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Should the United States Army Procure  
the Total Quantity of Black Hawk Helicopters  
it Requires?

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The Bottom-Up Review established the Army force structure requirement to be four corps and fifteen divisions. As a result of the Bottom-Up Review, procurement of Black Hawk helicopters was cancelled at the end of fiscal year 1996. This leaves the Army with a dilemma of whether to pursue programming procurements of the Black Hawk in the fiscal year 1996-2001 Program Objective Memorandum (POM) or to retain a mixed fleet of Black Hawk and UH-1H helicopters. This thesis does a comparative analysis of the Black Hawk and UH-1H to determine capabilities and cost differences that exist, and provides an analysis of their ability to perform Army utility helicopter doctrinal mission requirements. The results of the analysis suggest that based on current doctrinal requirements and force structure levels, the Army should continue to procure the Black Hawk helicopters needed to met the requirement of 2195 Black Hawks determined by the Bottom-Up Review.

Army Force Structure, Aviation Restructure Initiative,  
Bottom-Up Review, the Army Plan, Army Aviation Modern-  
ization, Plan

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SHOULD THE UNITED STATES ARMY PROCURE  
THE TOTAL QUANTITY OF BLACK HAWK  
HELICOPTERS IT REQUIRES?

A thesis presented to the Faculty of the U.S. Army  
Command and General Staff College in partial  
fulfillment of the requirements for the  
degree

MASTERS OF MILITARY ART AND SCIENCE

by

ROBERT W. KENNEALLY, Jr., MAJ, USA  
B.A., Saint Anselm College, Manchester, New Hampshire 1980

Fort Leavenworth, Kansas  
1994

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The opinions and conclusions expressed herin are those of the student author and do not necessarily represent the views of the U.S. Army Command and General Staff college or any other government agency. (References to this study should include the foregoing statement.)

## ABSTRACT

SHOULD THE UNITED STATES ARMY PROCURE THE TOTAL QUANTITY OF BLACK HAWK HELICOPTERS IT REQUIRES? By MAJ Robert W. Kenneally, Jr., USA, 115 Pages.

This study investigates whether the Army should procure the total quantity of Black Hawk helicopters needed to meet Bottom-Up Review Army force structure requirement of four corps and fifteen divisions. Procurement of Black Hawk helicopters was canceled at the end of fiscal year 1996. This leaves the Army with a dilemma of whether to pursue programming procurements of the Black Hawk in the fiscal year 1996-2001 Program Objective Memorandum (POM) or to retain a mixed fleet of Black Hawk and UH-1H helicopters.

This thesis does a comparative analysis of the Black Hawk and UH-1H to determine capabilities and cost differences that exist, and provides an analysis of their ability to perform Army utility helicopter doctrinal mission requirements. The results are intended to be provided to Headquarters Department of the Army, Deputy Chief of Staff for Operations and Plans, Aviation Force Development Office (DCSOPS) for use in their effort to resolve the modernization issue of the Black Hawk versus the UH-1H.

The results of the analysis suggest that based on current doctrinal requirements and force structure levels, the Army should continue to procure the Black Hawk helicopters needed to meet the requirement of 2195 Black Hawks determined by the Bottom-Up review.

#### ACKNOWLEDGMENT

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## LIST OF ACRONYMS

|         |   |
|---------|---|
| AAAA    | Army Aviation Association of America                            |
| AAMP    | Army Aviation Modernization Plan                                |
| ARI     | Aviation Restructure Initiative                                 |
| CARL    | Combined Arms Research Library                                  |
| CINC    | Commander in Chief  |
| COEA    | Cost and Operational Effectiveness Analysis                     |
| DAMPL   | Department of the Army Master Priority list                     |
| DCSOPS  | Deputy Chief of Staff for Operations and Plans                  |
| HUEY    | UH-1H Helicopter  |
| MNS     | Material Need Statement   |
| ODCSOPS | Office of the Deputy Chief of Staff for Operations<br>and Plans |
| ORF     | Operational Readiness Float                                     |
| PPBS    | Planning, Programming and Budgeting System                      |
| POM     | Program Objective Memorandum                                    |
| QMDC    | Qualitative Material Development Objective                      |
| RCF     | Repair Cycle Float  |
| SI      | Systems Integrator  |
| SLEP    | Service Life Extension Program                                  |

TAA            Total Army Analysis

TDA            Table of Distribution and Allowances

TOE            Table of Organizational Equipment

TAP            The Army Plan

TRADOC        Training and Doctrine Command

UTTAS         Utility Tactical Transport Aircraft System

## CHAPTER 1

### INTRODUCTION

#### Thesis Question Development

The purpose of this thesis is to analyze whether the Army should procure the remaining shortfall of Black Hawk helicopters required to meet Army force structure requirements. The thesis will focus on capabilities and costs of the Black Hawk versus the UH-1H helicopter to meet the Army's utility helicopter doctrinal mission requirements. The thesis will not consider service life extension programs for the UH-1H as part of the analysis because Training and Doctrine Command has not recognized a requirement for this type of program.

The Black Hawk helicopter is the primary utility helicopter for the U.S. Army. This fact is highlighted in the Army's Black Hawk Material Need Document where it is stated that "During war, the Black Hawk will provide the primary means by which the Army will conduct airmobile operations in all intensities of conflict."<sup>1</sup> The Black Hawk helicopter was developed in the 1970's as a replacement for the UH-1H utility helicopter. The UH-1H was a commercially

produced helicopter procured by the Army for use in the Vietnam War and was not developed based on military mission requirements. The evolving role of the utility helicopter in the implementation of Army doctrine since the Vietnam War led to the development of a Material Need Document that established requirements for a replacement for the UH-1H. As a result of the Material Need Document, the Black Hawk helicopter was produced to meet doctrinal performance requirements established by the Army.

The role of the Black Hawk today is to provide mobility on the modern battlefield throughout the range of the Battlefield Framework (deep, close, rear, security, and reserve operations) in support of AirLand Battle Doctrine. This means that the AirLand Battle doctrine established in Field Manual 100-5, Operations, relies on the mobility capability the Black Hawk provides in the implementation of Army Doctrine in a Force Projection environment. The missions of the Black Hawk helicopter include air assault operations, aero medical evacuation (MEDEVAC), command and control of battlefield operations, and general support operations. These missions rely on the assumption that a system is available with the capabilities required to implement established doctrine. In this case the system developed to meet the established requirement is the Black Hawk helicopter.

There are differing opinions on the dilemma whether to procure all the Black Hawks required or fill force structure shortages by retaining the UH-1H. These two schools of thought are basing their positions on different criteria. The procurement position recognizes doctrinal requirements and the capabilities of the Black Hawk helicopter to meet those requirements. While those who wish to retain the UH-1H are under the impression that cost savings will be realized by retaining the UH-1H and canceling the procurement of the Black Hawk. An analysis of the validity of these two positions will be the focus of this thesis.

Adding to the dilemma is the elimination of funding for the Black Hawk helicopter beyond 1996. This decision was made as a result of the Bottom-Up Review conducted by the Office of the Secretary of Defense. The next step for the Army is to address the Black Hawk funding dilemma for the next Program Objective Memorandum (POM) covering the period 1996 through 2001. The importance of the next Program Objective Memorandum (Fiscal Year 1996-2001) is that a decision to support continued procurement of the Black Hawk or retain the UH-1H in the force structure will have to be made. The Army's modernization programs are based on doctrine that supports the National Security and National Military Strategies of Forward Presence and Continental United States (CONUS) based Force Projection. The

capability of the Army to accomplish its doctrinal requirements will either be enhanced by continued procurement or limited with retention of the UH-1H.

Therefore, since the Black Hawk is not currently programmed for procurement of the total requirement beyond 1996, this thesis will address the research question: Should the US Army procure the total quantity of Black Hawk helicopters it requires?

#### Qualifications

My qualifications to complete a thesis on the US Army's procurements of Black Hawk helicopters include working from 1991 through 1993 for the Department of the Army Staff in the Deputy Chief of Staff for Operations and Plans (DCSOPS) office as the Systems Integrator (SI) for the Black Hawk helicopter. My responsibilities included establishment of the Army requirement in coordination with Training and Doctrine Command, working with the Utility helicopter Program Managers office to develop the procurement strategy and development of distribution plans for the Black Hawk helicopter. My experience as the Black Hawk Systems Integrator highlighted the importance of the need to procure all the Black Hawks required because of the diverse roles and missions the Army uses the helicopter to implement National Security Strategy throughout the world. Examples of the Black Hawk meeting the contingency mission

demands are operations conducted in Grenada, Operation Just Cause, Operation Desert Storm, and Operation Restore Hope.

### Problem Statement

The Black Hawk helicopter procurement thesis generated from my work at Headquarters, Department of the Army (HQDA) as the Black Hawk helicopter Systems Integrator (SI). The thesis question was posed several times during my tenure as the Black Hawk SI by the Deputy Chief of Staff for Operations and Plans (DCSOPS) of the Army, The Secretary of Defense and Congress. The thesis question's focus is on the modernization of the Army's utility helicopter fleet. The modernization goal of Army Aviation does not support a mixed fleet of Black Hawks and UH-1H helicopters to meet force structure requirements. That modernization goal is "the continued strategy of replacing older, technologically obsolete aircraft with fewer, more capable aircraft."<sup>2</sup> For the Army to support its modernization focus, the thesis will consider the affordability of procuring the shortfall of Black Hawks over retaining UH-1H helicopters in the inventory. To support the modernization strategy of the utility helicopter fleet, the Army needs to address the affordability of the modernization strategy during the development of the Fiscal Year 1996 to Fiscal Year 2001 Program Objective Memorandum (POM). What needs to be determined for the Program Objective Memorandum (POM)

submission is which alternative maximizes capabilities and minimizes costs to support the national military strategy. From this determination, the Army can focus its efforts in formulating the Army's submission for the President's Budget on the most affordable course of action for modernization of the utility helicopter fleet. This affordability of utility helicopter fleet modernization issue needs to be addressed in the Army Planning, Programming, Budgeting, and Execution System (PPBES). The decisions required from the PPBES process, on the issue of affordability of the Black Hawk versus retaining the UH-1H, should be made in the next POM cycle. This thesis will provide a comparative analysis of the Black Hawk and UH-1H to determine the capabilities and cost differences that exist between the two helicopters. This thesis will also provide an analysis that can be used by DCSOPS Aviation Force Development in their effort to resolve the modernization issue of the Black Hawk versus the UH-1H.

To provide background information to build the thesis position, one must be familiar with the fact that developments in doctrine and the advent of technological advancements since the Vietnam experience led to the development of the Black Hawk helicopter. Black Hawk procurements and fieldings have been ongoing since 1977 and are programmed to continue through 1996. The Black Hawk program development is illustrated in Figure 1, page 94.

The end of the Cold War impacted U.S. National Military Strategy and led to the Department of Defense initiating a Force Structure review titled the Bottom-Up Review completed in September 1993. The Bottom-Up Review was done "to determine the Force Structure Options and Modernization Choices which have to be made in response to the changing world environment."<sup>3</sup> Because of the changing world environment and,

the threat posed by the increasing number of potentially hostile states developing weapons of mass destruction, maintenance of a modern, fully capable, and reliable strategic deterrent remains the number one defense priority of the United States.<sup>4</sup>

The transition from the Cold War era to the New World environment impacts on the modernization of the Army's utility helicopter fleet by resulting in the cancellation of Black Hawk helicopter procurement at the end of 1996, when the current Multi-Year IV procurement contract is completed. The Office of the Secretary of Defense's decision to cancel programmed procurement of the Black Hawk helicopter after 1996 was not because force structure requirements were met, but was a result of an affordability issue. It has not been determined if the continued procurement of the Black Hawk is affordable in the sense that procurement and sustainment costs of the Black Hawk versus the UH-1H exceed the capabilities gained by purifying the utility helicopter fleet with Black Hawk helicopters.

Since the budget process is a two year cycle this decision impacts the current Program Objective Memorandum (POM) covering the period 1994 through 1999. However, this decision will have an opportunity to be re-addressed in the next POM cycle covering the period 1996 through 2001. The POM Cycle is flexible and adjusts to the changing threats to United States National Security. The mechanism that supports this flexibility is governed,

Under biennial Planning, Programming, and Budgeting and Execution System (PPBES) procedures, POM's will be submitted in even-numbered years in April.<sup>5</sup>

The significance of this cyclic system is the ability of the Army to adjust equipment modernization priorities over time to support doctrinal changes resulting from current threats.

With the procurement of Black Hawk helicopters programmed to end in 1996, the Army will be faced with a shortage of required replacements for the Vietnam era UH-1H. The shortage of Black Hawks will require the balance of UH-1H helicopters to remain in service to support current and future force structure requirements. The inability of the UH-1H to meet mission requirements combined with the end of the procurement of Black Hawk helicopters in 1996 leaves the Army with the problem of how to modernize the utility helicopter fleet. This thesis will analyze the Utility Fleet Modernization problem to determine if the Army should continue to procure Black Hawk helicopters to meet the Army's requirement.

The requirement for utility helicopters to meet Bottom-Up Review and Aviation Restructure Initiative force structure changes is determined by five categories which are depicted in Figure 2, page 95. These categories consist of force structure Table of Organizational Equipment (TOE), Operational Readiness Float (ORF), Repair Cycle Float (RCF), Table of Distribution and Allowances (TDA), and Attrition replacement helicopters. The TOE helicopters are mission helicopters that perform Air Assault, Command and Control, Medical Evacuation, and General Support missions. The ORF and RCF helicopters are maintenance requirements that are used as spares to rotate TOE helicopters that require repairs for the Army to meet readiness rates established for the Black Hawk. The TDA helicopters are required to support crew training and helicopter testing requirements. Attrition helicopters are required to replace those that are destroyed over the service life of the helicopter. These five categories combine to establish the total force structure requirement for Black Hawk helicopters.

In 1993 Training and Doctrine Command developed the Aviation Restructure Initiative (ARI). This initiative was Aviation Branches reaction to the downsizing of the Army, and it is designed to meet five major objectives.

First, the aviation structural design deficiencies created by the 1985 Army of Excellence (AOE) were corrected. Second and third, logistics requirements and cost were significantly reduced. Fourth, the entire aircraft fleet was modernized by retiring obsolete

airframes. Finally, all objectives were to be accomplished while remaining within resource constraints.<sup>6</sup>

The impact of the Aviation Restructure Initiative on the Black Hawk requirement was a reduction from 2252 to 2195 Black Hawk helicopters.

The Bottom-Up Review determined the Army force structure would consist of four corps and fifteen divisions (ten active and five reserve). The quantity of Black Hawks required to support this force structure projection is 2195. The Bottom-Up Review force structure is depicted in Figure 3, page 96. The current Black Hawk procurements scheduled through 1996 total 1513 Black Hawks delivered to the Army since 1977. With the current requirement, the Army will have a shortfall of 682 Black Hawk helicopters at the end of 1996 to meet projected Bottom-Up Review force structure requirements.

It is important to understand that replacement of UH-1H helicopters is not on a one-for-one basis in all cases. For an assault helicopter company 15 Black Hawks are required. When Black Hawks are not available 23 UH-1H's are substituted in an effort to compensate for the lost capabilities required for mission support. This study will show the difference in capabilities and costs between the UH-60 and UH-1H helicopters and how those differences relate to the Army's utility helicopter Material Need Document requirements. The difference in capabilities translates to

fewer quantities of helicopters required in the force structure and leads to retirement of the older UH-1H helicopters that are reaching the end of their service life. The reduction of the number of aircraft in the force structure also decreases quantities of personnel and equipment requirements. These force structure quantity reductions result in training savings and reduced sustainment costs. To develop a resolution to the thesis question a comparative analysis of the UH-60 and the UH-1H will be presented. From the results, a conclusion will be reached and a recommendation addressing whether the Army should procure the shortfall of required Black Hawks helicopters will be provided.

This thesis centers on the Army's ability to execute its doctrine by having equipment capable of supporting that doctrine. The fact that the Army has a shortfall in Black Hawks to meet its doctrinal requirements is the central issue this thesis analyzes. Whether the Army should continue procurement of the Black Hawks or retain UH-1H helicopters in the fleet will be determined through a comparison of the capabilities and costs of the two helicopters to recommend the course of action that best supports doctrinal requirements. The analysis is based on the position that the Army needs to maximize capabilities and minimize the costs of modernizing the Utility helicopter fleet. The need to focus this thesis on capabilities is

illustrated in an article in the 31 October 1993 edition of Army Aviation Association of America magazine that states,

We must continue to develop technologies that keep pace with the lethality of the modern battlefield, and then ultimately, bring these programs to maturation in a timely, cost effective manner, in order to modernize our total force and maintain our current capability to overmatch our enemies.<sup>7</sup>

The nature of the thesis problem is founded on the requirement to modernize the utility fleet and balance the necessity to prioritize the procurement of systems. The process the Army follows to deal with this dilemma is the Planning, Programming, Budgeting, and Execution System (PPBES). PPBES provides the focus on determining affordability of weapon systems in the Department of Defense. The affordability of the continued procurement of Black Hawk helicopters or retention of a mixed fleet containing UH-1H helicopters is a major factor impacting the Fiscal Year 1996-2001 POM Cycle decision. The affordability issue will be analyzed in the cost comparison portion of the thesis.

The scope of the modernization problem can best be described by highlighting the disparity between the requirement and the programmed procurement quantity of Black Hawks. The Army's shortfall of 682 Black Hawks has a significant impact on the Army's capability to execute its doctrine and impacts on the Army's ability to meet force structure requirements in a cost effective manner. This

shortfall has implications in the support of National Security Strategy in that the National Command Authorities (NCA) will be in a position of accepting risk in the area of the Army's capability to support all requirements identified for Force Projection throughout the World.

#### Importance of the Problem

This thesis is important because the problem of modernizing the Army with equipment required to implement Army Doctrine remains unresolved. The intent of this thesis is to provide DCSOPS, Aviation Force Development office, a study that will contribute to the development of future Aviation Modernization Plans. Also, by providing the analysis of the problem and formulating a recommendation; this thesis may be used to resolve the affordability dilemma of procuring all required Army Black Hawk helicopters.

To conduct the analysis several functional areas require consideration in determining a solution to the problem statement. The following functional areas are derived from the Army Command and Management, Theory and Practice reference text: "structure, equipping, training, manning, sustaining, mobilizing, deploying and warfighting."<sup>8</sup> These considerations are all related to the Department of Defense Planning, Programming, and Budgeting System (PPBS) and the Army's Planning, Programming, Budgeting, and Execution System (PPBES) which provides

resources to support the warfighting Commander in Chiefs (CINCs).

There are subcategories that will be discussed. These subcategories provide factors necessary to analyze the thesis problem. An analysis of these subcategories should provide the data necessary to form a conclusion and to recommend a resolution to the problem. These subcategories are key considerations that will guide the thesis.

The subcategories for structure are: doctrine, design, and requirements. Doctrine is the guidance that establishes requirements for the Black Hawk helicopter as a centerpiece in Force Projection. Design refers to the force structure draw downs that are evolving as a result of the end of the Cold War and is being considered in the Department of Defense's Bottom-Up Review. These Force Structure designs are validated through the Total Army Analysis (TAA) process at Headquarters Department of the Army. The Army's senior leadership guidance for the TAA process is generated by the Force Development (FD) Process. The Force Development process,

consists of defining military threats, designing force structures capable of deterring or defeating these threats, translating organizational concepts based on doctrine, technologies, material and manpower requirements, and limited resources into the shaping of a quality Army.<sup>9</sup>

These requirements established in the Force Development process support the Warfighting Commander in Chiefs (CINC's)

needs for implementing United States Army Doctrine. It is important to understand that force structure requirements must be properly equipped to execute missions in accordance with Army Doctrine. The Army's inability to meet these equipment requirements would result in the need to re-visit established doctrine or change the Force Structure requirements.

The subcategories for equipping are: acquisition and distribution. Acquisition is managed through the Defense Planning System and establishes the priorities which are supportable within the funding levels established by the National Command Authority (NCA) and Congress. In order for the acquisition of a system to occur, the system must be funded. Distribution is the process that provides the warfighting CINC with limited assets in priority order established by the Department of the Army Master Priority List (DAMPL).

The subcategories for training are: initial entry, specialty, professional and unit. Initial entry refers to the new pilots, crew chiefs and maintenance personnel. These personnel must be programmed three years before they are required. This accounts for many factors that must be coordinated to field a trained crew for the Black Hawk. The funds must be programmed to support the schools, flying hours and training simulators. Specialty training for maintenance personnel is crucial to supporting the Black

Hawk helicopter throughout the world. Professional training for the leadership to employ the asset in support of doctrine is essential to success on the battlefield. Unit training is the culmination of the decision to procure the Black Hawk in sufficient quantities to meet the requirement.

The subcategories for manning are: accession, assignment, and progression. Accession determines the quantity of personnel required to support the force structure. It is an element in the formula of sustainment of the Black Hawk that is driven by the quantities procured and fielded. Assignments and progression are determined by the quantity of the requirement fielded. Since force structure must be filled, it is important for personnel management that the modernization plan be established on how the Army will modernize the Utility helicopter fleet.

The subcategories for sustaining are: supply and maintenance. Supply has a large cost related to it that can be minimized with standardization. Standardization of fielded systems reduces the types and quantities of parts required to sustain the system. Maintenance is key due to the types of personnel and facilities required to sustain the Black Hawk. These all have associated costs that must be considered to determine if savings through eliminating the UH-1H helicopter will offset procurement of the Army's requirement for the Black Hawk helicopter.

The key consideration for mobilization and deployment is that the Army's Force Structure is fielded with systems that are capable of meeting our Doctrine of providing a force projection capability throughout the world. The key consideration for warfighting is to provide the CINCs with the equipment they require to implement the approved doctrine of the US Army in support of National Security Strategy and National Military Strategy.

#### Primary Question

Should the US Army procure the total quantity of Black Hawk helicopters it requires?

#### Secondary Questions

What are the differences in capabilities of the Black Hawk and the UH-1H?

Are there significant sustainment cost differences between the Black Hawk and UH-1H?

What are the risks and trade-offs associated with the problem of retaining UH-1H's in force structure?

Should a Multi-Year contract for procurement of Black Hawks beyond 1996 be considered for funding?

#### Assumptions

Army Aviation force structure must be filled with a system capable of supporting mission requirements.

Force Structure will not be reduced to equal the current quantity of Black Hawk helicopters programmed for procurement.

The Aviation Restructure Initiative (ARI) requirement established for Black Hawk helicopters through the Total Army Analysis (TAA) Fiscal Year 2001 process is valid.

The force structure shortage of UH-60's will have to be filled by UH-1H helicopters unless the Army continues to procure UH-60's.

#### Key Terms

These key terms are provided for clarification and to assist in understanding the context in which they are used throughout the thesis.

Army Doctrine. "The statement of how America's army as part of a joint team intends to conduct war and operations other than war...."<sup>10</sup>

Aviation Restructure Initiative (ARI). This is Army Aviation's effort to comply with the downsizing requirements the Army is facing. This was developed by TRADOC at Fort Rucker and is scheduled for implementation beginning in Fiscal Year 1995.

Bottom-Up Review. A study done by the Department of Defense in response to the end of the Cold War and the associated reduction of military budgets. The review is a

"Strategy to address dangers and seize opportunities in Force Structure Options and Modernization Choices."<sup>11</sup>

Cost and Operational Effectiveness Analysis (COEA).

a study directed to determine if a system is performing to the standards directed in appropriate requirement's documents.

Program Objective Memorandum (POM). This is the services product of the program development process that supports the development of the Presidents Budget Submission for defense acquisitions. The military departments "send POMs to the Secretary of Defense in the spring of even-numbered years."<sup>12</sup> These identify major issues that must be resolved during the year of submission.

Anticipated Problems

The military force structure decisions are still subject to change and could impact on the development of this thesis. The solution to this issue is to establish the cutoff for force structure changes that will be considered in this thesis as the Bottom-Up Review publishing date of 1 September 1993.

One problem with this approach is determining an affordable solution to the thesis that supports current force structure, is compatible with Army equipment priorities and could be implemented within current funding levels.

Another problem is ensuring thesis solutions are based on the modernization priorities established by HQDA, ODCSOPS, Aviation Force Development office.

A problem could be identifying changes in the Aviation Restructure Initiative that might have an impact on this thesis. The solution to this problem is to coordinate with TRADOC representatives at Fort Rucker, Director of Combat Developments to monitor the Aviation Restructure Initiative implementation efforts.

#### Likely Solutions

There are two likely solutions to the problem that may be suggested. The first is to procure the total quantity of Black Hawk helicopters that the Army requires and retire all UH-1H's. The second is to accept risk in one or more areas of force structure requirements for Black Hawks (TOE, Medical Evacuation, TDA, ORF, RCF, and Attrition). The acceptance of risk in force structure shortfalls would result in the elimination of Black Hawk procurements in Fiscal Year 1996 and would require the retention of a quantity of UH-1H helicopters in the fleet to fill force structure shortfalls.

## CHAPTER 2

### LITERATURE REVIEW

#### Survey of Work in the Field

A survey of the current states of publications in the field of Army utility helicopters revealed a large and varied quantity of sources in a variety of organizations and locations. Some of the more authoritative organizations include Headquarters Department of the Army, United States Army Training and Doctrine Command, The Utility Helicopter Program Manager's Office, and the Combined Arms Research Library (CARL). References used for the analysis outlined the historical development of Army doctrinal requirements for a utility helicopter. The patterns identified stem from the use of UH-1H helicopters in Vietnam to rapidly move troops into combat by overcoming the obstacles of jungle and mountains with the helicopter. This tactic developed over time to be incorporated into AirLand Battle Doctrine developed since Vietnam. The Army's recognition of the need for a utility helicopter designed to meet military mission specifications to exploit the third dimension of warfare, led to Training and Doctrine Command developing the requirements documentation in the early 1970's needed to

develop the utility helicopter capability. This doctrinal evolution resulted in the development and fielding of the Black Hawk helicopter beginning in 1977. These patterns drawn from the literature review established a strong movement in Army doctrine since Vietnam to incorporate the utility helicopter throughout the Battlefield Framework of deep, close, rear, security and reserve operations through Air, Land Battle Doctrine.

#### Key Works in the Field

Significant documents that assisted the research were: The Army Plan, Total Army Analysis, The Bottom-Up Review, The Black Hawk Material Need Document, Qualitative Material Development Objective (QMDO), The National Security of the United States, The National Military Strategy of the United States, the U.S. Army's doctrinal manual FM 100-5 Operations, The United States Army Modernization Plan (Annex L Aviation), The Joint Officers Staff Guide 1993, Army Command and Management Theory and Practice, and several Army Aviation Association of America magazine articles.

The Army Plan (TAP) "documents Army leadership policy and provides resource guidance."<sup>13</sup> The Army Plan established the program force approved by the Secretary of the Army and the chief of Staff of the Army. It incorporated the results of the Secretary of Defense's Bottom-Up Review and established the four corps and fifteen

division Army force structure that the analysis of the thesis question is predicated.

Total Army Analysis (TAA) is,

used to develop for each program year a proposed program force that best meets projected mission requirements within anticipated end strength and equipment levels and unalterable earlier decisions.<sup>14</sup>

This was helpful in providing the quantities of Black Hawks that would be programmed for procurement through the POM period and established the detailed end strength requirements of Black Hawk helicopters.

The Bottom-Up Review provided the "strategy to transition from Post-Cold War World to address the new Dangers and a plan to seize new opportunities."<sup>15</sup> The Bottom-Up Review provided the methodology of the Major Regional Conflict Force Options that clarified the National Security and National Military Strategy of Forward Presence and Force Projection as the policy to prepare for the future threats facing the nation.

The Black Hawk Material Need Document is the cornerstone of the material acquisition process. This document originated as the Utility Tactical Transport Aircraft System (UTTAS) in 1976, it established the Army's material need for a utility helicopter that could meet the doctrinal requirements established since the Vietnam war. In 1979, the Utility Tactical Transport Aircraft System Material Need document was updated to reflect the decision

to Acquire the Black Hawk helicopter as the system that meets the Utility Tactical Transport Aircraft System Material Need requirements. The 1979 Material Need document provided the information required to establish the parameters by which to analyze the comparison between the Black Hawk and UH-1H capabilities and cost differences. The 1979 Material Need document not only is the cornerstone of the material acquisition process for the Black Hawk, it provided the requirement parameters which established the baseline for the analysis of the thesis question.

The National Security Strategy of the United States is a document that establishes the Presidents guidance on the national security interests and objectives of the United States from which all National Military Strategy follows. The National Security of the United States document was useful in understanding how the National Military Strategy of the United States was developed. This clarified the purpose of Army doctrine and led to a better understanding of the utility helicopter role in supporting Army doctrine.

The National Military Strategy of the United States is a document that is developed by the Chairman of the Joint Chiefs of Staff to provide,

the President, the National Security Council and the Secretary of Defense as to the recommended national military strategy and fiscally constrained force structure required to support attainment of national security objectives.<sup>16</sup>

This document was useful in providing an understanding of how Army doctrine supports the National Military and National Security objectives of the United States.

The U.S. Army's doctrinal manual FM 100-5, Operations, "furnishes the authoritative foundation for subordinate doctrine, force design, material acquisition, professional education, and individual and unit training."<sup>17</sup> FM 100-5, Operations is the doctrinal product that defines how the Army will support National Military Strategy that in turn supports National Security Strategy. This manual provided the doctrinal guidelines on which the analysis of the thesis question was conducted.

The United States Army Modernization Plan (Annex L Aviation) provided the insights into the importance of the funding shortfall and directed the research to conduct a comparison of the Black and UH-1H capabilities and costs in support of Army doctrinal mission requirements. The Army Modernization Plan "provided a comprehensive review of aviation modernization."<sup>18</sup> This document translated Army doctrine into aviation requirements and established the guidance needed to further analyze the thesis question.

The Joint Officers Staff Guide 1993, Army Command and Management Theory and Practice provided the guidance needed to "explain how our Army supports national military strategy"<sup>19</sup> and explained the Army Planning, Programming, budgeting, and Execution System so that I had a better

understanding of how modernization of force structure through acquisition of equipment was accomplished.

Army Aviation Association of America magazine articles were used to fill the gap between official publications and the current Training and Doctrine Command and Army Aviation Center changes are being incorporated into the downsizing of Army Aviation.

The Qualitative Material Development Objective (OMDO), written in 1965, further defined the requirement for a utility helicopter to support the changing Army Doctrine of Air Mobility, a concept developed out of the Vietnam war. Limitations of ground movement and the need to project power at the tactical level, across long distances, in a short time resulted in the requirement for a utility helicopter for this mission. This requirement resulted in the procurement of an off-the-shelf helicopter (UH-1 HUEY) to support emerging doctrine. The lessons learned have resulted in a wealth of literature that will provide the framework for the approach to research on my thesis.

Other literature considered were requirements documents produced by the Defense Planning System which are submitted by the warfighting CINCs to facilitate development of equipment to support Operations Plans and Contingency Plans as part of the Force Projection Army. These requirements documents were helpful guides in developing the thesis problem. Further development of doctrinal

requirements resulted in the initiation of the Combined Arms and Support Study in 1975. By defining the requirement, a need was approved in 1976 which furthered the research and development of the Black Hawk helicopter. That document is the Utility Tactical Transport Aircraft System (UTTAS) Material Need Statement (MNS). The result of this effort was the UH-60 Black Hawk Material Need Statement (MNS).

From the MNS the Black Hawk was developed to meet the Army's utility helicopter mission requirements. The Black Hawk has been in production at varying procurement rates since 1977 and is scheduled to continue the current Multi-Year contract through 1996. The Army's procurement strategy has resulted in an incremental modernization of Army Aviation Force Structure with Black Hawk helicopters.

Training and Doctrine Command (TRADOC) provided many writings in the form of professional articles published in military periodicals such as Army Aviation Association of America (AAAA) Magazine and Jane's Defense Weekly. Also, government studies defined the requirements leading to the development of the Black Hawk. One study that was particularly helpful was the Utility Tactical Transport Aircraft System (UTTAS) Cost and Operational Effectiveness Analysis (COEA) Review conducted by TRADOC in 1980, that compares the Black Hawk and UH-1H capabilities and costs. This study was done because,

the House Armed Services Committee has requested that the Army certify that the Black Hawk is still the most cost effective alternative to fulfill each of the missions for which it is being procured.<sup>20</sup>

The results of the Training and Doctrine Command's Utility Tactical Transport aircraft System Cost and Operational Effectiveness Analysis Review showed that:

The UH-60A is the dominant aircraft alternative, when considering both cost and operational effectiveness in all the missions for which the alternative aircraft were analyzed, resulting in the UH-60A being the preferred alternative.<sup>21</sup>

This document served as an invaluable resource of data required for the cost analysis comparisons.

Transcripts from Congressional Hearings on the development of the Defense Budget provided the insight into the priorities congress feels are important enough to support. These hearings provided insights into trends for support of the continuation of the Black Hawk program and the continued retirement of the UH-1H helicopter. The affordability of the Black Hawk versus the UH-1H was highlighted in these documents and a sensing of what congress would support was gleaned to determine the degree of political support there is in congress for the priorities of the Army.

#### Patterns of Knowledge in the Field

Apparent trends and their relationship to the study are reflected in the current fielding and continued procurement of the Black Hawk helicopter. The Army trend is

to continue to upgrade the Black Hawks capabilities to meet changing mission needs of the warfighting CINCs. The relationships of these trends to the study are centered on the rate of production and the time required to meet the total procurement objective. The current production rate is sixty Black Hawks per year. The time required to field the total requirement of 2195 extends out through Fiscal Year 2010.

An additional trend that relates to this study is the continued downsizing of the military. The end state for the Army Force Structure is not finalized. The relationship of this trend to the study is that the force structure reductions will not significantly impact on the study due to the large shortage of Black Hawks to meet force structure requirements.

The research in the field to date reflects recognition of the importance of the requirement for Black Hawk helicopters to be fielded to replace the UH-1H. However, the issue of capabilities verses cost and the risk associated with not procuring the total requirement is the dilemma that seems to hold consistent throughout all the authoritative documents reviewed. This study provides the analysis of capabilities versus costs from the perspective of attempting to normalize the differences between the two helicopters. Normalizing the differences is an effort to close the gap between the capabilities and cost differences

that exists between these two helicopters for the purpose of conducting a comparative analysis. From the comparative analysis recommended solution is offered to the thesis problem of should the Army procure the remaining Black Hawk helicopters required and support modernization of the Army's force structure to meet doctrinal requirements.

## CHAPTER 3

### RESEARCH DESIGN

The research design for this thesis is based on the procedures outlined in the text:

Army Command and Management, Theory and Practice.... This text discusses the major Army systems and processes that provide the nation with the best Army it will afford.<sup>22</sup>

This text provides the structure necessary to develop an answer to the thesis question, analyze the modernization plan for Army utility helicopters and develop recommendations that support modernization of Army utility helicopter requirements.

The research design for this thesis is illustrated on Figure 4, page 97, and begins by examining the guidance published in The Army Plan (TAP). Using the TAP as the foundation for examining the thesis question the research flowed to a review of Total Army Analysis (TAA) documents and the Bottoms-Up Review. After the review of TAA and Bottoms-Up Review documents, the research focused on the four mission requirements identified by Army Doctrine for Army utility helicopters. These missions are: Air Assault, Command and Control, Medical Evacuation (MEDEVAC) and

General Support operations.<sup>23</sup> To conduct these missions the TAA process determines force structure that is required by doctrine to perform the Army's mission. The Army force structure for utility helicopter units was examined by comparing the Bottom-Up Review force structure with the TRADOC Aviation Restructure Initiative, in coordination with Headquarters, Department of the Army, Aviation Force Development Office, to verify quantities of helicopters required to support the Army's mission. Once the utility helicopter requirement was established and confirmed with DCSOPS, Aviation Force Development office, the quantities of UH-60 helicopters on hand were compared to determine the current shortage of UH-60's. By identifying UH-60 force structure shortfalls, it was possible to begin the analysis of the thesis question. The comparison focused on Army doctrinal requirements to support soldiers and equipment in the four mission areas established for utility helicopters.

#### Comparison Analysis

The force structure requirement shortage of UH-60's will have to be filled by UH-1H helicopters while this modernization issue is being decided. Since UH-1H's will fill the shortage of UH-60's, it was necessary to conduct a comparative analysis of the UH-60 versus the UH-1H in two areas helicopter capabilities and associated costs. The comparison of capabilities considered the UH-60 and UH-1H's ability to meet mission requirements established by the Army

for utility helicopters. The comparison of costs considered operational and sustainment costs associated with the UH-60 and UH-1H helicopters. Costs were reviewed using AR 11-18, The Cost and Economic Analysis Program through following the procedures of the Planning, Programming, Budgeting and Execution System (PPBES).

PPBES, in effect, is the decision structure within which Department of Defense determines its requirements and allocates constrained resources.... PPBES is simply a way of progressing from the general (the articulation of the national military strategy) to the specific (the organizations, manpower, material, training, and support of the forces necessary to carry out that strategy).<sup>24</sup>

PPBES factored into the analysis of the Program Objective Memorandum (POM) and sustainment funding planned for UH-60 procurement through Fiscal Year 2001.

The analysis was completed and the conclusion drawn was based on the significance of the difference between capabilities versus costs of continuing to procure the Army's total requirement of UH-60 helicopters. From this analysis the recommendation made on the thesis question is that the Army should procure the total quantity of Black Hawk helicopters it requires.

#### Research Design Plan

The plan used to conduct my research consisted of four phases that conformed to the Milestones established for the completion of the MMAS outlined in Student Text 20-10, Master of Military Art and Science Research and Thesis.

Phase One. This consisted of a review of historical data available at Combined Arms Research Library (CARL), HQDA, TRADOC and the Program Managers Office for Black Hawk helicopters. This historical review focused on the development of the requirement for a utility helicopter to support the emerging Army Doctrine for utilization of the third dimension of modern warfare. Once the historical review was developed the emphasis of the research plan moved to the requirements documents and existing study data available at HQDA, ODCSOPS, Aviation Force Development. These documents were requested and mailed to me for my analysis. The 1979 UH-60A, Black Hawk Material Need Statement (MNS) is the latest requirements document version. This MNS document is currently under revision and it is not known if the update will be completed in time to be utilized for this study.

The culmination of phase one was the collection of initial reference material required to conduct further analysis of the thesis statement.

Phase Two. Consisted of conducting telephone interviews with the points of contact at HQDA, TRADOC, and the Program Managers Office. The purpose of the interviews were to question HQDA on the current state of the Aviation Force Development Modernization Plan. To confirm the prioritization of equipment that will be programmed for

procurement within the Army Aviation funding allocation for POM Fiscal Year 1996 through Fiscal Year 2001.

The interviews also questioned TRADOC on the status of the Aviation Restructure Initiative (ARI) and its impact on the Force Structure requirements for Black Hawk helicopter procurements.

The interviews questioned the Program Managers Office for cost data on projected procurements in the POM and provided other pertinent data as necessary to complete the analysis. The Program Manager is the subject matter expert for costs associated with fielding and sustainment of the Black Hawk.

Phase two culminated with the identification of the specific references used to support the study. These references were determined by their suitability and validity to contribute to the development of a solution to the thesis problem.

Phase Three. This consisted of organizing, analyzing and interpreting the information collected. The method of organizing the information was to identify information required to establish a chronological sequence of events to support the doctrinal developments since the Vietnam War that influenced the results of the analysis of the thesis question. The impact of doctrinal development allows the reader to quickly grasp the scope of the problem

and provide them with the perspective required to interpret the remainder of the study through to the conclusion.

The analysis of the information was conducted by using economic analysis approach to determine the differences between the Black Hawk and the UH-1H helicopters. A cost benefit ratio factor was developed to facilitate the comparison of the two helicopter's capabilities and costs. The significance of this methodology is that it supports the perspective of determining a recommended solution to the thesis statement. This methodology also fosters an open minded approach that is critical because the limited funding available to procure the total requirement of Black Hawk helicopters, as the priorities are currently structured, tends to make this an emotional issue rather than one based on facts.

The interpretation of the information collected required me to draw from my experience in the Army and my recent exposure to the workings of the Defense Planning Process to arrive at a conclusion that provides a realistic recommended resolution to the problem.

Phase Three culminates with a thoroughly researched package of information that is organized in a manner that facilitates the analysis and interpretation of the information. The analysis and interpretation of the information results in a recommended solution to the thesis problem that supports the Army in making an informed

decision on which modernization position to support in the next POM Fiscal Year 1996 through Fiscal Year 2001.

Phase Four. This phase consists of applying the information compiled in Phase Three to determine the results of the analysis that translate into a conclusion which provides a recommended resolution to the thesis problem. The culmination of Phase Four is the completion of the thesis.

#### Milestones

The milestones for the conclusion of each phase of the Research Design are:

Phase One's conclusion was coordinated with the 8 September 1993 submission of the research proposal. This supported the objective in Student Text 20-10.

Phase Two's conclusion was coordinated with the second consulting faculty/committee meeting between 24 January and 4 February 1994. This supported the objective established in ST 20-10 of completing the research and the remainder of the thesis.

Phase Three's conclusion was coordinated with the 7 March 1994 submission of the revised chapters one through three and drafts of chapters four and five. This supported the objective established in Student Text 20-10.

Phase Four's conclusion was coordinated with the 4 April 1994 submission of the final draft of the thesis.

This supported the objective established in ST 20-10 of submitting a complete final draft of the thesis.

The next step was to conduct a comparative analysis of the problem statement: Should the US Army procure the total quantity of Black Hawk helicopters it requires? This analysis developed chapters 4 and 5 of the thesis. This analysis provided a recommendation that the Army should continue to procure the remaining requirement of Black Hawks and retire the remaining UH-1H helicopters and continue modernization of the Army utility helicopter fleet. The completed thesis will be provided to DCSOPS, Aviation Force Development for consideration in future Army Aviation Modernization Plans.

## CHAPTER 4

### ANALYSIS

#### U.S. Army Utility Helicopter Fleet Modernization Strategy

##### General Description

This chapter reports the results of a comparative analysis conducted of the capabilities and costs of the Black Hawk versus the UH-1H helicopter. The analysis model is organized with five economic analysis components. These are objectives, assumptions and constraints, alternatives, capabilities, and costs. The objective for the analysis model is to determine the best course of action to recommend on whether the Army should continue to procure the total quantity of Black Hawk helicopters required or retain a fleet mix of Black Hawks and UH-1H helicopters. The assumptions are that the primary issues concerning this situation are which alternative maximizes capabilities and minimizes costs to support the national military strategy, and which alternative is affordable to meet Army force structure, doctrinal and national military strategy requirements. The best option for these issues needs to be determined for the Fiscal Year 1996 through Fiscal Year 2001 Program Objective Memorandum (POM) submission.

It has been established, through review of requirements documents, that the Black Hawk helicopter is the primary utility helicopter for the U.S. Army. Without the Black Hawk the Army would not have the capability required to meet its utility helicopter missions. The Black Hawk's role provides mobility on the modern battlefield throughout the range of the Battlefield Framework in support of AirLand Battle Doctrine. The constraints address the requirement for utility helicopters to meet Bottoms-Up Review and Aviation Restructure Initiative force structure changes that total 2,195 Black Hawks. This requirement is determined by five categories that consist of force structure table of organizational equipment (TOE) of: 1,047 Black Hawks; operational readiness float (ORF) of 161 Black Hawks; repair cycle Float (RCF) of 92 Black Hawks; table of distribution and allowances (TDA) of 161 Black Hawks; and attrition replacement of 161 Black Hawk helicopters. Additional mission areas that require Black Hawks are medical evacuation (447), special operations (60), and electronic warfare (66) EH-60 Black Hawks. This information is illustrated in Figure 3, page 96.

Black Hawk mission's include air assault operations, aero medical evacuation (MEDEVAC), command and control of battlefield operations, and general support operations. The shortfalls in the requirements for Black Hawks are in the medical evacuation mission of 287 Black Hawks and in 395

Black Hawks in the mission sustainment categories. The mission sustainment category's shortfalls include: Operational Readiness Float (ORF) of 132 Black Hawks, Repair Cycle Float (RCF) of 92 Black Hawks, Table of Distribution and Allowances (TDA) of 58 Black Hawks, and attrition replacement of 113 Black Hawk helicopters. The mission areas projected to be filled at the end of Fiscal Year 1996 multi-year four contract are special operations with 60 MH-60 Black Hawks, electronic warfare mission with 66 EH-60 Black Hawks, and Table of Organizational Equipment (TOE) mission with 1,047 Black Hawks.

The shortfalls of 682 Black Hawks impact on all four mission areas identified. The table of organization and equipment is impacted because of the lack of attrition aircraft to replace losses. Without attrition replacements, losses would have to be drawn from other sources. For example, aircraft would have to be drawn from the operational readiness float aircraft resulting in reduction of quantities below their current level of 18% fill of the requirement. A reduction in TOE Black Hawks has an impact on readiness of TOE's because the requirement to maintain the Black Hawk fleet at an operational readiness rate of 70%. Not having the operational readiness float aircraft reduces the unit's capability to meet their readiness requirements due to the maintenance that must be done on a scheduled and unscheduled basis. The lack of repair cycle

float aircraft results in the depot level maintenance being reduced because when a unit sends an aircraft in for depot level repair there is no replacement provided to the unit to continue operations. Since depot level maintenance takes a much longer time to complete, due to shipment of the aircraft to a depot site, the unit's readiness is impacted for a longer time. This problem is magnified when you consider the units must maintain their aircraft at the same operational readiness rate with reduced numbers of aircraft to sustain the unit's readiness. Lack of repair cycle float aircraft further impacts the operational tempo (OPTEMPO) units must sustain for training and can impact training proficiency across the Corps, division, Brigade or other units being supported.

The shortfalls in the TDA Black Hawk requirements have an impact on the training and testing support base. The requirement to train additional crews in both flight and maintenance skills require sufficient numbers of helicopters to meet time constrained unit needs for crews and maintenance personnel. The point to be highlighted here is that as additional Black Hawks are fielded, additional TDA helicopters must be added to the training base to produce the trained crews in time to be ready when unit fielding begin on the effective date of the table of organization and equipment. The other area impacted is test aircraft. Ongoing testing for new systems to be added to the Black

Hawk and product improvements to incorporate new technologies that improve the Black Hawks capabilities and survivability must be supported to exploit these research and development opportunities.

The shortfall in medical evacuation Black Hawks is programmed through Fiscal Year 1996 to be 36% filled, this medical evacuation shortfall of 64% impacts on the ability of medical evacuation units to support the operational tempo of the modern battlefield that is based on Airland Battle doctrine. The requirement to evacuate patients from as far forward as possible is limited by the shorter range and 50% decreased patient capability of the UH-1H. If a medical evacuation mission is to support an air assault out to the maximum range of the Black Hawk, the UH-1H would not be capable of supporting that mission. Additionally the medical evacuation doctrine uses the criteria of "the golden hour" to determine medical evacuation requirements. The golden hour is the evacuation time elapsed from when a soldier is wounded to the time the soldier is in the medical treatment facility supporting the operation. The lift, speed, range, deployability and survivability criteria established for the medical evacuation helicopter requirement exceed the capabilities of the UH-1H and are met by the capabilities of the Black Hawk. The special operations and electronic warfare requirements are at 100% fill, however, the lack of attrition aircraft also limits

the ability of the Army to fill losses without reducing one of the other categories discussed.

This overview of the impact of the shortfall of Black Hawk helicopters in the future force structure can be further illustrated when one considers the impact of the shortfall of Black Hawk helicopters on Airland Battle doctrine. Airland Battle doctrine states that:

The future Army must be prepared to deploy on short notice and operate successfully on many battlefields and in many environments. It must be able to tailor its forces to the contingency at hand, whether for warfighting operations or for operations short of war.<sup>25</sup>

This statement shows that the most capable systems technology can provide are required to support this doctrine.

There are two alternatives that impact on this analysis. The first is to procure all the Black Hawks required or second, to retain a mixed fleet of UH-1H's to fill the current shortfalls of Black Hawks to fill force structure requirements. The procurement position recognizes doctrinal requirements and the capabilities of the Black Hawk helicopter to meet those requirements while the mixed fleet position is supported by those who wish to retain the UH-1H because of the impression that cost savings will be realized with a mixed fleet. The next section will provide an analysis of the differences of capabilities and cost between the Black Hawk and UH-1H helicopters. This analysis will focus on the unequal capabilities and unequal costs of

the two helicopters to determine the best option that maximizes capabilities and minimizes costs. A restatement of this is to determine the option that provides the best capability at the least cost.

#### Black Hawk and UH-1H Helicopter Capabilities Description

The following information describes the Black Hawk and UH-1H helicopter's capabilities in the areas of lift, speed, range, deployability and survivability. The two helicopters costs will be addressed in the areas of the Program Objective Memorandum (POM), Flying Hours, Sustainment and personnel cost requirements. This approach follows the research design model, illustrated on Figure 4, page 97, and provides the reader with a common base of knowledge to interpret the outcome of the comparative analysis described in the research design.

The Black Hawk helicopter's maximum gross weight is 22,000 pounds, the internal and external lift capability is 8,000 pounds. The mission speed is between 145 and 175 knots. The mission range is based on 2.2 hours of fuel at cruise speed of 145 knots which equals 319 nautical miles up to 175 knots which equals 385 nautical miles. The Black Hawk is self deployable when configured with up to four External Stores Support System (ESSS) fuel cells with a 230 gallon capacity per fuel cell. These cells provide an additional 920 gallons of fuel that when added to the 304 gallons of aircraft fuel equals 1224 gallons. This fuel

capacity provides 8 hours at 152 knots allowing the Black Hawk to travel 1,216 nautical miles without re-fueling. The ESSS capability of the Black Hawk is established by the Material Need Statement. This requirement meets the self-deployment need that supports the national military strategy of force projection from the continental United States.

Additionally, the Material Need Statement established that,

Range extension is required for UH-60 OCONUS self-deployment. Range extension must enable the UH-60 to fly at an altitude not to exceed 10,000 feet MSL, non-stop without refueling, 1150 nautical miles against a 10 knot headwind and provide a 10% fuel reserve.<sup>26</sup>

Another benefit of the self-deployment capability is that the airforce cargo aircraft that would be required to transport the Black Hawk to the theater of operation is able to be made available for transport of other critical equipment and personnel deployment requirements. However, if a deployment required the Black Hawk to be transported in airforce cargo aircraft the Black Hawk can be loaded in the following quantities. The C-5 can carry 6 Black Hawks, the C-141B can carry 2 Black Hawks and the C-17 will carry 3 Black Hawks.

The issue of survivability is best described by analyzing aircraft configuration and built in safety features that have been developed and incorporated into the Black Hawk. The Black Hawk has redundant flight controls, fuel, hydraulic and electrical systems, reinforced cockpit structure, armored pilot and copilot seats, ballistically

tolerant main and tail rotor systems up to a 23mm round impact, twin engine capability with power to continue flight on one engine, a modular main transmission with fail-safe lubrication and a crashworthy fuel system. An aircraft survivability suite is installed for protection against anti-aircraft missiles and radar detection to provide warning for the pilot to react to the threat.

The UH-1H helicopter's maximum gross weight is 9,500 pounds, the internal and external lift capability is 2,000 pounds. The mission speed is between 90 and 110 knots. The mission range is based on 2.1 hours of fuel at cruise speed of 110 knots which equals 231 nautical miles. The UH-1H is not self-deployable in that it does not have adequate auxiliary fuel tanks to support this capability. The current auxiliary fuel system configuration provides an additional 300 gallons of fuel which extends the range 409 nautical miles. When the additional fuel is added to the aircraft fuel it provides 5.8 hours at 110 knots allowing the UH-1H to travel 640 nautical miles without re-fueling. The distance requirement for self deployment is 1150 nautical miles, leaving the UH-1H not capable of meeting this requirement. This translates to the UH-1H being loaded into airforce aircraft for deployment. This limits the flexibility to support the Force Projection doctrine outlined in national military strategy. To illustrate the

importance of this point one must understand that doctrine states:

The capability to project military power from CONUS and other locations in response to regional crises is crucial to achieving national security objectives. Assembling forces and moving them great distances, often with little or no warning, requires versatile forces easily tailorable to accomplish a wide range of military operations under all environmental conditions.<sup>27</sup>

If deployment of the UH-1H is required in airforce cargo aircraft, the following quantities can be loaded. The C-5 can carry 7 UH-1H's, the C-141B can carry 3 UH-1H's and the C-17 can carry 3 UH-1H's. The UH-1H is older technology and does not have many of the survivability capabilities built into the Black Hawk. There is a crashworthy fuel system, the pilot seats are armored and there is an aircraft survivability suite installed to provide warning of radar and missile threats. There are no redundant flight controls, electronic, fuel, hydraulic or engine systems. The rotor blades are not designed to be ballistically tolerant.

The system descriptions show the differences in capabilities to be very different between the two systems. This difference is based in the developments of technology since the 1950's when the UH-1H was developed. The advances that have contributed to increasing lift, speed range, deployability and survivability are extensive. This extensive technological growth translates into technological

superiority on the battlefield. This technological superiority is addressed in the "National Military Strategy of the United States"<sup>28</sup> where it states:

The United States must continue to rely heavily on technological superiority to offset quantitative advantages, to minimize risk to US forces, and to enhance the potential for swift, decisive termination of conflict. In peace, technological superiority is a key element of deterrence. In war, it enhances combat effectiveness and reduces loss of personnel and equipment. Our collective defeat of Iraq clearly demonstrates the need for a superior intelligence capability and the world's best weapons and supporting systems. We must continue to maintain our qualitative edge. Therefore, advancement in and protection of technology is a national security obligation.<sup>29</sup>

This quotation supports the direction of the Army to develop and field the most technologically advanced weapons available to support the modernization objective of fielding newer systems and retiring older technologically obsolete systems.

However, the costs associated with this must be considered for the Program Objective Memorandum development covering Fiscal Year 1996 through 2001, along with associated flying hour, sustainment and personnel costs that come with a new system (Black Hawk) or are in place to support the old system (UH-1H helicopter). The following provides the analysis of capabilities and costs associated with the Black Hawk and the UH-1H and analyzes them using comparative techniques outlined in the Command and General

Staff College Student Text 25-1, "Resource Planning and Allocation."<sup>30</sup>

A cost-effectiveness analysis will be the primary means of conducting the comparison between the Black Hawk and the UH-1H. A cost-effectiveness analysis is defined as an analysis that "compares and ranks two or more programs, projects, or activities based on cost and effectiveness."<sup>31</sup> For the purpose of this analysis effectiveness is identified as capabilities to facilitate quantifying the comparative analysis between the Black Hawk and UH-1H helicopters. The criteria that will be used for the analysis are to compare two systems with unequal capabilities and unequal costs to determine which helicopter maximizes capabilities and minimizes costs.

#### Capabilities

The analysis of aircraft capabilities is organized by mission areas required to support air assault, aeromedical evacuation, command and control and general support operations. The criteria under each mission area to be analyzed include: lift, speed, range, deployability and survivability. The following mission area requirements describe the capabilities of the Black Hawk versus the UH-1H helicopter. The outcome is that in these areas analyzed the Black Hawk proved superior to the UH-1H in all categories. The following information describes the requirements identified by the Army for the utility helicopter mission

areas and determines if the Black Hawk and the UH-1H meet these mission requirements or not.

The first mission area to consider is air assault operations.

Air assault operations are those in which forces (combat, combat support, and combat service support), using firepower, mobility, and total integration of helicopter assets, maneuver on the battlefield under the control of the ground or air maneuver commander to engage and destroy enemy forces or to seize and hold key terrain.<sup>32</sup>

The lift requirement to accomplish this mission is that eleven combat loaded troops must be moved into combat with a combat loaded weight of two hundred and forty pounds per soldier. This must be accomplished with a worst case scenario of operating at four thousand feet and ninety five degrees farenheight, with the helicopter being capable of hovering out of ground effect (50 feet above ground level AGL). The Black Hawk meets this requirement. The UH-1H capability to hover out of ground effect is limited to one combat loaded troop at four thousand feet and ninety five degrees farenheight. The category of lift also has an external load requirement of eight thousand pounds. The Black Hawk meets this requirement the UH-1H is limited to 2000 pounds at temperatures and altitudes below those environmental conditions established in the material need statement.

The category of speed requires the helicopter to operate between 145 and 175 knots. The Black Hawk meets this requirement but the UH-1H does not meet this due to an airspeed limitation of 110 knots. The airspeed requirement becomes an issue when you consider the fuel endurance and range capabilities of the helicopters.

The category of range considers that each helicopter is limited to 2.2 hours of mission fuel for the Black Hawk and 2.1 mission hours for the UH-1H, which translates to a round trip radius that is directly effected by the airspeed the helicopters can sustain. Because the Black Hawk can sustain an airspeed 65 knots faster than the UH-1H, the Black Hawk's range is increased proportionally to the increased airspeed capability. The result is an increase in distance of 143 nautical miles with a mission radius of 71.5 nautical miles, or a 37% increase over the UH-1H.

The category of deployability requires that the helicopters can be air transported in airforce C-5 and C-141 aircraft, but also to be self deployable up to a distance of 1150 nautical miles. Both helicopters are air transportable, however the Black Hawk has the self-deployment capability and the UH-1H does not.

The category of survivability requires that the helicopter be crashworthy to include passenger seats and self sealing internal fuel system. Also that redundancy be built into the systems so that,

each be fully independent of the other, that each system be capable of performing all essential system functions whenever the counterpart system is incapacitated for any reason, and that each be widely separated within the aircraft to preclude incapacitation of both by the same cause.<sup>33</sup>

The technology to meet these requirements were not available when the UH-1H was developed and are not incorporated into the aircraft. However, these capabilities are characteristics of the Black Hawk. The different technological capabilities between the Black Hawk and UH-1H helicopters are illustrated in figures 5 and 6, on pages 98 and 99.

The second mission to consider is aeromedical evacuation (MEDEVAC).

In a force projection Army that is expected to win wars with minimal casualties, rapid aeromedical evacuation takes on increased importance. Expanded battlespace will require more reliance on air evacuation rather than surface means.<sup>34</sup>

The aeromedical evacuation mission definition is to "evacuate wounded soldiers from as far forward as possible to appropriate medical treatment facilities."<sup>35</sup> This is where the medical evacuation "golden hour" is incorporated into doctrine and illustrates the criticality of equipping the aeromedical evacuation mission to support the doctrine of force projection.

The lift requirement in the aeromedical evacuation mission is to transport up to six soldiers from as far forward as possible. The Black Hawk can accomplish this in

the required environmental conditions established. The UH-1H helicopter is limited to three soldiers and cannot operate in the environmental conditions required in the material need statement.

The speed requirement for the medical evacuation helicopter mission is the same as that for the Black Hawk. The justification for this is the air assault and combat search and rescue missions require that a recovery aircraft can operate in the combat zone with the capability to match the speed of the aircraft they are supporting. This requirement extends to support of deep operations conducted by air assault or attack helicopters. The Black Hawk has the capability required to support all the missions throughout the battlefield framework. The UH-1H does not meet all mission airspeed requirements.

The category of range is critical in the aeromedical evacuation mission because of the same requirements identified in the speed category. To support operations throughout the battlefield framework it is essential that the aeromedical helicopter have the same range as the systems that it is supporting in combat. If the mission requires evacuation of soldiers at the maximum range of the combat aircraft in a deep operation, then the medical evacuation system must have the capability to range the soldier in the combat zone. The Black Hawk has this capability and can enhance the range as needed to support

attack helicopter operations with the addition of the External Stores Support System (ESSS) for added fuel endurance. The UH-1H is limited in its range and would require that soldiers be evacuated by ground means back to a point within the UH-1H's range. This is not adequate to support deep operations. The UH-1H has some utility in supporting soldier evacuation in the close and rear portions of the battlefield framework, but its limitations result in it not having the capability to meet the range requirements established for medical evacuation operations.

The characteristic of deployability requires that the medical evacuation helicopter's self deploy with the combat helicopters. This capability is met by the Black Hawk, but is not met by the UH-1H helicopter.

The characteristic of survivability applies to the medical evacuation helicopter requirement because of the battlefield environment the helicopter is required to operate in. These requirements are the same as outlined for the Black Hawk earlier. The result is that the Black Hawk meets this requirement and the UH-1H does not have the required technology to be survivable on the modern battlefield.

The third mission to consider is command and control of battlefield operations. Army aviation has a requirement for command and control throughout all levels of the battlefield framework. The command and control requirements

apply in two areas. First, the aviation brigades must coordinate organic assets and the airspace those assets operate in. Second, the command and control requirement must have the capability,

to provide highly mobile airborne command posts to commanders at the brigade, division, corps, and echelons above corps levels. The communications suites in the C2 aircraft must be compatible with the assigned command post mission.<sup>36</sup>

This requirement to support command and control of operations throughout the battlefield is critical to resource with a system that can support the doctrinal requirements of force projection.

The lift requirement for the command and control mission is to transport the commander and the staff of up to seven soldiers. The Black Hawk has the capability to accomplish this in the required environmental conditions established of 4000 feet mean sea level (MSL) and 95 degrees fahrenheit. The UH-1H helicopter, with a crew of three, is limited to four soldiers while hovering in ground effect at 4000 feet and 95 degrees. The result is the UH-1H cannot operate in the environmental conditions required in the material need statement to support the command and control of battlefield operations mission.

The speed requirement for the command and control of battlefield operations mission is the same as that for the Black Hawk. The justification for this is the requirement for commanders to move across the battlefield at the same

rate as the systems supporting the battlefield operations. This requirement extends to the support of operations conducted by air assault or attack helicopters in that the Black Hawk can support all deep, close and rear missions by ensuring the commander has the flexibility needed to be at the correct location at the critical time to best influence the battle. The UH-1H does not meet this airspeed requirement.

The category of range is critical in the command and control of battlefield operations mission because of the requirement to support operations throughout the battlefield framework. The command and control helicopter must have the same range as the systems that it is supporting in combat. The Black Hawk has this capability and can enhance the range as needed to support a sustained operational requirement by adding External Stores Support System (ESSS) for increased endurance. The UH-1H is limited in its range and would result in commanders not having the flexibility required to be in the correct location at the critical time to influence the battlefield operations.

The characteristic of deployability requires that the command and control of battlefield operations mission helicopter's self deploy with the combat helicopters. This capability is met by the Black Hawk, but is not met by the UH-1H helicopter.

The characteristic of survivability applies to the command and control of battlefield operations mission helicopter requirement because of the battlefield environment the helicopter is required to operate in. Technologically advanced systems for communications are under development for incorporation into the Black Hawk, these systems are required to support the digitization of the battlefield concept the Army is developing for the future battlefield. For technologically advanced systems to operate on the modern battlefield they must be supported with a survivable platform that is technologically capable of supporting the equipment and personnel requirements those systems will need. The result of the analysis is that the Black Hawk meets survivability requirements and the UH-1H does not have the required technology to be survivable on the modern battlefield.

The forth mission to consider is general support operations. General support missions include,

the movement of critical material, troops, and services into forward areas when time is short or ground lines of communications are interdicted or congested.<sup>37</sup>

The general support operations mission requirement impacts on all aspects of the battlefield framework by providing the commander the capability to move large amounts of equipment and troops to the critical point on the battlefield in a short period of time without regard for the constraints of terrain restrictions to movement. This capability provides

the commander with the flexibility to position forces and equipment rapidly to significantly influence battlefield operations.

The lift requirement for the general support operations mission is to "sustain air and ground maneuver units during close, deep, and rear operations."<sup>38</sup> This requirement includes conducting external load operations to lift 500 gallon fuel and water blivets, High Mobility Multipurpose, Wheeled Vehicles (HMMWV), artillery pieces, pallets of ammunition and other required equipment and supplies. These loads require the 8,000 pound external load capability of the Black Hawk. The UH-1H helicopter is limited to a maximum of 2000 pounds external load in environmental conditions that are less than the required 4000 feet, 95 degrees established in the material need statement to support the general support operations mission.

The speed requirement for the general support operations mission is justified by the need for personnel, supplies and equipment to move across the battlefield at the same rate as the systems supporting the battlefield operations. The speed requirement ensures the commander has the flexibility needed to move support items across the battlefield when lines of communications on the ground are impeded. This ensures support items are at the correct location at the critical time to best influence the battle.

The UH-1H speed range is 90 to 110 knots which does not meet the airspeed requirement.

The category of range is critical in the general support operations mission because of the requirement to support operations throughout the battlefield framework. The general support mission helicopter must have the range to move throughout the battlefield framework without requiring multiple ground rearm and refuel points. The Black Hawk has this capability and can enhance its range as needed to support a sustained operational requirement by adding External Stores Support System (ESSS) for increased endurance. The UH-1H is limited in its range and would result in multiple rearm and refuel points to be established throughout the battlefield operational area. This would limit the commander's flexibility to support operations by quickly moving large quantities of troops and equipment long distances where they would be required to influence the battlefield operations at the critical time.

The characteristic of deployability requires that general support operations mission helicopter's self deploy with the combat helicopters. This capability is met by the Black Hawk, but is not met by the UH-1H helicopter.

The characteristic of survivability applies to general support operations helicopter requirement because of the battlefield environment the helicopter is required to operate in. These requirements are the same as outlined for

the Black Hawk earlier. The result is that the Black Hawk meets the survivability requirements and the UH-1H does not have the required technology to be survivable on the modern battlefield.

#### Costs

The second category that the analysis of the thesis question is based upon is the cost differences between the Black Hawk and UH-1H. The two helicopter's costs will be addressed in the areas of the Program Objective Memorandum, Flying Hours, Sustainment and Personnel cost requirements. The analysis will attempt to determine the significance of the cost differences and relate the findings to the capabilities' findings to determine a recommendation for the thesis question by determining which helicopter maximizes the capabilities and minimizes costs over the life cycle of the fleet.

The Program Objective Memorandum for the period Fiscal Year 1994 through Fiscal Year 1999 eliminated funding for the Black Hawk at the end of the Multi-Year contract in 1996. The next Program Objective Memorandum, Fiscal Year 1996 through Fiscal Year 2001, will consider funding for continued purchases of the Black Hawk beyond 1996. The significance of the time available between now and 1996 is that the procurement costs must be submitted in a timely manner for approval and contracting. Early submission of contracts will minimize the impact on the production

capability of contractors. It is important to minimize the impact of production of the Black Hawk because of the importance to sustain the training and readiness of the Army which could be degraded in a time when the Army is supposed to be small, capable and ready. The Army must also be expansable and this capability for the Black Hawk to react to the doctrinal requirement of two almost simultaneous theaters of operation will be degraded if the Black Hawk production line is not continued beyond 1996.

The findings on Flying Hours, which are included in operational and support costs, are that a one to one ratio comparison between the Black Hawk and the UH-1H does not adequately address which system can maximize capabilities and minimize costs. The means to close the gap in capabilities and costs between the Black Hawk and the UH-1H is to establish a ratio value which can be used in this study to conduct the comparative analysis. This study assigns a ratio value of 5 UH-1H's to 1 Black Hawk. The ratio was based upon the 8000 pound lift capability of the Black Hawk which was divided by the 2000 pound lift capability of the UH-1H to establish a 4 to 1 ratio. After consultation with the utility helicopter program manager an additional operational readiness float UH-1H was added to establish the 5 UH-1H to 1 Black Hawk ratio used for the study. This 5 to 1 ratio is an attempt to normalize the two helicopter's differences, and to show what attaining the

capabilities identified in doctrine will cost in Fiscal Year 1994 constant dollars. What results from establishing this ratio is a means to determine the maximum capabilities to minimum cost ratio. The analysis of that ratio can then show the capabilities and cost impacts of the utility helicopter requirement's shortfall on the high technology battle field. The critical factor in establishing this ratio is that a five UH-1H to one Black Hawk ratio does not work out to be an even comparison. The limitation is that the five UH-1H's, while providing the capability to move a similar quantity of weight, this does not translate to combat capability because of the types of equipment that exceed 2,000 pounds that must be lifted by one helicopter. The types of equipment are for example a light division's 105 Howitzer artillery piece with ammunition and crew, the High Mobility Multipurpose, Wheeled Vehicles (HMMWV) and 500 gallon fuel blivets (3,250 pounds each). The point being that five UH-1H's to one Black Hawk helicopter still provides only a limited capability less than the Black Hawk. This is also at a higher cost due to the increased quantities of crews, fuel, maintenance required to support five UH-1H's over the fewer assets required for the Black Hawk.

A requirement's ratio of five UH-1Hs to one Black Hawk for a capability that is close to but not equal to the Black Hawk translates the Army requirement from a short fall

of 682 Black Hawks to a need to retain 3410 UH-1H's to support the shortfall of Black Hawks required at the end of 1996 production. This difference translates to additional force structure, equipping, training, manning, sustaining, mobilizing, and deploying capabilities and cost requirements. These issues will be expanded further following a discussion of analysis findings of the differences in capabilities between the Black Hawk and UH-1H helicopters.

The differences in capabilities between the Black Hawk and UH-1H helicopters were found to be significantly different and presented the challenge of normalizing those differences to establish baseline criteria from which to conduct the analysis. The differences are illustrated in figure 7, page 100. In considering the differences, it was determined that a capabilities had to take into account not only the measurable differences of troop transport, internal and external cargo capability, the intangible or subjective factors of the differences in technology between the helicopters had to be factored in. Those differences in technology are a product of the period the helicopters were developed. The UH-1H is 1950's technology and the Black Hawk is 1970's technology. To narrow the field of consideration a factor of four UH-1H's to one Black Hawk covers the lift differences at optimum environmental conditions for the UH-1H of sea level and 65 degree's

farenheight. The subjective side of the determination focused on the survivability of the helicopters in a combat environment. The redundant systems of the Black Hawk built into the helicopter include dual engine, ballistic tolerance and redundant flight control systems. The UH-1H does not have these capabilities manufactured into the helicopter. Therefore a ranking of one additional UH-1H was added to the factor of four UH-1Hs to one Black Hawk. This means that the analysis results are based on a five UH-1H to one Black Hawk ratio. Information depicting data used in the analysis can be found in Figures 8 through 10, pages 101 through 103.

The differences between Black Hawks and UH-1Hs relate to the Army's utility helicopter Material Need Document requirements by significantly increasing the quantities of UH-1Hs required to partially support the capabilities that could be provided by a lesser quantity of Black Hawks. The five UH-1H to one Black Hawk ratio is important because of the need to support national military strategy with doctrinally capable force structure. The difference in capabilities translates to fewer quantities of Black Hawk helicopters required in the force structure and leads to retirement of the older UH-1H helicopters that are reaching the end of their service life. From this analysis, it was determined that procurement of the Black Hawk and retirement of the UH-1Hs would result in force structure helicopter quantity reductions, savings in operational and

support sustainment, flying hour, and personnel costs over the life cycle of the Black Hawk versus the UH-1H.

Therefore, the Army's ability to execute its doctrine relies on having equipment capable of supporting that doctrine.

These seven Functional areas show that a solution to the problem statement is more complex than comparing the operational and support cost of a single UH-1H against a single Black Hawk. This approach has supporters because the cost factors seem significantly lower for the UH-1H. This study has determined that this simplistic approach adversely impacts on several critical areas of national security strategy, national military strategy and force projection doctrine. The significant areas mentioned earlier that must be considered are Force Structure, Equipping, Training, Manning, Sustaining, Mobilizing, and Deploying. These areas have sub-areas that will be used to focus the findings of the analysis and serve to clarify the impacts of both sides of the issue concerning the thesis question of whether the Army should procure all the Black Hawk helicopters it requires. The analysis uses the five UH-1H's to one Black Hawk to normalize the comparison and the difference in the quantities required of UH-1H's to replace the shortfall of 682 Black Hawks at the end of the Fiscal Year 1996 production contract.

The area of force structure is significant because the Total Army Analysis process has identified the force

required to support doctrine established in the national military strategy as requiring Black Hawks on the battlefield to support the strategy of fighting two almost simultaneous conflicts in different theaters of operation. Through discussions with the personnel involved in the Total Army Analysis Process it was identified that the UH-1H was not used in the process. This point serves to illustrate the importance of the Black Hawk in the implementation of the current doctrine. Because the UH-1H's were not used in the TAA process this allowed the Army to fight the scenario and support the requirements for reduced force structure with the assumption that the requirement for Black Hawks on the battlefield would be supported. The Total Army Analysis process reveals the requirement for the technological edge of the Black Hawk on the modern battlefield in lift, range, speed and survivability. The technological edge was reflected throughout all the mission areas of the utility helicopter. The TAA process showed that the increased force structure required for UH-1Hs to support not procuring all the Black Hawks required is not supportable and could adversely impact on the ability of the Army to implement the national military strategy identified in the Bottom-Up Review completed by the Office of the Secretary of Defense.

The area of equipping the force in the analysis showed that when the five UH-1H to one Black Hawk ratio were applied to the 682 Black Hawk shortfall in 1996, this

resulted in an adjusted utility helicopter requirement of 3,410 UH-1Hs would need to remain in the force structure. This is significant because the Army has retired UH-1H's and reduced the quantity of UH-1H's in the force to below 2700 at the end of 1993. This means that the UH-1H alternative does not exist in the fleet in sufficient quantities to support a mixed fleet option if the Black Hawk procurement does not continue beyond 1996. This would indicate that the UH-1H would require a procurement program of 710 UH-1H helicopters to fill the shortfall gap needed to retain the UH-1H as an interim solution to the shortfall of Black Hawk helicopters. This shows that an acquisition and distribution program would be required for the Army regardless of which position is supported in the Fiscal Year 1996 to Fiscal Year 2001 Program Objective Memorandum (POM) Army submission.

The area of training indicates the requirement for increased personnel to support developing crew and maintenance personnel needed for an increase in UH-1H's required to fill the shortfall of Black Hawks. When the quantities of the aircraft personnel requirements were compared the results indicated for the Black Hawk shortfall of 682 helicopters, 2,728 crew members were required in the force structure. These personnel would have to be supported with funding, training facilities, resources and instructors. The requirement for the UH-1H would be for

3,410 helicopters with a crew of four would need 13,640 personnel to support the requirement for UH-1H's. This requirement is 80% higher than the personnel requirement for the Black Hawk. This personnel comparison between the Black Hawk and UH-1H indicates that a significant difference in cost will exist in crew training across all areas required for the Army to produce the personnel required to operate the UH-1H helicopters required instead of procuring the total quantity of Black Hawks required.

The area of manning must consider accession, assignment and progression. The force structure levels reviewed by the Aviation Restructure Initiative identified the force structure accessions required to increase the quantity of maintenance personnel required to support the modernized helicopters at the unit and aviation installation maintenance AVIM levels. The personnel assignments that will form the units under the Aviation Restructure Initiative require a reduced quantity of helicopters to ensure personnel requirements are met within the funding authorization levels determined in the Bottom-Up Review which are the four corps and fifteen division force structure levels. Maintaining the required personnel and ensuring proper progression is available was the primary task accomplished by Aviation in the TAA force structure development process. This means that an increase in personnel above the TAA approved levels would have to be

requested and supported by the Army. Also, another Army branch would have to be reduced in personnel to support the UH-1H option. The issue of the Army transferring force structure from within the Army to increase Army aviation to support the utility helicopter requirement is beyond the scope of this study but is mentioned to highlight the impact of the analysis of not procuring the Black Hawk beyond 1996.

The area of sustaining the utility fleet focuses on operational and support costs and crew costs. The comparison of the Black Hawk and the UH-1H helicopters required a base line for an economic analysis of the two helicopters as they relate to the missions that they are required to perform. The means used to establish that base line was to consider the capabilities of the Black Hawk and the UH-1H, then compare their operational capabilities at sea level and 65 degree's farenheight. This approach determined that a five UH-1H to one Black Hawk ratio allowed the analysis a normalized means to determine the capabilities to cost comparison. This comparison factored in capability differences for the two helicopters to support the required missions. The analysis suggested that the sustainment and crew costs of the 682 Black Hawk shortfall are less than the normalized quantity of 3,410 UH-1H's that would be required to remain in the force to provide a capability close to but not equal to the Black Hawk. An illustration of this point is in Figure 11, page 104. Using

the five UH-1Hs to one Black Hawk ratio, the evidence suggests that the quantity of Black Hawks that are short of the requirement would be less costly to procure and sustain over the course of a twenty year life cycle than the normalized quantity of UH-1Hs that would be required if production of the Black Hawk is ended in 1996.

The analysis indicated that in the sub categories of supply and maintenance; retention of the UH-1H beyond its service life would be difficult to sustain because of the shortage of spare parts for the helicopters which is compounded by the budget reductions at the DEPOT level of maintenance. These reductions are impacting on the DEPOTS ability to support two types of utility helicopters simultaneously. This is highlighted by the experience level of the work force to train the right quantity of personnel required to meet the demand for maintenance support of two competing systems. The problem is compounded with a retirement schedule being implemented by the Army for the UH-1Hs that is driving the future planning for DEPOT level support. The DEPOTS must convert their work force, parts, equipment and procedures over to sustain the modernized aircraft. If this process is slowed or reversed their are costs that are not able to be determined in the scope of this analysis. Depending on the option that is decided on for the POM, the costs of DEPOT level support for retaining a mixed fleet must be considered in any future decision

regarding a mixed fleet of Black Hawks and UH-1Hs option versus a pure fleet of Black Hawks option.

The areas of mobilization and deployment are considered requirements of the utility helicopter fleet because of the national military strategy that calls for a doctrine of Force Projection. The environmental conditions throughout the world vary considerably and one is considering helicopter capabilities and performance limitations. The requirement in the Black Hawk Material Need Document is 4000 feet MSL and 95 degrees farenheight for the helicopter to operate out of ground effect at full mission weights. This is the most critical consideration in the analysis and provides the most conclusive evidence that the UH-1H is unsuitable for use in combat in any of the four major mission area requirements (Air Assault, MEDEVAC, Command and Control, and General Support). The most telling finding in the areas of mobilization and deployment suggests that Army force structure must be fielded with systems that are capable of meeting Army Doctrine established in support of national security and national military strategy of providing a force projection capability throughout the world. This leads to the area of consideration for fielding the force structure with modernized systems capable of implementing the Army's warfighting doctrine. Warfighting CINCs are the implementors of national military strategy and they rely on doctrine to guide the implementation of that

strategy, which is based on the equipment being available that was envisioned by the planners, who were responsible for determining the equipment requirements the CINCs require to accomplish, with modernized equipment, to implement the approved doctrine of the US Army in support of national security strategy. The Army's inability to meet these equipment requirements would result in the need to re-visit established doctrine or change the Force Structure requirements.

The evidence suggests that the comparison of Black Hawk and UH-1H's normalized life cycle costs result in the Black Hawk procurement option providing maximized capabilities at the minimum cost. This evidence suggests that continued procurement of the Black Hawk and the continued retirement of the UH-1H would be the favorable course of action for the Army to pursue in the next Program Objective Memorandum development. This course of action is supported by findings illustrated in Figure 12, page 105. These figures illustrate that when capabilities of the helicopter are converted to a quantifiable factor, reflecting a normalized capabilities to cost ratio, the cost analysis results show that an increased capability allows the quantities of helicopters required can be reduced. The increased capability results in reduction in the quantity of helicopters which reduces life cycle costs. Because of the reduced life cycle costs it was determined that the

procurement costs are offset over a twenty year life cycle for the Black Hawk. Therefore, the evidence suggests that the Black Hawk maximizes capabilities and minimizes costs over a twenty year life cycle.

The analyses on the UH-1H life cycle costs show that the increased quantities of UH-1Hs required to provide a normalized comparison of capabilities show that the costs of supporting the UH-1H fleet over a twenty year life cycle result in minimizing capabilities and maximizing cost when compared against the Black Hawk. These findings are the reverse of the Black Hawk findings and show that the UH-1H cannot provide the capabilities required at an affordable cost to support the missions identified for the utility helicopter in support of national military strategy.

Other considerations in the analysis are the risks and trade-offs associated with the problem of retaining the UH-1H in the force structure. The risks were determined to be in the area of capabilities to conduct missions with a helicopter that is not capable of performing doctrinal mission requirements. This is linked to the differences in capabilities of the Black Hawk and the UH-1H. These differences are significant and require a ratio of five to one to determine an effective comparative analysis that reveals the risks throughout all the categories that make up the requirement.

The significant sustainment cost difference between the Black Hawk and UH-1H further establishes the need to procure the remainder of the Black Hawks to eliminate two different types of helicopters to provide personnel, sustainment and flying hours for at a significant reduction of capabilities and increase in costs.

A tool that would assist in reducing costs is a Multi-Year contract for procurement of Black Hawks beyond 1996. The analysis showed that the multi-year contract should be considered for funding in the Program Objective Memorandum. This would allow the Army to continue to procure the Black Hawks at an acceptable economic rate, the production capability of Sikorsky helicopter would be preserved and the time required to establish the multi-year contract and order the required long lead parts would be available to meet production requirements.

This analysis of the thesis question indicates that the United States Army should procure the total quantity of Black Hawk helicopters it requires. The national military strategy of force projection is supported by the Army Aviation modernization goal of procuring technologically capable helicopters to meet force structure needed to implement doctrine. The analysis also indicates that the shortfall of 682 Black Hawk helicopters is affordable when compared to a normalized quantity of UH-1Hs. Therefore the analysis findings support procuring the shortfall of Black

Hawks over retaining UH-1H helicopters in the force structure.

The next step is for the Army to address the Fiscal Year 1996 to Fiscal Year 2001 Program Objective Memorandum (POM) to determine if there is support for funding when shown that the Black Hawk maximizes capabilities and minimizes costs to support national military strategy. From this determination, the Army could focus its efforts in formulating the POM submission on the Black Hawk being the most affordable course of action for modernization of the utility helicopter fleet.

## CHAPTER 5

### CONCLUSION

#### Summary

This thesis has addressed the primary question of whether the US Army should procure the total quantity of Black Hawk helicopters it requires? The methodology used to analyze this question began by looking at several documents that are used by the Army to determine how to support doctrine. It has been shown that Army doctrine is developed by using the national military strategy (NMS) that translates national security strategy into guidance that the Army can use to develop doctrine. To further illustrate this point:

The NMS furnishes the advice of the Chairman of the Joint Staff and information to the Secretary of Defense, Joint Chiefs of Staff, in consultation with the other members of the Joint Chiefs of Staff and the combatant commanders, to the President, the National Security Council, and the Secretary of Defense as to the recommended national military strategy and fiscally constrained force structure required to support attainment of national security objectives.<sup>39</sup>

The Army uses, along with the national military strategy, several documents and procedures to determine force structure and equipment requirements needed to

implement the doctrine established to support the national security and national military strategy. Those documents and processes include The Army Plan, Total Army Analysis, Bottom-Up Review and the Aviation Restructure Initiative. The use of these documents and procedures in the conduct of the analysis enabled the study to show that the Army needs a helicopter system that can maximize capabilities and minimize costs in support of Army doctrine. The procedure used to analyze whether the Black Hawk or the UH-1H were able to meet doctrinal requirement, while maximizing capabilities and minimizing costs, was to conduct a comparative analysis. The results of this analysis produced evidence that indicated, over the course of the research, that the comparison of the Black Hawk and the UH-1H is a very complex issue. These complexities surfaced because of the two helicopters significant differences in capabilities and costs to meet doctrinal missions and force structure requirements. Because of the significant differences in the two helicopters, a normalized ratio of five UH-1Hs to one Black Hawk was used to compare the two systems. The comparative analysis focused on capabilities and costs of the Black Hawk versus the UH-1H helicopter to meet Army utility helicopter force structure and doctrinal mission requirements. The comparison showed that the Black Hawk is the most capable helicopter and when the normalized ratios were applied, the evidence indicated that the Black Hawk was

also the helicopter that minimized costs to attain the capabilities required by the Army to support Army doctrine.

The components of the economic analysis used in addressing the thesis question were objectives, assumptions and constraints, alternatives, capabilities and costs. The analysis results of these components indicated that the Black Hawk is capable of providing the mobility on the modern battlefield in deep, close, rear, security and reserve operations required to implement Army doctrine.

The analysis showed the requirement for Black Hawk helicopters for the Army consists of five categories. Those categories are the table of organization equipment (TOE), operational readiness float (ORF), repair cycle float (RCF), table of distribution and allowance (TDA), and attrition helicopters. The analysis revealed the categories where requirements would be short and that the shortfall was significant enough that the Army would not have the capabilities in lift, range, speed, deployability and survivability needed to implement the stated force projection doctrine from the national military strategy. That is that the capability of the Army's utility helicopter fleet would not have the capability required to implement the almost two nearly simultaneous theater conflicts with a mixed fleet of Black Hawks and UH-1H helicopters. Also the Army would not be equipped to meet the force structure quantities outlined in the Bottom-Up review. These findings

indicate that the option that best supports the Army doctrine is to procure the total requirement of Black Hawk helicopters required for the Army.

The analysis also included four mission areas required to be executed by Army utility helicopters in support of doctrine. These mission areas are air assault, aero medical evacuation (MEDEVAC), command and control, general support. The evidence showed that in order for the Army to implement these missions effectively the Black Hawk's capabilities would be required to accomplish these missions to the standards established in the Material Needs Document for an Army utility helicopter.

To analyze the cost differences between the Black Hawk and the UH-1H four areas were considered: Program Objective Memorandum, flying hours, sustainment, and personnel. The evidence indicated in the area of the POM that there is a window of opportunity for the Army to influence the program objective memorandum in the budget development process for the Fiscal Year 1996 to Fiscal Year 2001 time period. This window of opportunity showed that the time needed to establish a follow on Multi-Year V contract for the Black Hawk can be accomplished if funding is added into the next POM cycle. The need for reducing costs by establishing a multi-year procurement contract was determined to be the critical factor influencing the window of opportunity. To illustrate this need, a contractor must

order long lead items such as engines, rotor blades, transmissions and other parts from sub-contractors in time to introduce the parts into the manufacturing process when they are required. This point is critical in reducing costs of continued procurement of the Black Hawk. The other factor identified that influences this window of opportunity for funding the continued procurement of Black Hawks in the POM is the sustainment of the production capability of Sikorsky helicopters. The means for Sikorsky helicopters to sustain their capability to produce helicopters at an acceptable economic rate that supports cost savings for the Army is a multi-year production contract.

Furthermore the analysis showed that flying hours, sustainment, and personnel are critical areas that have a significant impact on the costs of the two alternatives. That impact is highlighted in Figures 11 and 12, pages 104 and 105. What the study indicated is that the comparison of the Black Hawk and the UH-1H is based on two systems that have unequal capabilities and unequal costs. The difficulty was to determine which helicopter maximizes capabilities and minimizes costs. The combinations of all these cost factors were used to establish the most relevant criteria to the thesis question that would provide a framework for quantitative results. These results were translated into conclusions and recommendations.

When the cost factors were analyzed, it was from the perspective of a system that can maximize capabilities and minimize the costs of providing that capability. It was determined that the Black Hawk is the helicopter that can meet that objective. The results of supporting continued procurement of the Black Hawk would be a force structure that is equipped to meet the doctrinal requirements that the force structure was designed to support.

The results of the Bottom-Up review option of eliminating funding for the Black Hawk after 1996 would be a mixed fleet that would not have the capability to implement the force projection doctrine established in the national security Strategy and the national military strategy. The normalized ratio difference between the Black Hawk and the UH-1H indicated in the analysis a significant impact on the functional areas of force structure, equipping, training, manning, sustaining, mobilizing, deploying, capabilities and cost requirements. The impact on these functional areas established the complexity of the comparison of the Black Hawk and the UH-1H as needing more analysis than a one UH-1H to one Black Hawk comparison to determine whether the Black Hawk procurement option should be programmed for funding in the program objective memorandum. By establishing a ratio that considered the capabilities and costs to provide those capabilities, a comprehensive comparative analysis showed that these functional areas were critical in determining

that the Army should continue to procure the Black Hawk helicopter to meet the total force structure requirement.

The analysis determined that the differing opinions on the dilemma to procure all the Black Hawks required or fill force structure shortages by retaining UH-1Hs were basing their positions on different criteria. The Black Hawk procurement position used doctrinal requirements and the capabilities of the Black Hawk helicopter to meet those requirements as the basis of their position. Those who recommend retention of the UH-1H and canceling procurement of the Black Hawk are under the perceived condition that cost savings will be realized. What the analysis of the validity of these two positions indicated was that the Black Hawk allows you to maximize capabilities and minimize the cost to provide those capabilities. Retaining the UH-1H was identified as not having the capability to support doctrine and force structure. By retaining the UH-1H as a replacement for the shortfall of Black Hawks beyond 1996 would result in the need of the Army to address two issues. First, the Army would need to address its doctrine to determine if changes were required based on the equipment that is fielded to the force. The second issue is that the Army would need to assess its force structure to determine if changes were required to support the national military strategy and Army doctrine with the equipment that is fielded. The third issue would deal with establishing a

requirement for a service life extension program for the UH-1H helicopter that would include as a minimum a more powerful engine and drive train, and avionics and aircraft survivability system. These changes would reduce the risk of operating the technologically obsolete helicopter on the modern battlefield. The concern with this option is to identify if the upgrades would allow a reduction of the risk to crews and soldiers that retaining the UH-1H in the force structure would have on meeting doctrinal mission requirements.

The next step for the Army is to decide whether to continue to modernize the utility helicopter fleet beyond Fiscal Year 1996. The window of opportunity for this issue is the next Program Objective Memorandum covering the period 1996 through 2001. The importance of the next Program Objective Memorandum (Fiscal Year 1996 through 2001) is that a decision to support continued procurement of the Black Hawk or retain the UH-1H in the force structure will have to be made. The analysis suggests that the criteria be based on the need to equip the force structure established in the Bottom-Up Review with a helicopter capable of meeting doctrinal mission requirements that support the National Security and National Military Strategy of Forward Presence and CONUS based Force Projection. Therefore, since the Black Hawk is not currently programmed for procurement of the total requirement beyond 1996, this decision will need

to be addressed prior to the submission of the Fiscal Year 1996 to Fiscal Year 2001 Program Objective Memorandum.

### Conclusion

The results of the analysis suggest that based on current doctrinal requirements and force structure levels, the Army should continue to procure the Black Hawk helicopters needed to meet the requirement of 2195 Black Hawks determined by the Bottom-Up review. The significance of this conclusion to the Army is that if the Black Hawk procurement option is not supported, then the option that must be considered is to explore changing doctrinal use of the utility helicopters needed to implement doctrine. That determination would set the conditions for further review of the force structure requirements for utility helicopters and lead to possible reductions in the quantities below the current 2195 Black Hawk requirement.

The significance of this study is in its applicability to the current force structure issues associated with the Bottom-Up Review downsizing of the Army as a result of the end of the cold war era. This study is meant to be used by Headquarters, Department of the Army Force Development Aviation office, Training and Doctrine Command, Director of Combat Development, Aviation at Fort Rucker and the Utility Helicopter Program Managers office in Saint Louis. These offices are responsible for the

development of doctrine for Army Aviation, validating the force structure requirements, developing the Aviation Modernization Plan, developing the equipment required to meet doctrine and force structure requirements and developing the input for the Program Objective Memorandum (POM) which requests the funding to procure the modernized systems. Modernized systems are funded when they are determined to be needed to implement the doctrine established in the national security and national military strategy.

The recommendations of this study are made with the understanding that they provide all the offices mentioned above with information that is hopefully useful in the process of developing the Aviation Modernization strategy for the Fiscal Year 1996 to Fiscal Year 2001 Program Objective Memorandum and Total Army Analysis process for funding and validation of capabilities to implement doctrinal utility helicopter mission requirements. Additionally, the recommendations are based on the modernization priorities established by HQDA, ODCSOPS, Aviation Force Development office.

#### Recommendations

The comparison of Black Hawk and UH-1H's capabilities and costs indicate that when you establish a normalized ratio for the analysis the results indicate the Black Hawk maximizes capabilities and minimizes costs to

provide those capabilities. This evidence suggests that the Army should procure the total quantity of Black Hawk helicopters it requires. Therefore, the continued procurement of the Black Hawk and the continued retirement of all the UH-1H helicopters would be the favorable course of action for the Army to pursue in the next Program Objective Memorandum development.

If the Army is not successful in securing funding for continued procurement of the Black Hawk helicopter beyond Fiscal Year 1996, this study recommends that the Army consider reviewing doctrine and force structure requirements to assess if doctrinal or force structure changes could be made to reduce the requirement for the Black Hawk to an affordable level. The primary consideration in this approach would be the determination that the doctrine and force structure changes are capable of implementing the national military strategy of force projection. This would require another effort much like the Aviation Restructure Initiative. This effort could be validated in the Total Army Analysis (TAA) process by determining if doctrinal and force structure changes could meet the Army's mission requirements.

This thesis is not all inclusive on the research that can be conducted on this subject. There are several areas that were identified in the course of the research on this subject that warrant further inquiry. Topic areas that

are recommended for further study are to review the factors used to determine the TDA, ORF, RCF, and Attrition requirements. These factors seem to be based on less technologically capable systems and modernized systems could have increased maintainability that are not considered in determining helicopter quantity requirements in those sustainment areas.

Another area that warrants further inquiry is whether a service life extension program for the UH-1H would be required if funding is not provided for the continued procurement of the Black Hawk helicopter.

A study to determine if there is a quantity of Black Hawks that could be procured that is below the requirement, that would have the capability to support doctrine and force structure. This would allow for the retirement of all the remaining UH-1H's and would establish a pure fleet of Black Hawks. What would have to be measured is the level of risk required in one or more areas of force structure requirements that would be acceptable and supports implementation of doctrine and force structure requirements in the current national security strategy and the Bottom-Up Review.

## GLOSSARY

- Army Aviation Association of America (AAAA) Magazine: A periodical that focuses on Army Aviation issues.
- Army Command and Management, Theory and Practice: A text that defines the army force development structure.
- Army Doctrine: "The statement of how America's Army as part of a joint team intends to conduct war and operations other than war"<sup>40</sup>
- Army Force Structure: The size of the force determined by National Security and National Military Strategy requirements. Currently four corps and fifteen divisions.
- Attrition: Loss of equipment over time due to war, maintenance, accidents and retirement.
- Aviation Restructure Initiative (ARI): This is Army Aviation's effort to comply with the downsizing requirements the Army is facing. This was developed by TRADOC at Fort Rucker and is scheduled for implementation beginning in FY95.
- Black Hawk helicopter: The primary utility helicopter developed to meet US Army mission requirements of Air Assault, Command and Control, Battlefield resupply and Medical Evacuation.
- Bottom-Up Review: a study done by the Department of Defense in response to the end of the Cold War and the associated reduction of military budgets. The review is a "Strategy to address dangers and seize opportunities in Force Structure Options and Modernization Choices."<sup>41</sup>

Combined Arms Research Library (CARL): The library at Fort Leavenworth that supports the Command and General Staff School.

Commander in Chief (CINC): The CINC is the combatant commander of unified commands. CINCs work for the National Command Authority (President and Secretary of Defense) and are responsible for developing wartime strategy in support of the National Security Strategy.<sup>42</sup>

Congressional Hearings on the development of the Defense Budget: conducted to allocate funds for the Presidents Defense Budget.

Cost and Operational Effectiveness Analysis (COEA): a study directed to determine if a system is performing to the standards directed in appropriate requirement's documents.

Department of the Army Master Priority list (DAMPL): The DAMPL "is the primary prioritization tool of the Army Readiness Management System.... DAMPL allows the Army to optimize the readiness value of scarce resources and to place the shortages where the least risk is involved."<sup>43</sup>

Department of the Army Staff in the Deputy Chief of Staff for Operations and Plans (DCSOPS) office: The office responsible for development of the Army Aviation Modernization Plan, development of force structure and funding requirements for Army Aviation.

Functional Areas: Topics that organize planning for the U.S. Army requirements. They are: structure, equipping, training, manning, sustaining, mobilizing, deploying and warfighting.

Jane's Defense Weekly: A periodical magazine that focuses on military issues.

ODCSOPS: Office of the Deputy Chief of Staff for Operations and Plans.

Operational Readiness Float (ORF): Unit and intermediate level additional equipment available for issue while repair and maintenance of unit equipment is being performed<sup>44</sup>

Planning, Programming and Budgeting System (PPBS): The Army process to develop the defense budget.

Program Managers Office: Office responsible for establishing contracts to procure equipment directed by Department of the Army.

Program Objective Memorandum (POM): This is the services product of the program development process that supports the development of the Presidents Budget Submission for defense acquisitions. The military departments "send POMs to the Secretary of Defense in the spring of even-numbered years."<sup>45</sup> These identify major issues that must be resolved during the year of submission.

Qualitative Material Development Objective (QMDO): A study conducted to determine the requirements for a replacement for the UH-1H Vietnam era helicopter in the Army.

Repair Cycle Float (RCF): Depot level additional equipment available for issue while repair and maintenance of unit equipment is being performed.

Systems Integrator: The Headquarters Department of the Army "point of contact for determining requirements, accomplishing fielding and other user-oriented functions related to material acquisition."<sup>46</sup>

Service life: The time period from delivery of the system until programmed retirement.

Sustainment costs: The funds required to maintain the equipment after it is procured, to train the operators and operate the equipment on a daily basis.

Table of Distribution and Allowances (TDA): TDA  
"records the mission, organizational structure, and personnel and equipment requirements and authorizations...to perform added non-TOE peacetime missions."<sup>47</sup>

Table of Organizational Equipment (TOE): "Is a document which prescribes the organizational design, including personnel and equipment requirements, for a type unit displayed in discrete evolutionary increments of capability."<sup>48</sup>

The Army Plan (TAP): Army guidance for development of force structure, equipment and personnel requirements for the future.

The Aviation Modernization Plan: The document developed by Headquarters, Department of the Army to forecast Army Aviation Modernization requirements through FY2010.

Total Army Analysis (TAA) FY2001: This is the process conducted at Headquarters Department of the Army level to validate Force Structure requirements. It is important to understand that,

The Total Army Analysis is a multi-phased force structure process. It consists of both qualitative and quantitative analyses to generate tactical support forces and general purpose forces necessary to sustain and support the divisional and nondivisional combat forces designated in the Objective Force. TAA is a biennial process conducted during even-numbered years followed by a Force Integration Analysis (FIA) conducted during odd-numbered years. The continuum and combination of the TAA and FIA are the basis for the Army's Program Objective Memorandum (POM) development and establishment of the programmed force.<sup>49</sup>

TAA is the basis for determining equipment and personnel requirements that must compete for funding in the Programming, Planning and Budgeting System (PPBS).

Training and Doctrine Command (TRADOC): Is the organization that produces "training, doctrine, tactics, techniques, and the required user representation in material acquisition."<sup>50</sup>

UH-1H (HUEY): Utility helicopter procured during and after the Vietnam war to support Army utility helicopter requirements.

Utility Fleet Modernization: The process of procuring new equipment to replace obsolete equipment in the force structure.

Utility helicopter missions: Air Assault, Command and Control, Medical Evacuation and General Support.

Utility Tactical Transport Aircraft System (UTTAS)  
Material Need Statement (MNS): A document that initiates the procurement process for equipment identified by the Department of the Army leadership as a requirement.

FIGURES

CHRONOLOGY OF UTILITY HELICOPTER MODERNIZATION REQUIREMENT

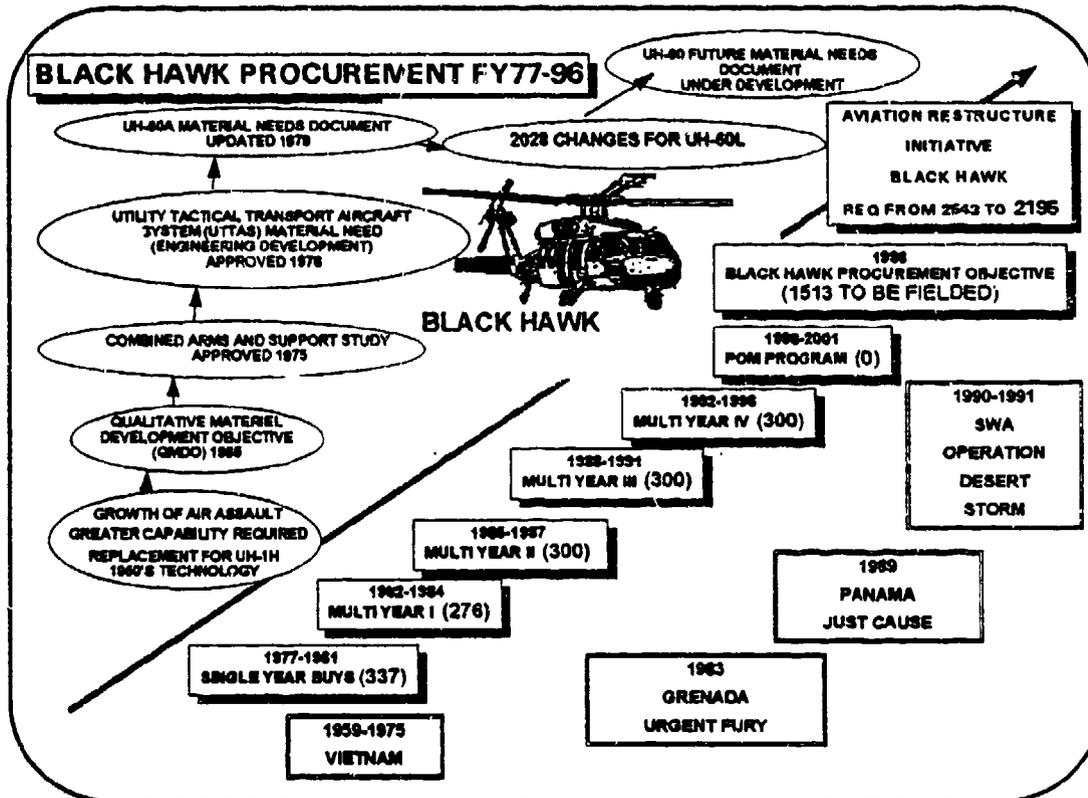


Figure 1. This information was obtained from the Black Hawk Material Need Statement and documents furnished by Headquarters, Department of the Army, Office of the Deputy Chief of Staff for Operations and Plans, Aviation Force Development.

**BOTTOM-UP REVIEW REQUIREMENT**

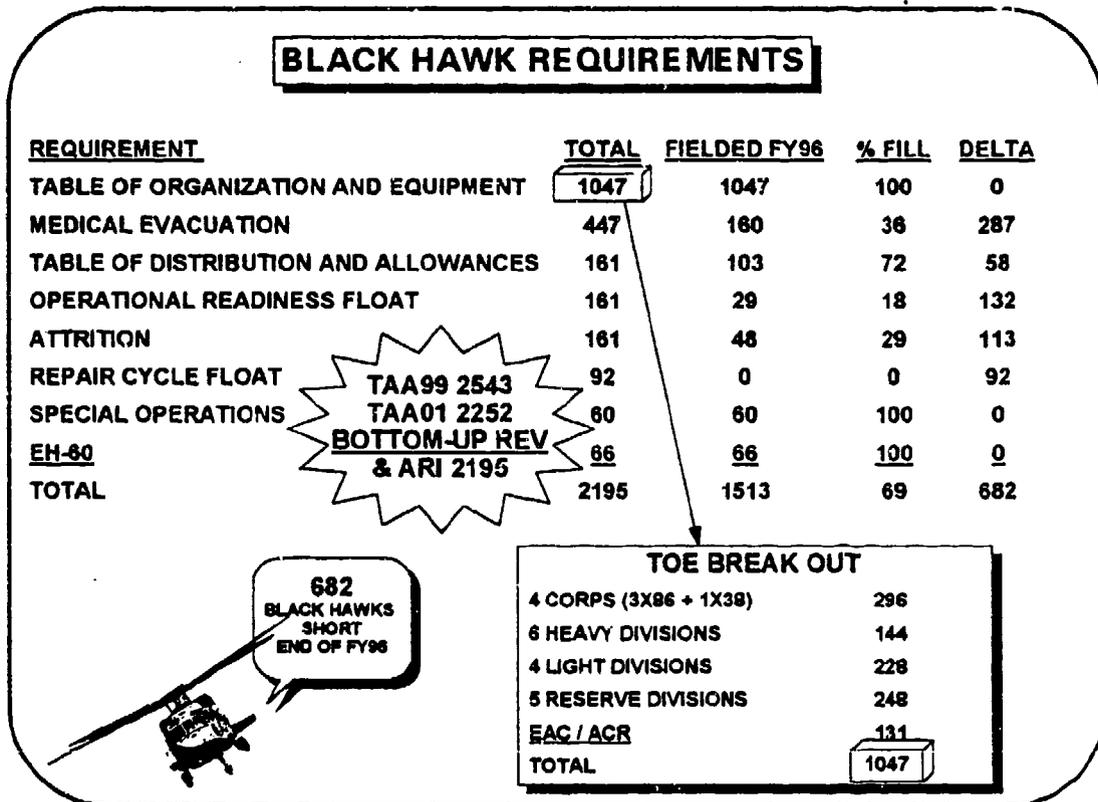


Figure 2. This information was obtained from the Black Hawk Material Need Statement, The Bottom-Up Review and The Aviation Restructure Initiative documents furnished by Headquarters, Department of the Army, Office of the Deputy Chief of Staff for Operations and Plans, Aviation Force Development.

BOTTOM-UP REVIEW FORCE STRUCTURE

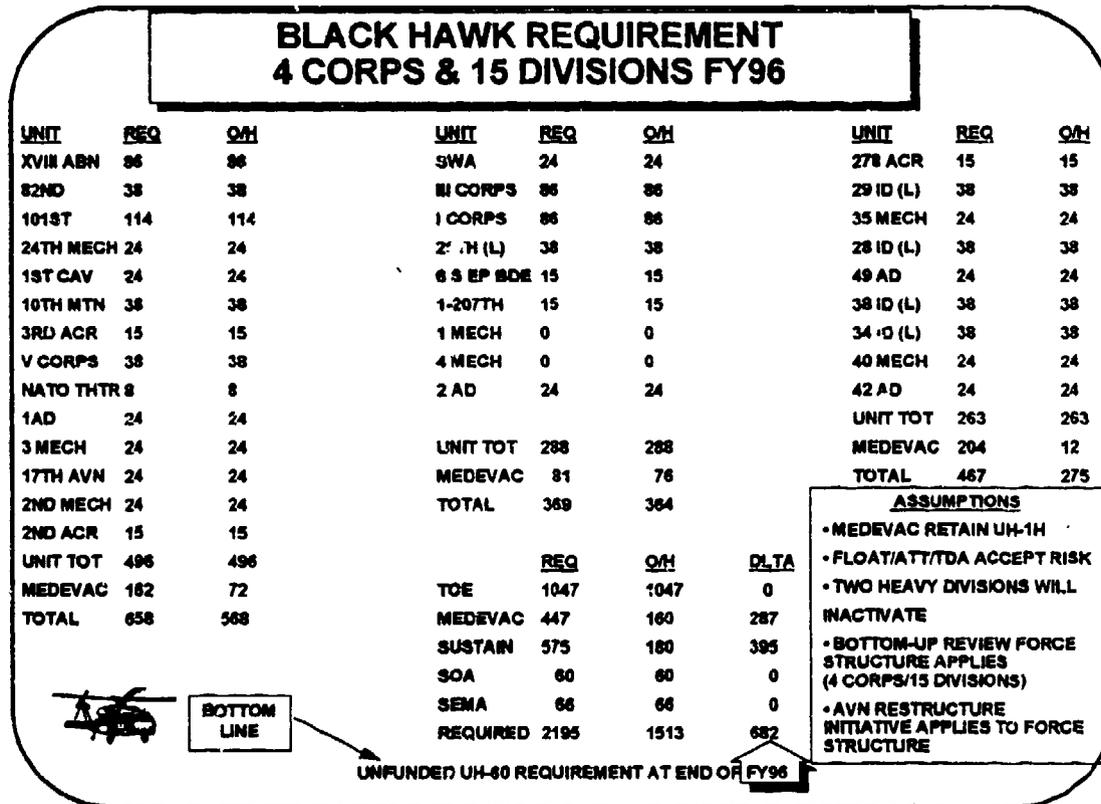


Figure 3. This information was obtained from the Black Hawk Material Need Statement, The Bottom-Up Review and The Aviation Restructure Initiative documents furnished by Headquarters, Department of the Army, Office of the Deputy Chief of Staff for Operations and Plans, Aviation Force Development.

RESEARCH DESIGN

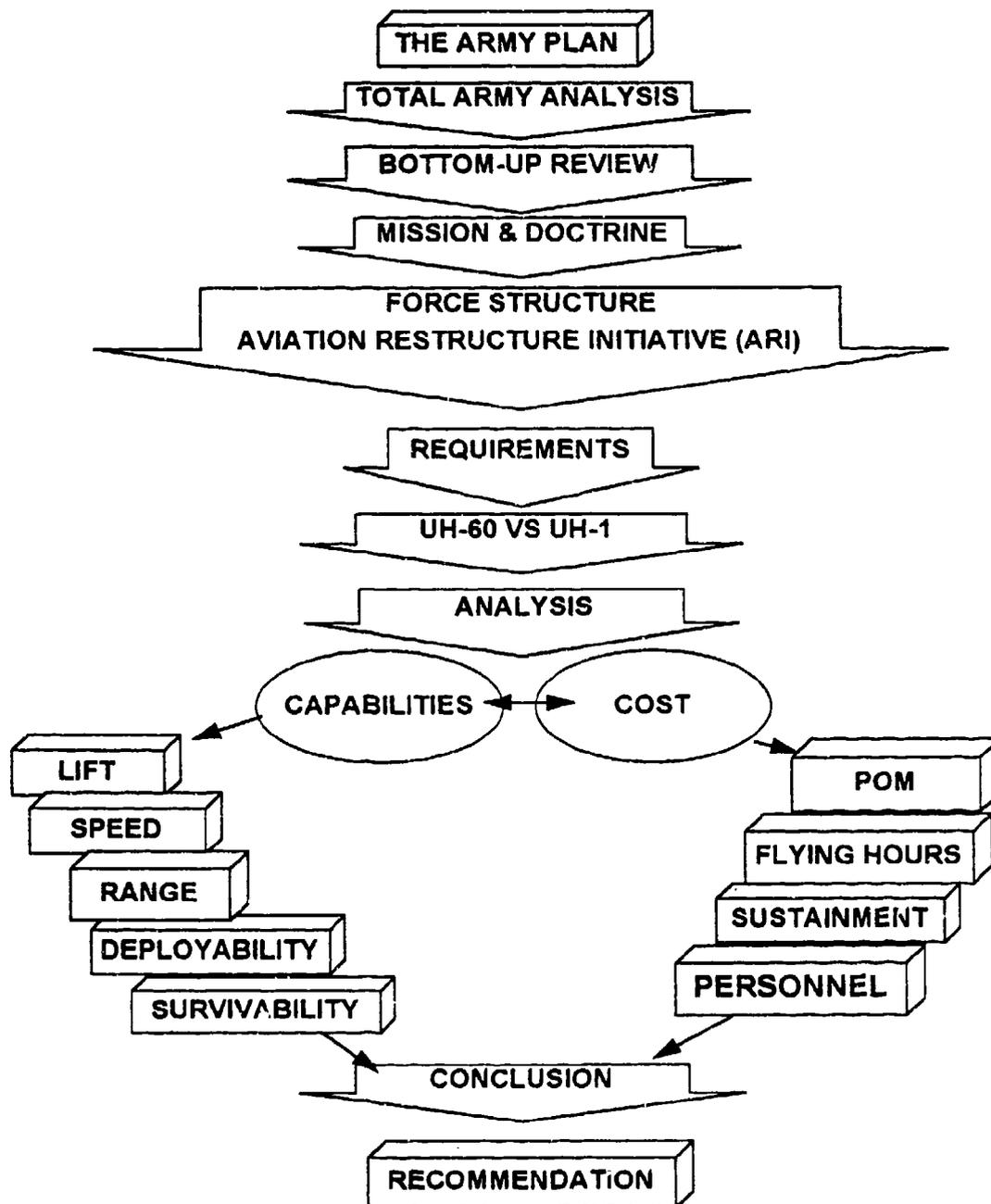


Figure 4. Research Design model developed by the author of this thesis based on guidance in the Master of Military Art and Science (MMAS) Research and Thesis Student Text 20-10.

**BLACK HAWK HELICOPTER  
TECHNOLOGICAL CAPABILITIES**

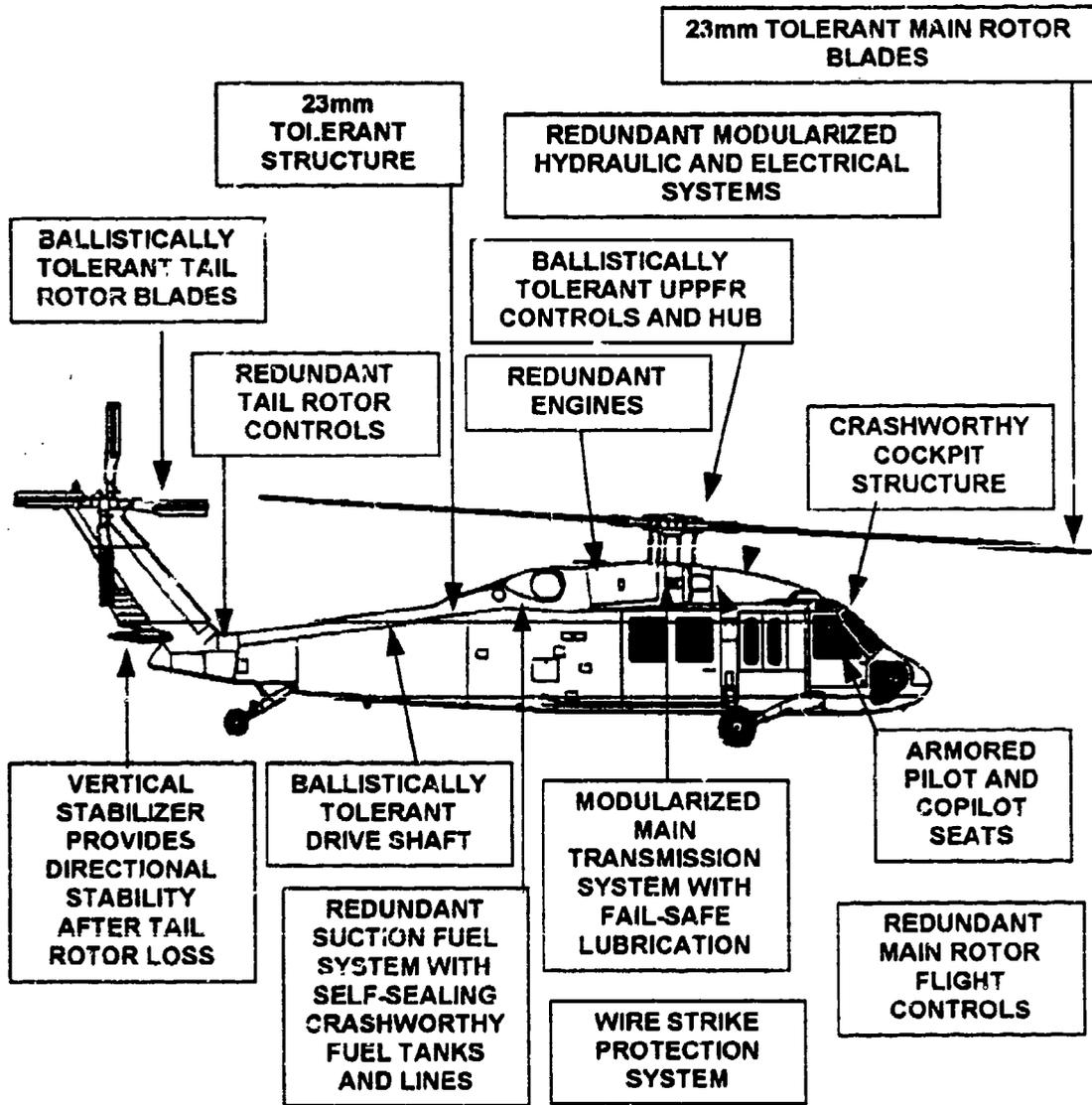


Figure 5. This information was obtained from the Black Hawk Helicopter Technical Manual 55-1520-237-10.

**UH-1H HELICOPTER  
TECHNOLOGICAL CAPABILITIES**

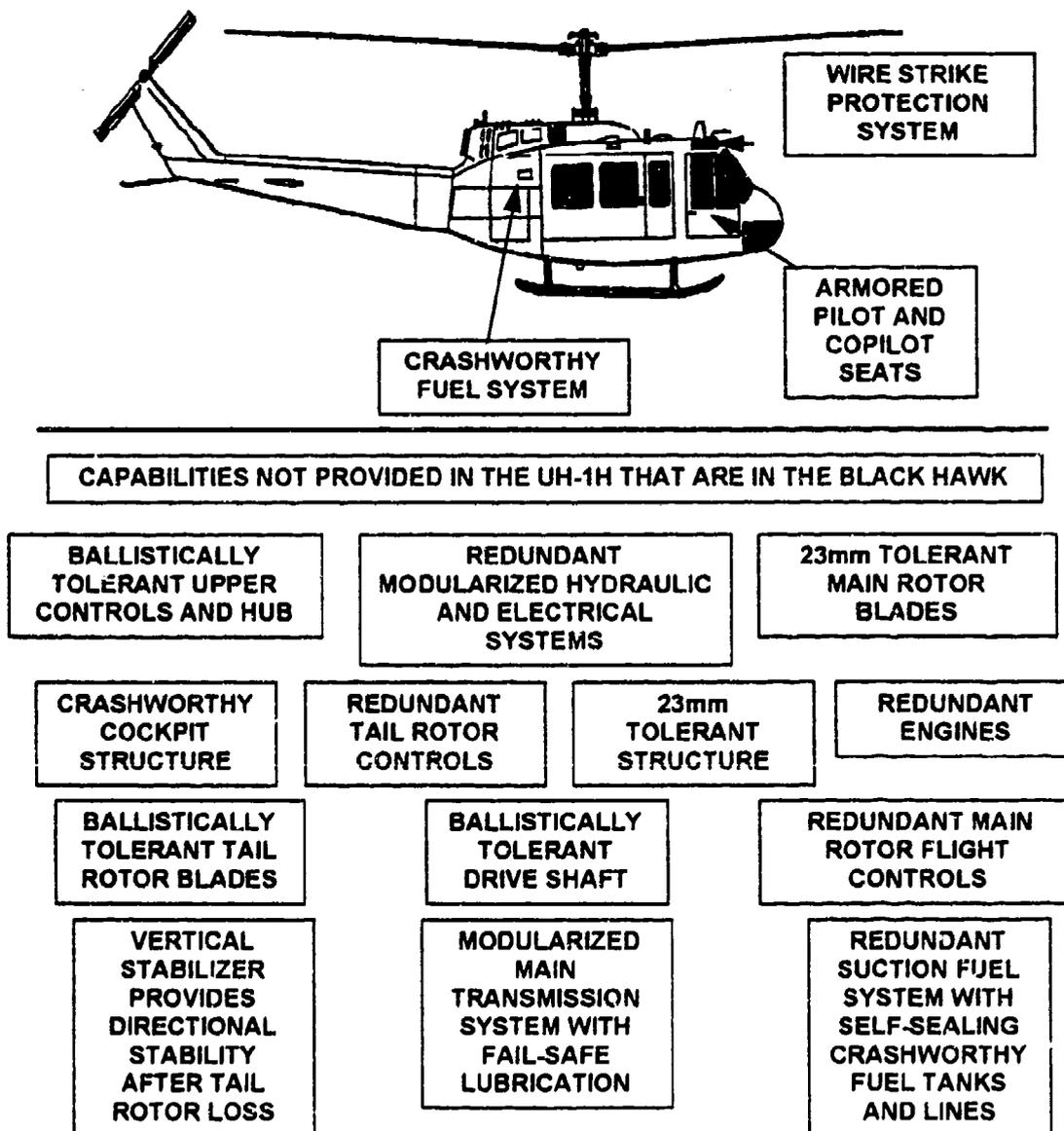


Figure 6. This information was obtained from the UH-1H Helicopter Technical Manual 55-1520-210-10.

CAPABILITIES AND COST COMPARISON

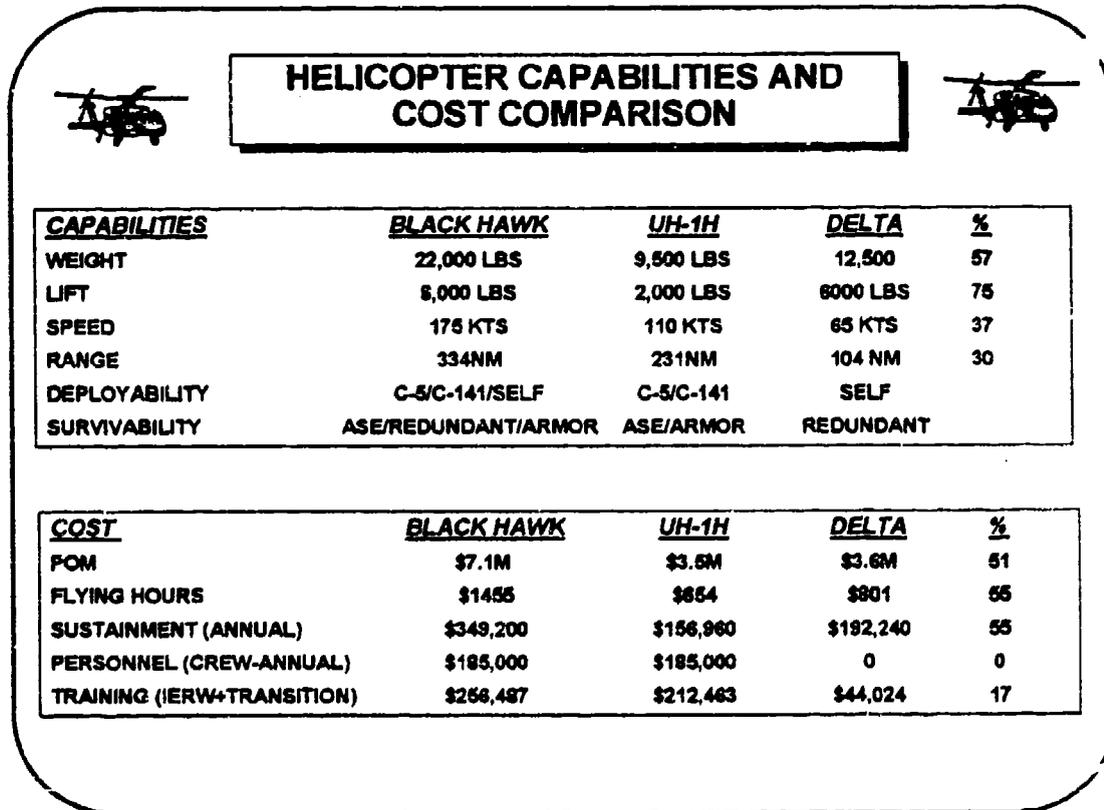


Figure 7. This information was furnished by the Office of the Secretary of the Army for Research and Development, Sikorsky Helicopter and the Utility Helicopter Program Manager in Saint Louis.

## CAPABILITIES COMPARISON

### BLACK HAWK AND UH-1H CHARACTERISTICS USED FOR COMPARATIVE ANALYSIS

|                   | BLACK<br>HAWK | UH-1H | WEIGHT<br>DELTA | CAPABILITY<br>DELTA % |
|-------------------|---------------|-------|-----------------|-----------------------|
| BASIC WEIGHT      | 11516         | 5421  | 6095            | 53                    |
| CREW              | 720           | 720   | 0               | 0                     |
| CARGO HOOK        | 25            | 21    | 4               | 16                    |
| MACHINE GUN       | 85            | 85    | 0               | 0                     |
| FULL FUEL         | 1976          | 1342  | 634             | 32                    |
| TOTAL WEIGHT      | 14322         | 7589  | 6733            | 47                    |
| <br>              |               |       |                 |                       |
| GROSS WEIGHT      | 22000         | 9500  | 12500           | 57                    |
| TOTAL WEIGHT      | 14322         | 7589  | 6733            | 47                    |
| ALLOWABLE<br>LOAD | 7678          | 1911  | 5767            | 75                    |

Figure 8. This information was obtained from the Operator's Technical Manuals for the Black Hawk and UH-1H helicopters.

## HELICOPTER CAPABILITIES COMPARISON

### BLACK HAWK AND UH-1H CAPABILITIES USED FOR COMPARATIVE ANALYSIS

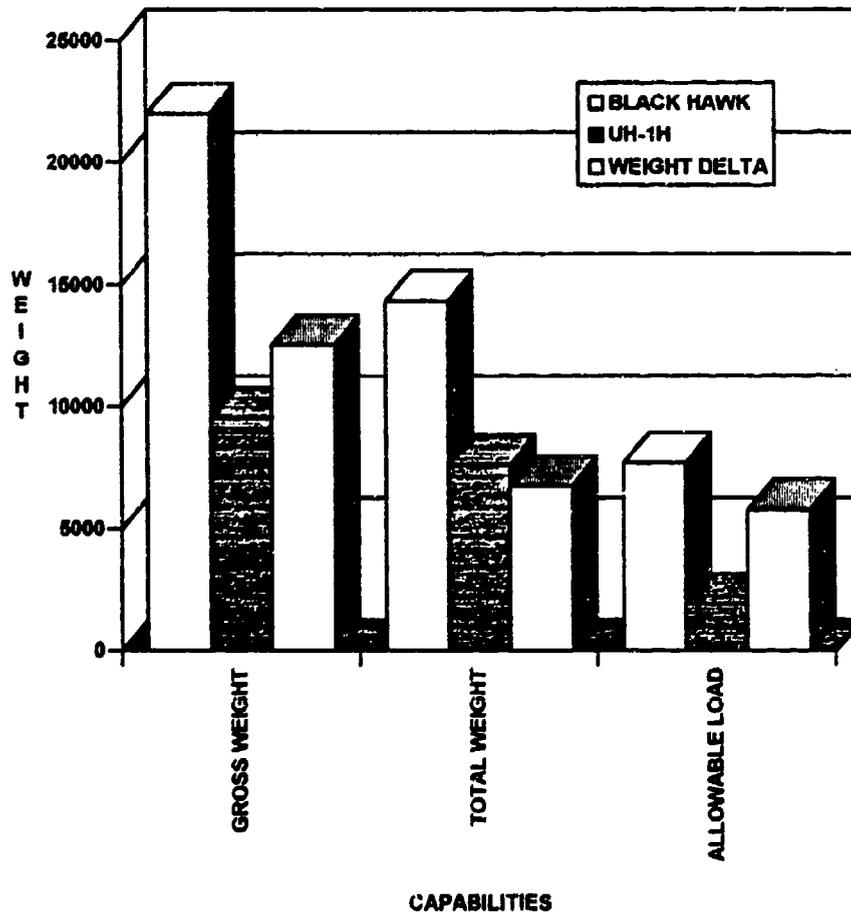


Figure 9. This information was obtained from Operator's Technical Manuals for the Black Hawk and UH-1H helicopters.

## COST FACTORS

| COST FACTORS FOR BLACK HAWK AND UH-1H COMPARATIVE<br>ANALYSIS USING FY94 CONSTANT YEAR DOLLARS |                           |   |
|--|---------------------------|---|
|  | BLACK HAWK                | UH-1H   |
| PROJECTED ON<br>HAND QUANTITY<br>FOR ANALYSIS  | 1513                      | 3410  |
| PROCUREMENT<br>QUANTITY<br>SHORTFALL   | 682                       | 710<br>NOTE: INCLUDED IN<br>THE 3410 QUANTITY |
| RESEARCH AND<br>DEVELOPMENT  | SUNK COST FOR<br>ANALYSIS | SUNK COST FOR<br>ANALYSIS                     |
| PROCUREMENT  | 7.1 MILLION EACH          | 3.5 MILLION EACH                              |
| OPERATIONS &<br>SUPPORT  | 1455 PER HOUR             | 654 PER HOUR                                  |
| PERSONNEL<br>CREWS   | 682 X 4 = 2728            | 3410 X 4 = 13640                              |
| SALVAGE  | 4.8 MILLION EACH          | 230 THOUSAND EACH                             |
| FLYING HOURS   | 20 PER MONTH              | 20 PER MONTH                                  |
| LIFE CYCLE   | 20 YEARS                  | 20 YEARS                                      |
| NORMALIZED<br>FACTOR   | 1                         | 5   |

Figure 10. This information was provided by the Utility Helicopter Program Manager and The Deputy Chief of Staff for Operations and Plans Training Office, The Pentagon.

## LIFE CYCLE COST COMPARISON

LIFE CYCLE COST COMPARISON IN MILLIONS OF FY94 CONSTANT YEAR DOLLARS

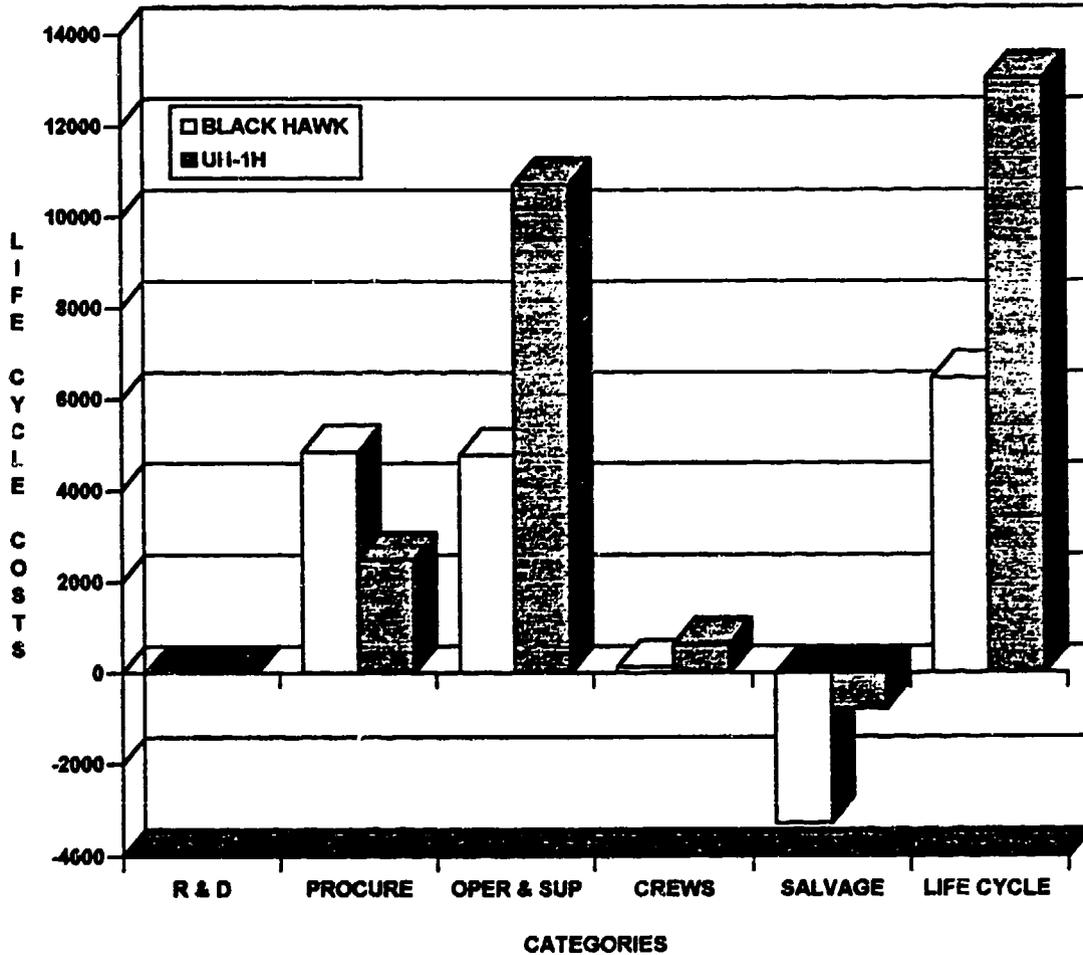


Figure 11. This information was obtained from documents provided by The Office of the Secretary of the Army for Research and Development, Department of the Army Logistics Office for Aviation, in the Pentagon and from telephone interviews with the Army Utility Helicopter Program Managers Office in Saint Louis, Mo.

LIFE CYCLE COSTS

|                          | BLACK HAWK    | UH-1H          |
|--------------------------|---------------|----------------|
| R & D                    | SUNK COST     | SUNK COST      |
| PROCURE                  | 4,842,200,000 | 2,485,000,000  |
| OPER & SUP               | 4,763,088,000 | 10,704,672,000 |
| CREWS                    | 126,170,000   | 630,850,000    |
| SALVAGE                  | 3,273,600,000 | 784,300,000    |
| LIFE CYCLE<br>COST TOTAL | 6,457,858,000 | 13,036,222,000 |

Figure 12. This information was gathered from multiple sources provided by the Utility Helicopter Program Manager, Training and Doctrine Command (TRADOC), Director of Combat Developments, Fort Rucker and Headquarters, Department of the Army staff agencies in the Pentagon.

## ENDNOTES

### Chapter 1

<sup>1</sup>United States Army Training and Doctrine Command, UH-60A Black Hawk Material Need, Production, Updated (MN) (P) 1979, p. 2.

<sup>2</sup>United States. Headquarters, Department of the Army, The Army Modernization Plan, Aviation, Annex L. 1993, p. 11.

<sup>3</sup>United States. Department of Defense, Bottom Up Review, Department of Defense Briefing to Secretary of Defense, September, 1993, p. 1.

<sup>4</sup>United States. Department of Defense, National Military Strategy of the United States. Washington D.C.: U.S. Government Printing Office, 1992, p. 6.

<sup>5</sup>Richard H. Goldsmith, Army Command and Management, Theory and Practice. U.S. Army War College, Carlisle Barracks, PA., 1992, p. 14-9.

<sup>6</sup>Major General John D. Robinson, Aviation Restructure Initiative (ARI): Aviation in Your Future, Army Aviation Association of America (AAAA) 30 November 1993, p. 16.

<sup>7</sup>General Dennis J. Reimer, FORSCOM Aviation: A Part of Our Total Army Readiness, Army Aviation Association of America, 31 October 1993, p. 14.

<sup>8</sup>Richard H. Goldsmith, Army Command and Management, Theory and Practice. U.S. Army War College, Carlisle Barracks, PA., 1992, p. 3-16.

<sup>9</sup>Richard H. Goldsmith, Army Command and Management, Theory and Practice. U.S. Army War College, Carlisle Barracks, PA., 1992, p. 11-1.

<sup>10</sup>United States. Headquarters, Department of the Army, Field Manual 100-5, Operations, U.S. Government Press, 1993, p. 1-1.

<sup>11</sup>United States. Department of Defense, "Bottom-Up Review," Department of Defense Briefing to Secretary of Defense, September, 1993 p. 3.

<sup>12</sup>Ibid., p. 14-21.

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<sup>13</sup>Richard H. Goldsmith, Army Command and Management, Theory and Practice, U.S. Army War College, 1992, p. 14-17.

<sup>14</sup>Richard H. Goldsmith, Army Command and Management, Theory and Practice, U.S. Army War College, 1992, p. 14-17.

<sup>15</sup>United States. Department of Defense, "Bottom Up Review," Department of Defense Briefing to Secretary of Defense, September, 1993, p. 6.

<sup>16</sup>United States. Department of Defense, The Joint Staff Officer's Guide, AFDC PUB 1. Washington D.C.: U.S. Government Printing Office, 1993, p. 5-8.

<sup>17</sup>United States. Headquarters, Department of the Army. Field Manual 100-5, Operations. Washington D.C.: Government Printing Office, 1993, p. iv.

<sup>18</sup>United States. Headquarters, Department of the Army, The Army Modernization Plan, Aviation, Annex L. 1993, p. 1.

<sup>19</sup>Richard H. Goldsmith, Army Command and Management, Theory and Practice, U.S. Army War College, 1992, p. i.

<sup>20</sup>United States. Headquarters, Department of the Army, Utility Tactical Transport Aircraft System Cost and Operational Effectiveness Analysis Review (UTTAS COEA Review), TRADOC, 16 December 1980, p. iii.

<sup>21</sup>United States. Headquarters, Department of the Army, Utility Tactical Transport Aircraft System Cost and Operational Effectiveness Analysis Review (UTTAS COEA Review), TRADOC, 16 December 1980, p. iv.

### Chapter 3

<sup>22</sup>Richard H. Goldsmith, Army Command and Management, Theory and Practice, U.S. Army War College, 1992, p. 1-1.

<sup>23</sup>Major Robert W. Kenneally, U.S. Army, "Decision Briefing on Black Hawk Fielding Plan 1993-1999." DCSOPS, Force Development, Director of Requirements, The Pentagon, 1993, p. 6.

<sup>24</sup>Richard H. Goldsmith, Army Command and Management, Theory and Practice, U.S. Army War College, 1992, p. 14-1.

### Chapter 4

<sup>25</sup>United States. Headquarters, Department of the Army, TRADOC PAM 525-5, Airland Operations, A Concept for the Evolution of Airland Battle for the Strategic Army of the 1990s and Beyond, TRADOC, 1991, p. 1.

<sup>26</sup>United States Army Training and Doctrine Command, UH-60A Black Hawk Material Need, Production, Updated (MN) (P) 1979, p. 28.

<sup>27</sup>United States. Headquarters, Department of the Army, TRADOC PAM 525-5, Airland Operations, A Concept for the Evolution of Airland Battle for the Strategic Army of the 1990s and Beyond, TRADOC, 1991, p. 4.

<sup>28</sup>United States. Department of Defense, National Military Strategy of the United States. Washington D.C.: U.S. Government Printing Office, 1992, p. 10.

<sup>29</sup>United States. Department of Defense, National Military Strategy of the United States. Washington D.C.: U.S. Government Printing Office, 1992, p. 10.

<sup>30</sup>U.S. Army Command and General Staff College, Student Text 25-1 Resource planning and Allocation. Fort Leavenworth, Kansas, 1994, p. 1-1.

<sup>31</sup>Ibid., p. 11-1.

<sup>32</sup>United States. Headquarters, Department of the Army, Field Manual 90-4, Air Assault Operations, U.S. Government Press, 1987, p. 1-1.

<sup>33</sup>United States Army Training and Doctrine Command, UH-60A Black Hawk Material Need, Production, Updated (MN) (P) 1979, p. 44.

<sup>34</sup>United States Army Aviation Center, Aviation Warfighting Treatise. Fort Rucker, Alabama, 1993, p. 12.

<sup>35</sup>Ibid., p. 13.

<sup>36</sup>Ibid., p. 12.

<sup>37</sup>Ibid., p. 12.

<sup>38</sup>United States. Headquarters, Department of the Army, Field Manual 1-111, Aviation Brigades, U.S. Government Press, 1990, p. 3-12.

#### Chapter 5

<sup>39</sup>United States. Department of Defense, The Joint Staff Officer's Guide, AFDC PUB 1. Washington D.C.: U.S. Government Printing Office, 1993, p. 5-8., para 502, b, (3).

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<sup>40</sup>United States. Headquarters, Department of the Army, Field Manual 100-5, Operations, U.S. Government Press, 1993 p. 1-1.

<sup>41</sup>United States. Department of Defense, "Bottom Up Review," Department of Defense Briefing to Secretary of Defense, September, 1993 p. 3.

<sup>42</sup>The Joint Staff Officer's Guide, AFDC PUB 1. 1993.  
pp. 5-14-5-15

<sup>43</sup>Goldsmith, Richard H. and others, eds., Army Command and Management, Theory and Practice. U.S. Army War College, Carlisle Barracks, PA., 1992. p. 9-15.

<sup>44</sup>Ibid., p. 18-15.

<sup>45</sup>Ibid., p. 14-21.

<sup>46</sup>Ibid., p. 17-11.

<sup>47</sup>Ibid., p. 11-18.

<sup>48</sup>Ibid., p. 11-10.

<sup>49</sup>Ibid., p. 11-12.

<sup>50</sup>Ibid., p. 8-3.

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