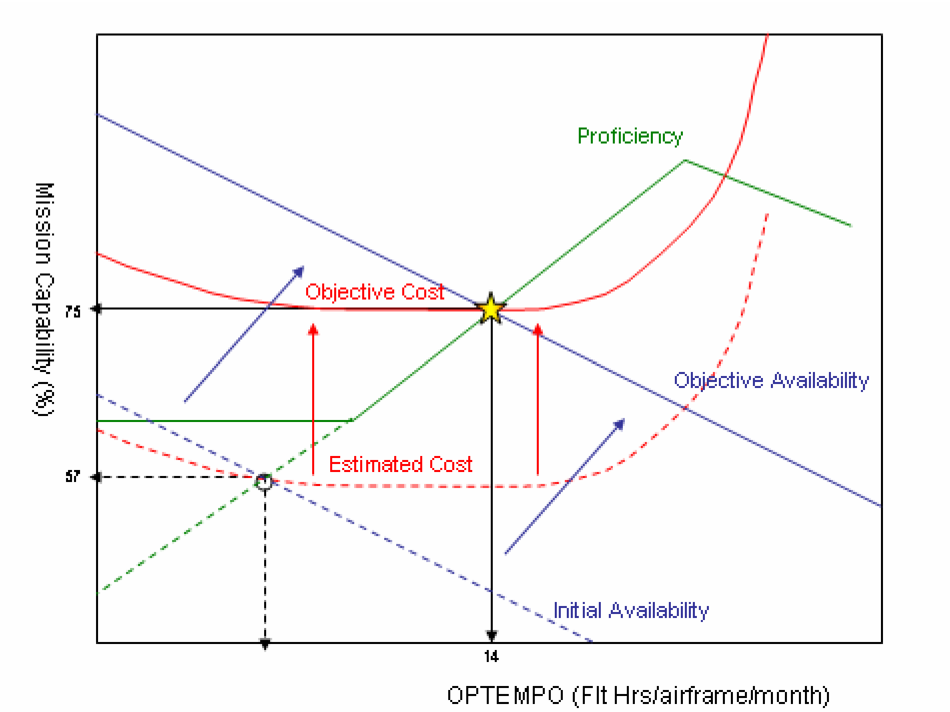

Figure 16. V-22 Resource Application

c. Alternate Resource Application for Increased Mission Capability

Figure 17 depicts an alternate solution to this V-22 problem. As mentioned earlier, extreme reliability improvements may be cost prohibitive. In this situation, it is necessary to address possible proficiency solutions, as well as reliability improvements. By shifting both the availability curve and the proficiency curve, achieving the required level of Unit Mission Capability is possible while reducing OPTEMPO.

Implementing this course of action still requires an increase in funding. The shift in the cost curve, and the corresponding funding, could be lower than the funding required in figure 16. The application of efficient non-flight training will increase proficiency without increasing OPTEMPO. The net result is a V-22 program that meets Unit Mission Capability requirements at a cost that is lower than previously anticipated.

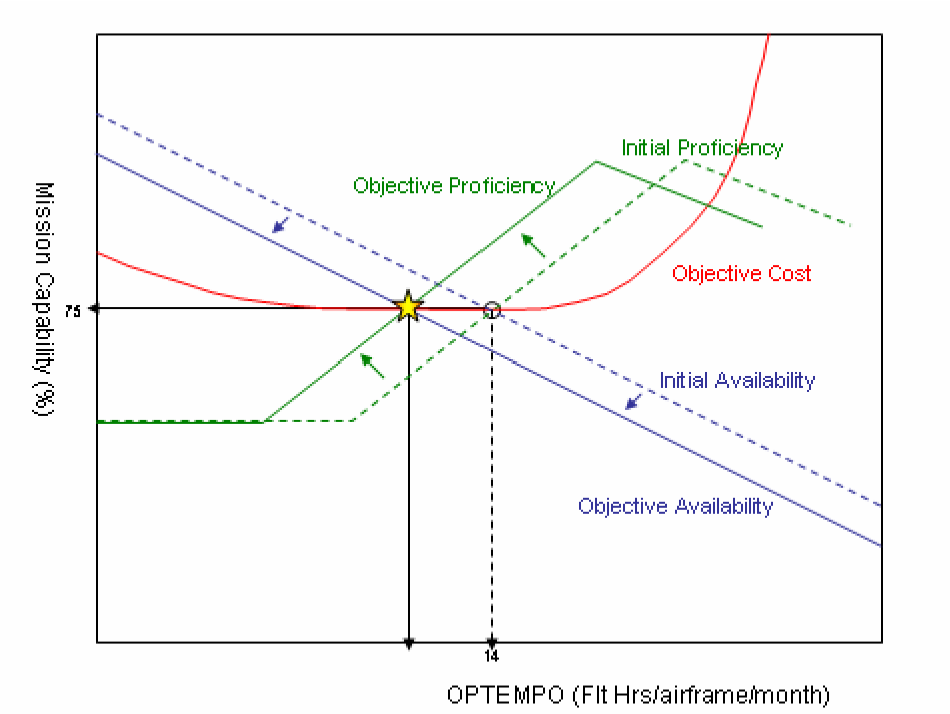

Figure 17. V-22 Alternate Resource Application

E. CHAPTER CONCLUSION

This chapter focused on the variables that affect Unit Mission Readiness. Relationships exist between these variables. Users with an understanding of these relationships are better prepared to make proactive choices relating to OPTEMPO and their desired level of Unit Mission Capability. A number of external factors influence a user's ability to achieve this desired level of Unit Mission Capability. The next chapter focuses on the external factors that impact funding.

III. APCO MODEL AND EXTERNAL INFLUENCE

A. CHAPTER OVERVIEW

Chapter II discussed the variables affecting Unit Mission Capability. It laid out the relationships and their influences within the APCO model. Specifically identified was the importance of level of funding in mitigation of the impacts of OPTEMPO and the costs associated with a unit's operations, maintenance and capital improvement initiatives. This chapter will look at the past trends for funding and potential current concerns. It will also look at future concerns that are currently the focus of discussion among senior leaders within our Government (the Department of Defense, Whitehouse, Congress…).

B. BUDGET PROCESS AND FUNDING

1. Categories of Spending

Although the budgeting process of the United States Government is beyond the focus of this work, it is important to note several key characteristics of that process. First characteristic is that the budgeting process generally differentiates between several distinct categories of spending: Mandatory Spending, Net Interest and Discretionary Spending.

The Congressional Budget Office (CBO) defines mandatory spending as the budget authority provided and controlled by laws other than appropriation acts and the outlays that result from that budget authority. In layman's terms, mandatory spending covers areas of spending that are mandated by law and are often referred to as entitlements. These include such areas as Social Security, Medicare and Medicaid. They are "set" obligations that require "acts of Congress" to change.

Net Interest consists of the government's interest payments on debt held by the public (as recorded in budget function 900). This is offset by interest income that the government receives on loans and cash balances and by earnings of the National Railroad

Retirement Investment Trust.[10] Like mandatory spending, Net Interest is "set" and not easily influenced or changed. Discretionary spending, on the other hand, is subject to annual legislative appropriations by congress. As its name implies, Discretionary Spending is easily influenced by congress and is subject to turbulent fluctuations each year.

2. Department of Defense Budget

The second key characteristic is that the Department of Defense's budget falls under discretionary spending. Its budget makes up the largest portion of that category. For this reason, the discretionary category is often broken out into "defense related and non-defense related" spending. Consequently, because of its size (historically 50% or greater), defense funding is a prime target for budget cuts.

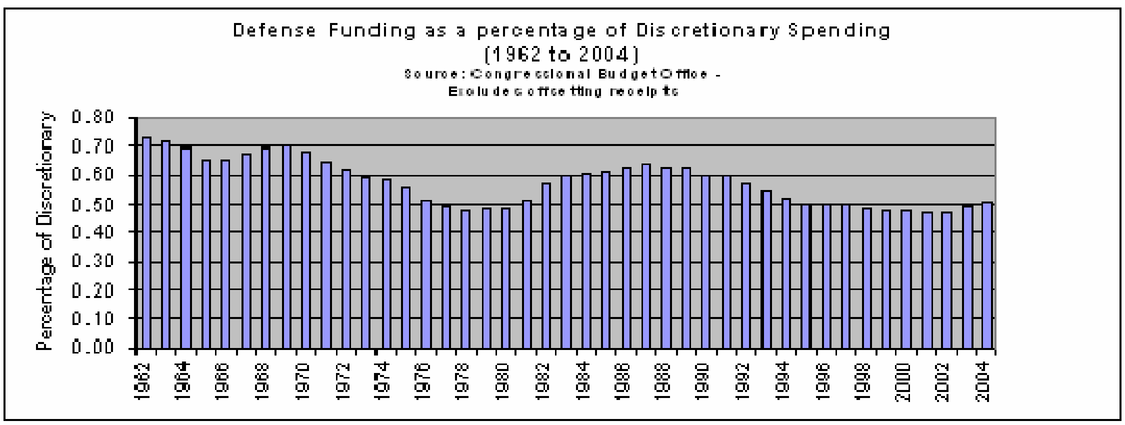

Figure 18. Defense Spending

3. Mandatory Spending Trends

The third and final characteristic is the trend of increasing growth in the size of mandatory spending. An aging population of Baby Boomers, the related social security bill and rising healthcare costs (Medicare) are several of the causes. The percentages in the diagram below are only estimations, but CBO predictions show the percentage of

[10] Congressional Budget Office, *Glossary of Budgetary and Economic Terms* (Washington, D.C., 2005).

mandatory spending will continue to grow to further "squeeze" discretionary expenditures in the coming decades. This was the basis for a considerable debate during the presidential election.

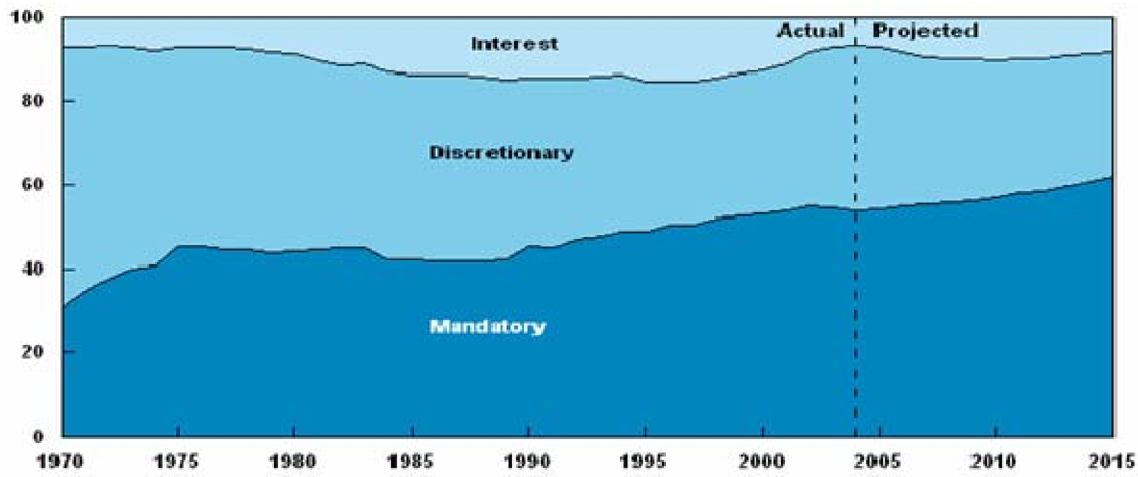

Figure 19. Mandatory Spending Increase

C. PAST FUNDING LEVELS MASK EFFECTS IN APCO MODEL

For the past several decades, the level of funding appropriated to the Department of Defense has been sufficiently high enough to mask the impacts of lower reliability and OPTEMPO. Simply put, the funds have been there for aircraft to fly more hours (maintaining a high level of proficiency) and still pay the bill for the wear and tear on the airframes (availability). This level of funding has made it possible to reach a point above their normal equilibrium (particularly with regard to maintenance and repairs) (see figure 8).

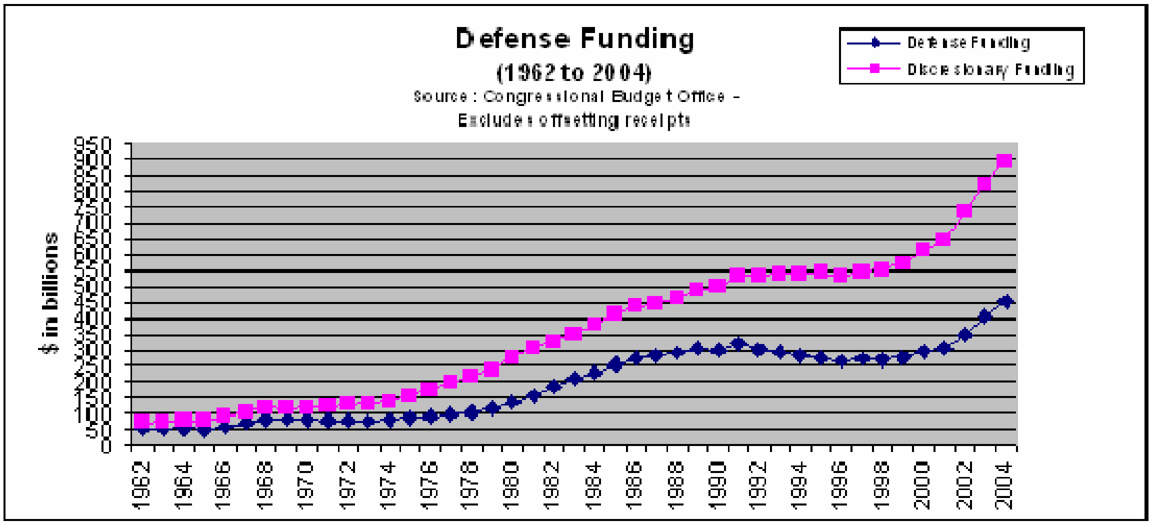

Figure 20. Defense Funding

Periodic Supplemental Appropriation Bills from Congress covering military operations are at the root of the masking. These supplements covered Desert Shield, Desert Storm, the War on Terrorism and Operation Iraqi Freedom. They have significantly (artificially) bolstered the Department of Defense funding levels.

In 2003, 2004 and 2005, supplementals alone equated to an artificial injection of defense funding of over $276 billion. (See Appendix for Supplementals 2003-2005). Not only have these dollars gone to fighting the war, but to maintain and upgrade the equipment as well. This has made the normal depreciation associated with the OPTEMPO less apparent.

Many senior defense leaders are concerned though as LTG David Melcher conveyed in the following quote.

> My sense is that people want to move away from supplementals and try and address more of this in a programmed approach or a budget approach. However, it remains to be seen whether that is possible. In any case, I don't think the market will bear it [supplementals] for year after year to come.[11] No quote marks

[11] Jen DiMascio, "Army Leaders Worried About Increasing Pressure on the Top line Budget," *Inside Washington Publishers*, 10 October 2005, 1.

The Army recently submitted a document to the Office of the Secretary of Defense stating, "Without continuing supplemental support from Congress, the Army is facing a $7 billion-a-year budget shortfall." It also indicated that the Army intends to rely on Congress to fund personnel and reset costs with supplemental appropriations after 2006. It estimated $4 billion dollars per year for at least two years after the conflicts end in order to reset equipment, which has been operating up to eight times over its normal OPTEMPO in an extremely harsh environment. The document also expressed that "the costs for recruiting and the training of soldiers would also be covered by supplementals, as they have been in the past several years."[12]

The Government Accountability Office (GAO) in a recent report calls into question the way the Defense Department formulates its supplemental budget requests to fund the global war on terrorism, to the point of urging Congress to direct DOD to better explain how money is spent.[13]

D. UNEASE OVER DEFICIT GROWTH AND SPENDING

In his address before the Joint Economic Committee, November 3, 2005, Federal Reserve Chairman, Alan Greenspan stated, "The longer-term prospects for the U.S. economy remain favorable." However, he still expressed "concern" over the magnitude of the federal deficit as a whole and impacts of such recent events as hurricanes Katrina and Rita. This reaffirmed previous addresses in which he conveyed a "sense of uneasiness" with the potential future implications.

Deficit growth equates to diminished defense dollars on a macro-level. At the unit level, reduced funding will equate to tougher decisions by commanders with regard to the variables of the APCO model (OPTEMPO, Proficiency and Availability).

Over the next six years, the Defense Department is weighing $32 billion in cuts to major weapon systems and Army force structure. These reductions may represent only a down payment on the total bill facing the Pentagon as federal budget pressures mount.

[12] Jen DiMascio, "Future Army Budgets to Come Up Short Without Supplemental Funding," *Inside the Army*, 19 September 2005, 1.

[13] John Liang, "GAO Questions Manner in Which DoD Requests Supplemental Funds," *Inside Washington Publishers*, 28 September 2005, 1.

The steep cuts, including an $8 billion decrement in fiscal year 2007, were proposed by the services after Gordon England, acting deputy defense secretary, directed them to nominate $32.1 billion in reductions to their respective programs across the fiscal year 2007 to 2011 spending plan. The $32 billion does not "reflect the total shortfall, therefore we may need to adjust further in the future," said England in an interview.[14]

The Army is due to shoulder $11.7 billion worth of the new cuts; the Air Force's share is $8.6 billion; the Navy's is $8.5 billion (which includes Marine Corps reductions); and defense-wide cuts total $3.3 billion. For the out-years, the Army must slice $2.3 billion in FY-07, $2.8 billion in FY-08, $1.2 billion in FY-09 $1.8 billion in FY-10 and $3.6 billion in FY-11. Subsequent cuts, if enacted, will be based on results of the Quadrennial Defense Review as well as expected cuts from the White House, which would be spelled out in the forthcoming annual Office of Management and Budget "pass-back memo." That memo is expected to reflect mounting federal budget pressures, including the huge bill expected from Hurricane Katrina relief efforts.[15]

In light of the concerns over cuts, LTG Joseph Yakovac, the Army's military acquisition chief, said that he is "very concerned" about pressures on the service's budget. The strains are from within as well as from outside sources. Within the Army, the budget is strained by the wars, the resulting need to repair and reset equipment used in those wars and the Army's plans for transformation.

> These effects put the Army's procurement and research and development (R&D) goals at some doubt. We are not going to get what we need simultaneously. Procurement and R&D are likely targets for budget trimming. Regardless of how any cuts are meted out, their impact will be significant.[16]

[14] Jen DiMascio and Jason Sherman, "Pentagon to Slash $32 Billion from Service Budgets; More Cuts May Follow," *Inside the Army*, 2 November 2005, 1.

[15] Ibid.

[16] Jen DiMascio, "Army Budget Chief of Sees Threat to Service's Budget Priority," *Inside Washington Publishers*, 3 October 2005, 2.

E. FUNDING COMPETITORS: OUTSIDE SOURCES

As alluded to by LTG Yakovac, many strains (competitors) are vying for the same discretionary federal dollars. Some of the more prominent ones follow:

1. Hurricanes Katrina and Rita

Hurricanes Katrina, Rita, and their devastating impacts have already claimed $62 billion in supplemental appropriations. In a recent report, the CBO reviewed anticipated macroeconomic and budgetary effects of both hurricanes.[17] The office examined the economic impacts to date and projected impacts from the disruption of production of oil, oil products, and natural gas. Additionally, the report examined the loss of wealth to those most directly affected, the needed support for recovery and rebuilding of the affected region and overall impacts on the gross domestic product (GDP). Findings concluded that the economic effects of the hurricanes arise from the loss of life and the destruction of private and government capital stocks in the Gulf States.

Hurricane Katrina destroyed considerable numbers of residential structures; consumer durable goods, such as motor vehicles, household furnishings, and appliances; and business structures and equipment, particularly in the energy and petrochemical industries.

Hurricane Rita appears to have had a smaller impact on residential structures and consumer durable goods, but its damage to the energy industry may be as great as or greater than Katrina's impact. The damage to capital stocks has temporarily reduced employment and the growth of income in the affected areas. [18]

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[17] Congressional Budget Office, *The Macroeconomic and Budgetary Effects of Hurricanes Katrina and Rita: An Update* (Washington, D.C., 2005), 2.

[18] Ibid.

Estimated Net Effect of Hurricane Katrina on Real Gross Domestic Product

(Billions of 2005 dollars at annual rates)

	2005	2006		2007	
	2nd Half	1st Half	2nd Half	1st Half	2nd Half
Energy Production	-18 to -28	-8 to -10	-5 to -7	-5 to -7	-5 to -7
Housing Services	-1 to -2	-2 to -4	-1 to -3	0 to -2	0 to -2
Agricultural Production	-1 to -2	0	0	0	0
Replacement Investment	6 to 12	16 to 34	16 to 35	16 to 35	12 to 25
Government Spending on Goods and Services	6 to 10	12 to 18	14 to 20	10 to 16	7 to 11
Effect of Higher Energy Prices on Nonenergy Consumption	-6 to -10	-5 to -7	-2 to -5	-1 to -3	0 to -2
Other Consumption	-8 to -12	-2 to -4	-1 to -3	-1 to -3	0 to -2
Real GDP	**-22 to -32**	**11 to 27**	**21 to 37**	**19 to 36**	**14 to 23**

Source: Congressional Budget Office.

Note: This table is an updated version of a similar table published by CBO on September 29, 2005. The estimates for "Replacement Investment" have changed slightly since that time.

Figure 21. Net Effect of Hurricane Katrina

Additionally, because of higher prices at the pump, double-digit oil revenues (in the billions) flowed into the industry as they reported profits in the quarter immediately following the hurricanes. Exxon Mobil, the world's largest oil company, reported that its third-quarter net income jumped 75 percent, to $9.92 billion. Its profit in the first nine months of this year - $25.42 billion - already equals its full-year earnings for 2004. This year's sales, which topped $100 billion in the last quarter, are expected to exceed those of Wal-Mart.[19] Contrarily, the estimate loss by the insurance industry may exceed the estimated $150 billion.

2. Transformation Costs

The Army continued its sweeping transformation in 2005, including the fundamental restructuring that makes its primary organizational structure the combat brigade instead of the division. The Future Combat System (FCS) is the material component centerpiece of the initiative. In its unprecedented complexity, FCS confronts

[19] Jad Mouawad and Simon Romero, "Big Rise in Profit Puts Oil Giants on Defensive," *New York Times*, 28 October 2005.

the Army with significant technical and managerial challenges in its requirements, development, finance, and management.

Technical challenges include the need for FCS vehicles to be smaller, weigh less, and be as lethal and survivable as current vehicles. This requires (1) a network to collect and deliver vast amounts of intelligence and communications information and (2) individual systems, such as manned ground vehicles, that are as complex as fighter aircraft. Its cost will be very high: its first increment—enough to equip about 1/3 of the force—will cost over $108 billion, with annual funding requests running from $3 billion to $9 billion per year. The program's pace and complexity also pose significant management challenges.[20]

The Army is using a Lead System Integrator to manage FCS and is using a contracting instrument, an Other Transaction Agreement (OTA), which allows for a more flexible negotiation of roles, responsibilities, and rights with the integrator.

The FCS is at significant risk for not delivering required capability within budgeted resources. Currently, about 9½ years is allowed from development start to production decision. DOD typically needs this period of time to develop a single advanced system, yet FCS is far greater in scope. The program's level of knowledge is far below that suggested by best practices or DOD policy: Nearly 2 years after program launch and with $4.6 billion invested, requirements are not firm and only 1 of over 50 technologies are mature. As planned, the program will attain the level of knowledge in 2008 that it should have had in 2003, but things are not going as planned. Progress in critical areas—such as the network, software, and requirements—has in fact been slower, and FCS is therefore likely to encounter problems late in development, when they are very costly to correct. Given the scope of the program and the fact that FCS will command a significant share of the Army's acquisition budget (particularly that of ground combat vehicles) the impact of cost growth could be dire.[21]

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[20] Government Accountability Office, *Future Combat Systems Challenges and Prospects for Success* (Washington, D.C., 2005), 3.

[21] Ibid

3. Manning Issues: Recruiting, Retention and Incentives

Army recruiting has suffered significant, continuous shortfalls in all of the components (Active, National Guard and Reserves). Many analysis and senior leaders attribute public opinion on the ongoing wars in Iraq and Afghanistan as major if not the most significant contributors. Retention has also been affected, although not as dramatically.

An indication of the importance of this shortfall lies in senior Army leadership's reaction to the developments. Many "creative" proposals are currently under consideration. Monetary incentives (direct or indirect) appear to be the foundation for the majority of the proposed solutions. Examples of the proposals include raising the cap on signing bonuses for some specialties from $20,000 to $40,000 and shorter enlistments, as brief as 18 months are on the table as well as an increase in the age limit cut-off. These fiscally based solutions are double edged, though, in that they drain funds away from the whole of the Army's budget. Additionally, in some cases, they create further potential long-term obligations. This can be found in service benefits paid out to shorter enlistees after completion of their obligation (i.e. GI Bill) or health benefits to older recruits entering with more physical health issues.

RECRUITING TRACKER

The Active Army, Army Reserve and Army National Guard each have their own recruiters and recruiting goals. All three components missed multiple goals in fiscal 2005, which began Oct. 1, 2004, and ended Sept. 30. These numbers do not include Army Reserve goals or accessions made through Human Resources Command.

	Oct	Nov	Dec	Jan	Feb	March	April	May	June	July	Aug	Sept
Active Army Annual goal: 80,000												
Goal	6,935	6,800	400	8,000	7,050	6,800	6,600	6,700*	5,650	7,450*	9,250	8,365
Actual	6,952	6,838	429	8,086	5,134	4,666	3,820	5,039	6,158	8,084	9,453	8,713
Percent of goal	100%	101%	107%	101%	73%	69%	58%	75%	109%	109%	102%	104%
Year-to-date goal	6,935	13,735	14,135	22,135	29,185	35,985	42,585	49,285	54,935	62,385	71,635	80,000
Year-to-date met	6,952	13,790	14,219	22,305	27,439	32,105	35,925	40,964	47,122	55,206	64,659	73,373
Percent of year to date	100%	100%	101%	101%	94%	89%	84%	83%	86%	88%	90%	92%
Army Reserve Annual goal: 22,175												
Goal	1,020	1,095	300	2,495	1,320	1,600	1,355	2,759	3,610	2,585	2,536	1,500
Actual	1,055	1,241	389	1,913	991	847	850	2,269	3,654	2,134	2,255	1,802
Percent of goal	103%	113%	130%	77%	75%	53%	63%	82%	101%	83%	89%	120%
Year-to-date goal	1,020	2,115	2,415	4,910	6,230	7,830	9,185	11,944	15,554	18,139	20,675	22,175
Year-to-date met	1,055	2,296	2,685	4,598	5,589	6,436	7,286	9,555	13,209	15,343	17,598	19,385
Percent of year to date	103%	109%	111%	94%	90%	82%	79%	80%	85%	85%	85%	87%
Army National Guard Annual goal: 63,002												
Goal	3,675	3,925	3,720	5,514	5,533	5,933	5,866	5,791	5,032	5,921	5,942	6,148
Actual	2,546	2,902	3,661	3,712	3,824	5,203	4,333	4,071	4,337	4,712	4,870	6,048
Percent of goal	69%	74%	98%	67%	69%	88%	74%	70%	86%	80%	82%	98%
Year-to-date goal	3,675	7,600	11,320	16,835	22,369	28,302	34,168	39,959	44,991	50,912	56,854	63,002
Year-to-date met	2,546	5,448	9,109	12,821	16,645	21,848	26,181	30,252	34,589	39,301	44,171	50,219
Percent of year to date	69%	71.9%	80.5%	76.2%	74.4%	77%	77%	76%	77%	77%	78%	80%

*The Army originally listed its May goal as 8,050 but lowered it by 1,350. In turn, July's goal is now 1,350 higher than previously reported. All calculations are based on the new goals.

Source: U.S. Army Recruiting Command and National Guard Bureau

TIMES STAFF

Figure 22. Recruiting Results

Public opinion and polls in general indicate a decline in propensity to join the military service as the wars in Iraq and Afghanistan continue. Recruiters report similar feedback, as reported in the opinion poll below, from potential recruits regarding their reluctance to be immediately deployed into a war zone.

"Which of these do you think is most likely? (1) Iraq will become a stable democracy in the next year or two. (2) Iraq will become a stable democracy, but it will take longer than a year or two. Or, (3) Iraq will probably never become a stable democracy."

	Next Year Or Two	Longer	Never	Unsure
	%	%	%	%
10/3-5/05	4	45	49	2
9/9-13/05	4	43	50	3
8/29-31/05	6	43	48	3
12/21-22/03	7	59	31	3

Table 1. CNN/USA Today/Gallup Poll. Oct. 21-23, 2005.
N=1,008 adults nationwide. MoE ± 4.

"How would you say things are going for the U.S. in its efforts to bring stability and order to Iraq? Would you say things are going very well, somewhat well, somewhat badly, or very badly?"

	Very Well	Somewhat Well	Somewhat Badly	Very Badly	Unsure
	%	%	%	%	%
10/3-5/05	4	39	27	28	2
8/29-31/05	5	35	29	28	3
7/29 - 8/2/05	7	41	29	21	2
6/10-15/05	7	33	34	26	0
5/20-24/05	5	36	31	26	2
4/13-16/05	7	41	32	18	2
2/24-28/05	10	43	29	18	0
1/14-18/05	5	36	28	29	2
11/18-21/04	5	40	26	27	2
10/28-30/04 RV	7	40	25	25	2
10/14-17/04 RV	5	38	27	28	2
7/11-15/04	4	39	28	28	1
6/23-27/04	2	38	31	26	3
5/20-23/04	3	34	38	22	3
4/23-27/04	4	34	31	29	2
12/21-22/03	8	57	24	9	2
12/14-15/03	12	53	21	10	4
11/10-12/03	5	42	28	22	3
10/20-21/03	5	49	31	12	3
9/15-16/03	5	44	29	18	4
8/26-28/03	5	46	31	16	2
8/11-12/03	6	47	28	13	6
7/03	6	54	25	11	4
5/03	11	61	19	5	4

Table 2. CNN/USA Today/Gallup Poll. Oct. 21-23, 2005.
N=1,008 adults nationwide. MoE ± 4.

The American killed in action (KIA) body count has surpassed 2000, while insurgent attacks (particularly improvised explosive devices) continue unrelentingly. Reports in the media of stop-loss measures and involuntary extension are also negative persuaders. Reports of the heavily, potentially over-extended use of guard and reserve forces and multiple rotations have also been detractors. All indicators, in spite of fiscal incentives thus far, point to continued shortfalls in recruitment and unit manning.

Again, it is important to consider the point that all of these concerns equate to fewer dollars availability at the unit level to balance the APCO model to reach the desired level of equilibrium.

F. AN AGING FLEET

"Aging" weapon systems, equipment and vehicle fleets are emerging as another significant competing concern. Many of our current systems were procured during the heavy defense spending years that characterized President Reagan's term in office. There was a significant flow of new equipment into the Armed Forces during that period. They were new technologically advanced items at the time. That equipment has now aged and is in need of repair and/or replacement. Various defense officials share the sentiment that "We have big bills coming up [in the replacement of those systems]."

1. Wear and Tear from Combat Operations

GAO's report on the aging effects of current war indicates the significantly accelerated wearing out equipment. The consequential early replacement and reset requirements are aptly depicted in the APCO model. The CBO testified that the potential costs resulting from increased usage of military equipment in ongoing operations in Iraq could equate to over $9 billion from the Army alone for the year 2005.[22] They estimate significant acceleration on those vehicles and equipment. They further acknowledge the effects of such upgrades as up-armor in that they increase a vehicle's weight beyond its initial design parameters also causing earlier wear out.

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[22] Congressional Budget Office, *The potential costs resulting from increased usage of military equipment in ongoing operations* (Washington, D.C., 2005), 2.

Illustrative Relationship between Vehicle Usage, Age, and Lifetime

(Miles on odometer)

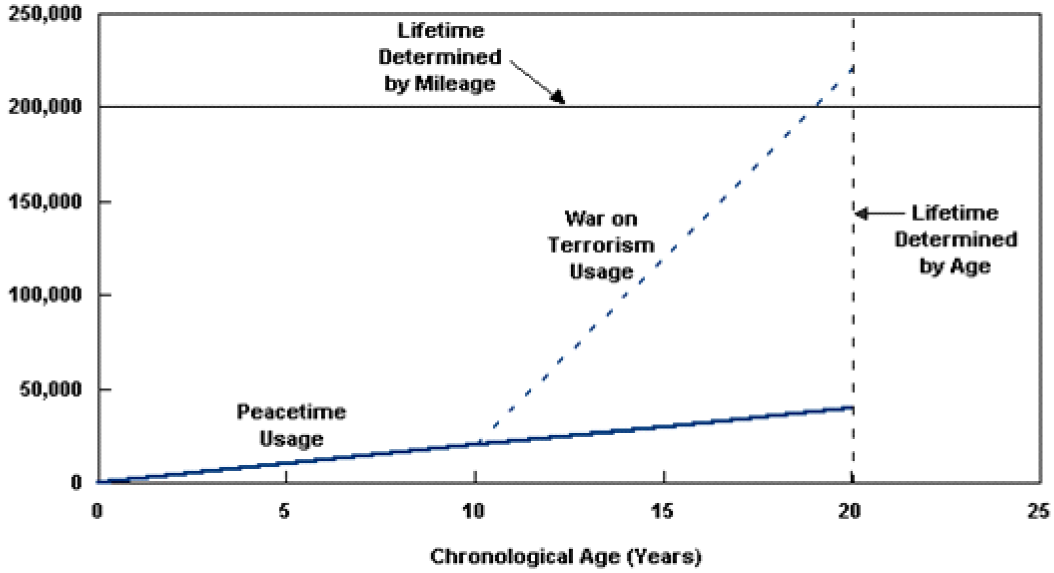

Figure 23. Vehicle Usage, Age and Lifetime
Source: Congressional Budget Office

Army Equipment Use In-Theater in 2005

	Value of Equipment (Millions of dollars)		Assumed Lifetime (Years)	OPTEMPO Ratio (Wartime/ peacetime)	Increase in Annual Depreciation	
	In Divisions	**Outside Divisions**			**Percent**	**Millions of Dollars**
Aviation	4,150	8,980	20	2	5	660
Tracked Vehicles and Other Weapons	9,540	0	30	5	13	1,270
Trucks	2,110	1,930	20	10	45	1,820
Other	4,630	0	20	5	20	930
Total	**20,430**	**10,910**	**n.a.**	**n.a.**	**n.a.**	**4,680**

Source: Congressional Budget Office based on data from the Army.
Note: OPTEMPO = operating tempo; n.a. = not applicable.

Table 3. Army Equipment Use

2. Force Composition

In a current report, the GAO reviewed current force compositions and employment (mix of Active, Reserve and National Guard). The GAO concluded that the Guard is working on an old business model in which it only deployed in the later stages of a major conflict if needed. As a result, Guard units on average are only provided 65 percent to 74 percent of the personnel and 65 percent to 79 percent of the equipment required to conduct their wartime duties, the report said.[23]

While deploying, Army National Guard units have had priority for getting the equipment they needed. Readying these forces has degraded the equipment inventory of the Guard's non-deployed units. This threatens the Guard's ability to prepare forces for future missions at home and overseas. Non-deployed Guard units now face significant equipment shortfalls because (1) they have been equipped at less than war-time levels with the assumption that they could obtain additional resources prior to deployment and (2) current operations have created an unanticipated high demand for certain items, such as armored vehicles. To fully equip its deploying units, as of July 2005, the Army National Guard had transferred more than 101,000 pieces of equipment from its non-deployed units. As of May 2005, such transfers had exhausted the Guard's inventory of more than 220 high demand equipment items, such as night vision equipment, trucks, and radios. Further, as equipment requirements for overseas operations continue to evolve, the Army has been unable to identify and communicate what items deploying units need until close to their scheduled deployments, which challenges the Guard to transfer needed equipment quickly. To meet the demand for certain types of equipment for continuing operations, the Army has required Army National Guard units to leave behind many items for use by follow-on forces, but the Army can account for only about 45 percent of these items and has not developed a plan to replace them.[24]

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[23] Associated Press, "Army NG Short of Equipment at Home," A*rmy Times*, 21 October 2005.

[24] Government Accountability Office, *Plans Needed to Improve Army National Guard Equipment Readiness and Better Integrate Guard into Army Force Transformation Initiatives* (Washington, D.C., 2005), 2.

As of June 05, Army National Guard units had left overseas more than 64,000 pieces of equipment worth more than $1.2 billion, and the Army cannot account for more than half. Pennsylvania Gov. Ed Rendell, said that items sent in their replacement are not the same quality or quantity. Additional, Idaho's governor identified the same issue further stating that his state will not be protected in a disaster or terrorist attack. Lt. Gen. David Melcher, deputy chief of staff of the Army, agreed with the report's findings concluding that $21 billion will be spent from 2006 to 2011 to replace equipment and modernize the Army National Guard. "Quite simply, we are robbing the non-deployed Peter to pay the deployed Paul," said committee Chairman Thomas Davis, R-Va.[25]

3. Mission Creep

A final competitor is mission creep. Lessons from Hurricane Katrina require that the military assume a greater role during major disasters, said Assistant Secretary of Defense for Homeland Security Paul McHale (an initiative also endorsed by the senior level of the administration). The Pentagon is planning to take a larger role responding to "catastrophic" events within the United States such as natural disasters and terrorist attacks. They are developing plans to use active duty troops to respond to an avian flu pandemic, the Defense Department's top homeland security official said. He however, also reflected wariness within the military over the added duties. Many fear that active duty troops are already stretched by protracted deployments in Iraq and Afghanistan.[26] This combined with further Homeland Security initiatives could prove an additional challenge.

G. CHAPTER CONCLUSION

It is clear that defense funding will diminish in the near future. Consequently, the relationships identified and discussed within the APCO model will be more prevalent and pertinent as fiscal resources become constrained. It is key for current and future commanders to be aware of the less obvious consequences of their decisions. The model provides a tool when perhaps it will be most needed.

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[25] Associated Press, "Army NG Short of Equipment at Home," *Army Times*, 21 October 2005.

[26] Mark Mazzetti, "Military's Role to Expand in Disaster Relief, Disease Outbreaks," *Los Angeles Times*, 20 October 2005.

IV. ACCELERATED DEPRECIATION DATA STUDY

A. CHAPTER OVERVIEW

Chapter III presented a wide range of external factors that influence the APCO model. The best way to represent the relevance of these factors is to apply the APCO model to actual unit OPTEMPO and availability data. This chapter will demonstrate the concept of accelerated depreciation and introduce the element of time. OPTEMPO over time has a unique impact in shaping the nature of the availability curve.

B. METHODOLOGY AND RESULTS

Monthly operational availability and OPTEMPO data for the LBA was collected between 1999 and 2005. This data provides the basis for the statistical analysis. The data is segregated into three discrete samples with various definitions. Regression analysis is the tool applied to determine the relationship of availability to OPTEMPO. The results of the regression analysis are found in appendix A.

Each of these discrete data sets provided similar results. The slope of availability curve is determined to be linear with a near-zero slope and a Y-intercept value of 78-82 percent. This means that as OPTEMPO increases, availability will hold relatively constant at approximately 80 percent. These results are possibly inconsistent with the assumption listed in chapter II. The following sections will reveal the explanation of this possible inconsistency.

C. APCO MODEL WITH LBA DATA

The results of the regression analysis are applied to the availability curve in the APCO model in the figure below. This model portrays the effect of having a predictable availability rate. A commander can select any level of OPTEMPO needed to maintain proficiency and they will not have to trade-off availability. As long as funding remains consistent with the selected OPTEMPO, a commander would choose to maximize proficiency while continuing to operate his systems at an increased rate. This represents the environment that commanders of LBA battalions have been facing for the past five years.

The assumptions listed in chapter II for the shape of the availability curve were based on the total life of a weapon system. As the LBA continues to age, it will become increasing difficult to maintain this level of steady-state availability. This system is rapidly entering the wear-out phase of its useful life. The entrance into the wear-out phase is accelerated due to a significant increase in OPTEMPO. The actual impacts of increased levels of OPTEMPO are not apparent unless the element of time is considered.

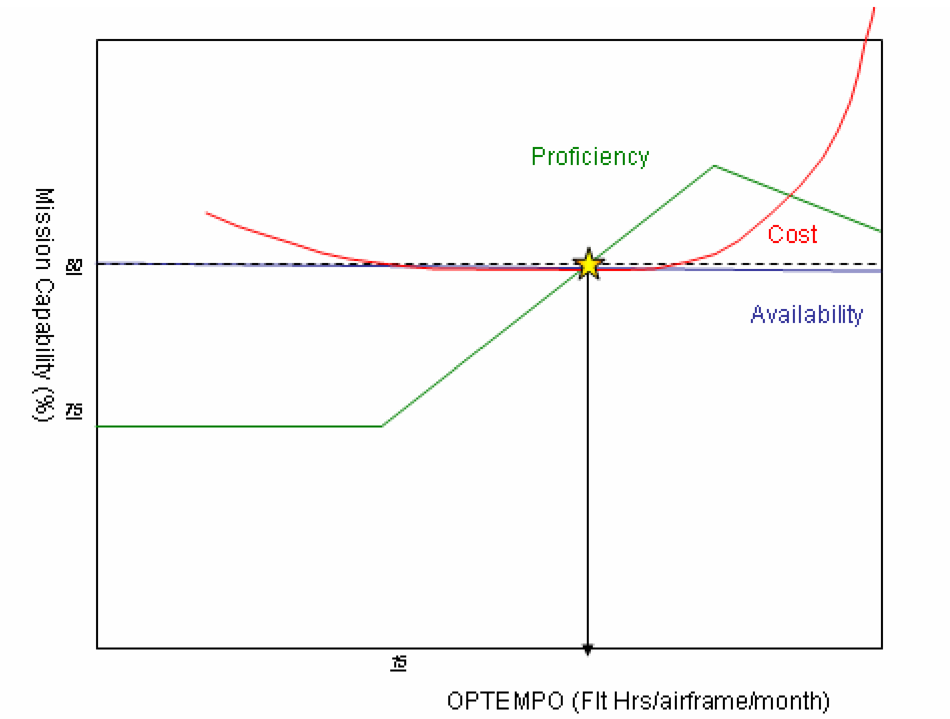


Figure 24. APCO Model with LBA Data

D. IMPACT OF ACCELERATED DEPRECIATION

As operational requirements continue to drive up weapon system OPTEMPO, the systems are impacted by the element of time. Accelerated depreciation is the term used to explain the phenomena of decreasing the useful life of weapon system through the mismanagement of OPTEMPO. The chart in the figure below describes the cause and the significant impact of accelerated depreciation.

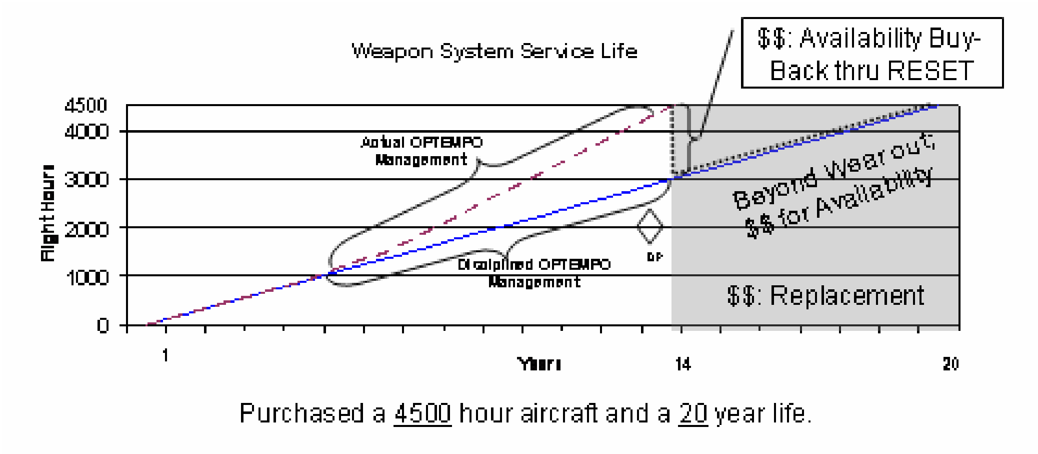


Figure 25. Accelerated Depreciation

1. Cause of Accelerated Depreciation

The LBA user requirement defined a weapon system with an anticipated service life of 4500 flight hours over a 20-year period.[27] This equals an OPTEMPO of 225 flight hours per year. The current (Jan-Jul 05) OPTEMPO is 418 hours. Figure 2 represents these values and the widening gap between disciplined OPTEMPO management and actual OPTEMPO. This gap will reach maximum displacement well before the use life of the system is achieved. At this point, significant cost decisions must be weighed to overcome the potential shortfall of having an overextended weapon system in the inventory.

2. Decision Options

Three options exist for a weapon system that is about to reach the limits of its useful life. The first is the buy back of availability. This is accomplished through the funding and implementation of a robust RESET program. This program effectively extends the designed hour limits of the system through component replacement and upgrade.

The second option is to continue to operate the system beyond its useful life. This option is often unacceptable due to the exponentially increasing cost of logistics support.

[27] Department of the Army, *Operational Requirements Document for the Modernized Longbow, Block III, Multi-Role Helicopter* (Fort Rucker, 2004), 6.

Historically, weapon systems become more difficult to maintain as they are operated beyond their useful life. This leads to less than acceptable levels of availability.

The third option involves the program initiation for a replacement system. The costs associated with a new system can reach into the billions of dollars. The most significant impact of this decision often comes from not making a timely commitment to a new system. Often times the DOD is operating in a period of overlapping options, future increasing costs.

E. CHAPTER CONCLUSION

The influences in Chapter III provide an interesting backdrop to the discussion presented in the previous paragraphs. Many weapon systems are beyond this point of service life decision. The DOD is faced with difficult choices brought on by accelerated depreciation at precisely the same time of anticipated budget reductions.

V. CONCLUSIONS AND RECOMMENDATIONS

A. CHAPTER OVERVIEW

The objective of this research project was to provide unit commanders with a valuable tool for maximizing Unit Mission Capability. This was accomplished through the detailed presentation of the APCO model. Additionally, this project provides a comprehensive look at the external factors that influence the APCO model. This chapter provides the recommendations and conclusions relevant to these presentations.

B. ANSWERS TO RESEARCH QUESTIONS

Secondary Question #1: What can the user community do to increase Unit Mission Capability?

The user community, specifically aviation unit commanders, can increase Unit Mission Capability through accurate management of system OPTEMPO. Chapter II demonstrates that the disciplined management of OPTEMPO will provide higher Unit Mission Capability. Additionally, chapter IV demonstrates that disciplined management contributes to the life support of the weapon system.

Secondary Question #2: What terms define Unit Mission Capability?

Weapon system availability, crew proficiency, cost management, and OPTEMPO define Unit Mission Capability. Chapter II demonstrates that these variables have a complex and interrelated relationship to each other. Availability and proficiency directly contribute to Unit Mission Capability. This represents the epic struggle between training and maintenance for aviation unit commanders. Although some of these factors are difficult to measure, e.g., proficiency, it is important to understand the relative relationship of each variable.

Secondary Question #3: How does the variability in OPTEMPO affect Unit Mission Capability?

OPTEMPO has a profound effect on Unit Mission Capability. OPTEMPO represents the independent variable in the APCO model. This holds true since a fluctuation in OPTEMPO influences each of the other variables. This is demonstrated in Chapter II. Commanders will face long-term availability challenges when OPTEMPO exceeds the rate established at inception of the weapon system.

Secondary Question #4: <u>How does weapon system availability affect Unit Mission Capability?</u>

Availability directly influences Unit Mission Capability. As defined in Chapter II, capability decreases as availability decreases. Commanders are able to sustain a high degree of proficiency when availability remains consistently above minimum standards. The opposite is true if availability is below minimum standard. Commanders need the right balance of weapon system availability and proficiency in order to achieve success in combat.

Secondary Question #5: <u>What external factors affect Unit Mission Capability?</u>

Factors outside the control of unit commanders also contribute to Unit Mission Capability. Chapter III indicates that the most significant external factor is funding. Many programs compete for government funding and funding for operations and maintenance is one of the few pots of money that Congress can touch each year. The funding level, or the flying hour program for aviation units, must be commensurate with stated Unit Mission Capability goals.

Primary Research Question: <u>How does an aviation unit commander maximize Unit Mission Capability?</u>

Aviation Unit Commanders must be aware of that factors that influence Unit Mission Capability. This includes both internal and external factors. The APCO model is a tool designed to assist commanders as they gain this necessary understanding.

The user community must understand how competing funding requirements influences their ability to train and maintain a strong fighting force. Current DOD funding levels will decline in the near future. It will become more and more difficult to achieve the desired state of Unit Mission Capability. Users must implement strategic cost saving initiatives to preserve our war fighting capability.

Commanders and users must implement strong management policies for weapon systems OPTEMPO. OPTEMPO affects Unit Mission Capability on a daily basis. Sustain over utilization results in the accelerated depreciation of weapon systems. This accelerated depreciation is costly in term of availability and proficiency. Chapter IV clearly demonstrates the effects of accelerated depreciation.

C. AREAS OF FURTHER RESEARCH

The scope of this report included using actual LBA availability and OPTMEPO data. Further research could include the study of unit data from older weapon systems. Proficiency and maintenance costs could also be included in this type of study. This would enable further development of the APCO model.

Funding was the primary external factors covered in this report. Further research could include other distracters that influence Unit Mission Capability. This type of study could include personnel tempo, training distracters, or unit structure. Sensitivity analysis could be used to determine which factor has the greatest impact.

Further research could include a study of the Unit Mission Capability of V-22 squadrons. These squadrons have unique challenges associated with shipboard operations. Additional variables and constraints influence this type of unit. This type of research would reveal the capability of the V-22 to accomplish required missions.

D. CONCLUSION

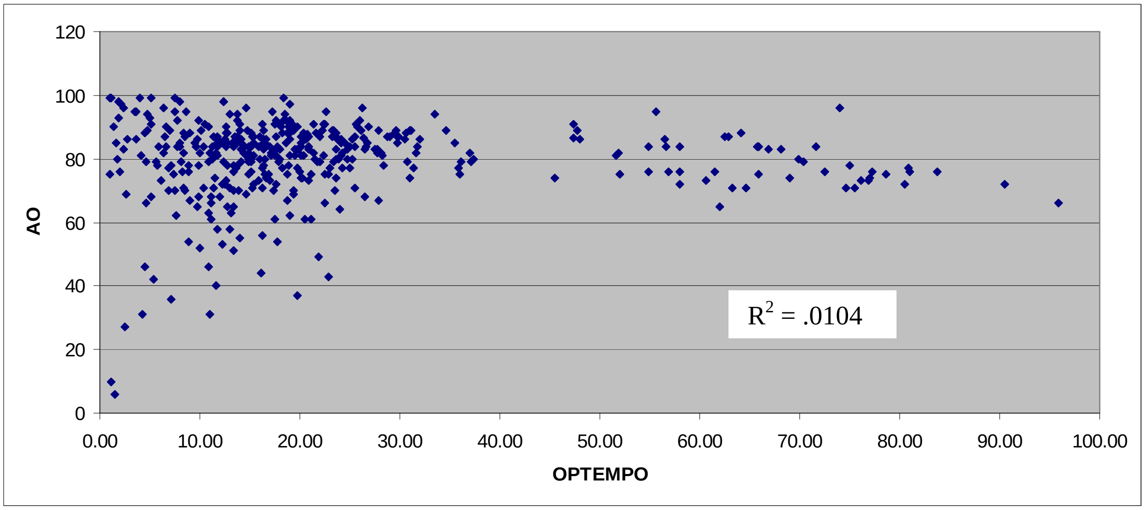
The highest level of Unit Mission Capability is the ultimate goal of any unit commander. Members of the user community, and especially unit commanders, must be aware of the factors that influence their war fighting capability and implement specific strategies designed to maximize Unit Mission Capability. The APCO model is an especially powerful decision making tool designed to assess Unit Mission Capability.

External factors will have a significant impact on mission capability in the years to come. DOD budgets in the future will be constrained and declining weapon system availability will influence a commander’s ability to achieve maximum Unit Mission Capability. Our aging fleet of weapon systems will not be able to avoid the effects of accelerated depreciation. The efficient management of OPTEMPO is the responsibility of the user community. OPTEMPO management is the key to sustaining a unit's mission capability.

APPENDIX: DATA ANALYSIS RESULTS

FULL DATA SET

The first data set used to establish the parameters of the availability curve included all 411 data points. The correlation coefficient indicates that no relationship exists between Ao and OPTMEPO.

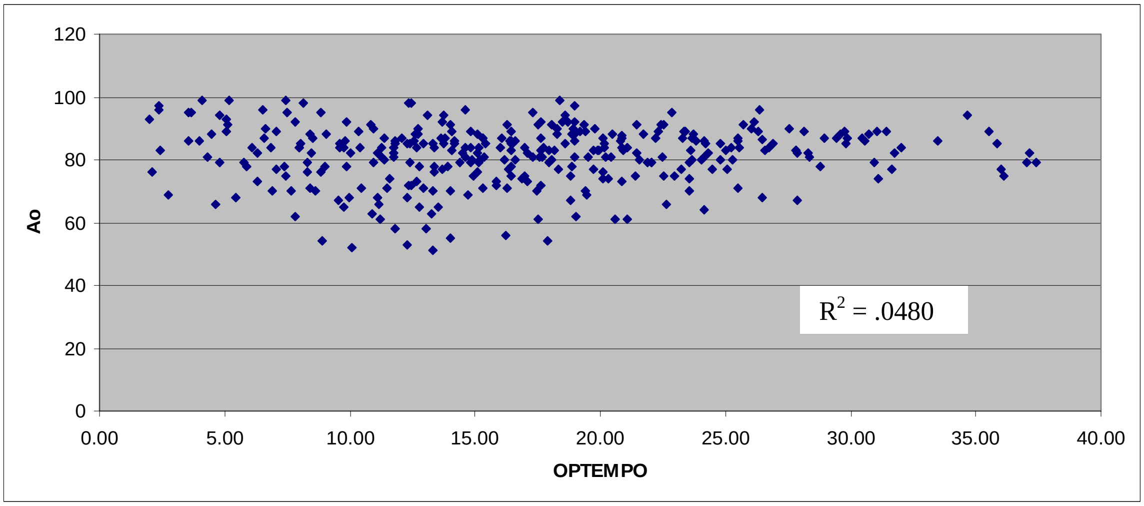


FILTERED DATA SET

The second data set incorporated a number of refinements designed to eliminate inconsistencies. The data points that exceeded the following limits were excluded:

1. OPTEMPO less than 2.00 hours per month
2. OPTEMPO greater than 40.00 hours per month
3. Availability less than 50 percent
4. This data set consists of 336 data points.

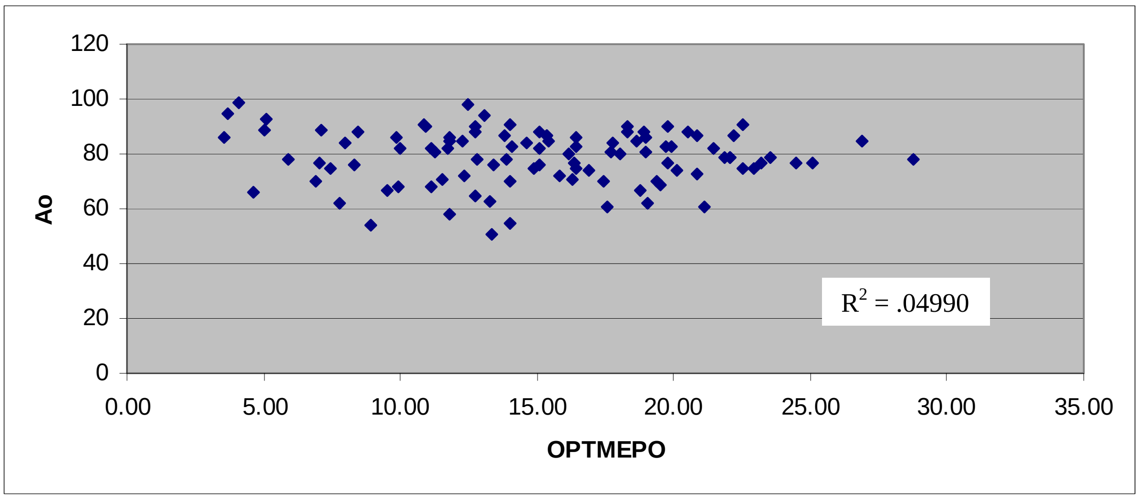
The correlation coefficient indicates that no relationship exists between Ao and OPTMEPO.



LIMITED DATA SET

The third data set incorporated an additional refinement intended to eliminate further inconsistencies. The period of the data was restricted to peacetime only by eliminating availability and OPTEMPO data point beyond July 2002. This data set consists of 101 data points.

The correlation coefficient indicates that no relationship exists between Ao and OPTMEPO.



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