NAVAL POSTGRADUATE SCHOOL

MONTEREY, CALIFORNIA

THESIS

A COST BENEFIT ANALYSIS OF FIRE SCOUT VERTICAL TAKEOFF AND LANDING TACTICAL UNMANNED AERIAL VEHICLE (VTUAV) OPERATOR ALTERNATIVES

by

Kevin L. Heiss

March 2012

Thesis Advisor:	Bill Hatch
Second Reader:	Ben Roberts

Approved for pubic release; distribution is unlimited

THIS PAGE INTENTIONALLY LEFT BLANK

REPORT DOCUMENTATION PAGE		Form Approved OMB No. 0704-0188

1. AGENCY USE ONLY *(Leave blank)*	2. REPORT DATE	3. REPORT TYPE AND DATES COVERED
	March 2012	Master's Thesis

4. TITLE AND SUBTITLE A Cost Benefit Analysis of Fire Scout Vertical Takeoff and Landing Tactical Unmanned Aerial Vehicle (VTUAV) Operator Alternatives	5. FUNDING NUMBERS
6. AUTHOR(S) Heiss, Kevin L.	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Naval Postgraduate School Monterey, CA 93943-5000	8. PERFORMING ORGANIZATION REPORT NUMBER
9. SPONSORING /MONITORING AGENCY NAME(S) AND ADDRESS(ES) N/A	10. SPONSORING/MONITORING AGENCY REPORT NUMBER

11. SUPPLEMENTARY NOTES The views expressed in this thesis are those of the author and do not reflect the official policy or position of the Department of Defense or the U.S. Government. IRB Protocol number ___N/A____

12a. DISTRIBUTION / AVAILABILITY STATEMENT	12b. DISTRIBUTION CODE
Approved for public release; distribution in unlimited	A

13. ABSTRACT (maximum 200 words)

A cultural debate exists to determine if the MQ-8B Fire Scout Vertical Takeoff and Landing Tactical Unmanned Aerial Vehicle (VTUAV) should be operated by rated pilots, commissioned officers, or enlisted personnel. Each military service has historically treated this issue differently. The U.S. Navy currently requires rated pilots to fly Fire Scout, the U.S. Army and Marine Corps allow enlisted personnel to fly their Shadow Unmanned Aerial Vehicle (UAV), and the Air Force only allows rated pilots to fly their UAV systems. Technology has advanced rapidly in the area of UAVs as they have advanced from being remotely piloted aircraft to now being completely autonomous. This research examined the Air Vehicle Operator (AVO) requirements for autonomous vehicles such as Fire Scout and will demonstrate that the U.S Navy should create a pilot program that trains enlisted personnel to operate Fire Scout.

This research identifies the costs and benefits associated with each type of prospective operator alternative—rated pilots, commissioned Surface Warfare Officers (SWO), and Operations Specialist (OS) enlisted personnel. By utilizing enlisted AVOs vice rated pilots, training costs will be found to be reduced from millions to tens of thousands, annual amortized manning costs will be cut by more than half, and total cost savings will be found to be on the order of a billion dollars over a ten-year period. The research will also identify both tangible and intangible benefits by allowing enlisted personnel to become Fire Scout AVOs. Benefits are identified relating to training time, manning constraints, physiological constraints, culture, and safety. Furthermore, this research will summarize current Knowledge, Skills, and Abilities (KSA) necessary to operate an autonomous air vehicle such as Fire Scout.

14. SUBJECT TERMS Fire Scout VTUAV, Air Vehicle Operator (AVO), Mission Payload Operator (MPO), Intelligence Surveillance Reconnaissance (ISR), Unmanned Aerial Vehicle (UAV) Unmanned Aerial System (UAS), Human Resources Cost Analysis Tool (HRCAT)	15. NUMBER OF PAGES 91
	16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
Unclassified	Unclassified	Unclassified	UU

NSN 7540-01-280-5500 Standard Form 298 (Rev. 8-98)
Prescribed by ANSI Std. Z39.18

THIS PAGE INTENTIONALLY LEFT BLANK

Approved for public release; distribution is unlimited

A COST BENEFIT ANALYSIS OF FIRE SCOUT VERTICAL TAKEOFF AND LANDING TACTICAL UNMANNED AERIAL VEHICLE (VTUAV) OPERATOR ALTERNATIVES

Kevin L. Heiss
Commander, United States Navy
B.S., University of Southern California, 1996

Submitted in partial fulfillment of the
requirements for the degree of

MASTER OF SCIENCE IN MANAGEMENT

from the

NAVAL POSTGRADUATE SCHOOL
March 2012

Author: Kevin L. Heiss

Approved by: Professor Bill Hatch
Thesis Advisor

Dr. Ben Roberts
Second Reader

William Gates
Dean, Graduate School of Business and Public Policy

THIS PAGE INTENTIONALLY LEFT BLANK

ABSTRACT

A cultural debate exists to determine if the MQ-8B Fire Scout Vertical Takeoff and Landing Tactical Unmanned Aerial Vehicle (VTUAV) should be operated by rated pilots, commissioned officers, or enlisted personnel. Each military service has historically treated this issue differently. The U.S. Navy currently requires rated pilots to fly Fire Scout, the U.S. Army and Marine Corps allow enlisted personnel to fly their Shadow Unmanned Aerial Vehicle (UAV), and the Air Force only allows rated pilots to fly their UAV systems. Technology has advanced rapidly in the area of UAVs as they have advanced from being remotely piloted aircraft to now being completely autonomous. This research examined the Air Vehicle Operator (AVO) requirements for autonomous vehicles such as Fire Scout and will demonstrate that the U.S Navy should create a pilot program that trains enlisted personnel to operate Fire Scout.

This research identifies the costs and benefits associated with each type of prospective operator alternative—rated pilots, commissioned Surface Warfare Officers (SWO), and Operations Specialist (OS) enlisted personnel. By utilizing enlisted AVOs vice rated pilots, training costs will be found to be reduced from millions to tens of thousands, annual amortized manning costs will be cut by more than half, and total cost savings will be found to be on the order of a billion dollars over a ten-year period. The research will also identify both tangible and intangible benefits by allowing enlisted personnel to become Fire Scout AVOs. Benefits are identified relating to training time, manning constraints, physiological constraints, culture, and safety. Furthermore, this research will summarize current Knowledge, Skills, and Abilities (KSA) necessary to operate an autonomous air vehicle such as Fire Scout.

THIS PAGE INTENTIONALLY LEFT BLANK

TABLE OF CONTENTS

THIS PAGE INTENTIONALLY LEFT BLANK

LIST OF FIGURES

THIS PAGE INTENTIONALLY LEFT BLANK

LIST OF TABLES

THIS PAGE INTENTIONALLY LEFT BLANK

LIST OF ACRONYMS AND ABBREVIATIONS

(AQD)	Additional Qualification Designator
(ASTAC)	Anti-Submarine Tactical Action Coordinator
(ASW)	Anti-Submarine Warfare
(AVO)	Air Vehicle Operator
(AZ)	Aviation Administrationman
(CIC)	Combat Information Center
(DoD)	Department of Defense
(FAA)	Federal Aviation Administration
(GCS)	Ground Control Station
(HRCAT)	Human Resources Cost Analysis Tool
(HSL)	Helicopter Anti-Submarine Light
(ISR)	Intelligence, Surveillance, and Reconnaissance
(KSA)	Knowledge, Skills, and Abilities
(LCS)	Littoral Combat Ship
(MC)	Mission Commander
(MIT)	Massachusetts Institute of Technology
(MOS)	Military Occupational Specialties
(MPO)	Mission Payload Operator
(NROTC)	Naval Reserve Officer Training Corps
(NEC)	Navy Enlisted Classification
(NEOCS)	Navy Enlisted Manpower and Personnel Classifications and Occupational Standards
(NOMI)	Naval Operational Medicine Institute

(NTSP) Navy Training System Plan

(NGC) Northrop Grumman Corporation

(OCS) Officer Candidate School

(OS) Operations Specialist

(PCSM) Pilot Candidate Selection Method

(SWO) Surface Warfare Officer

(TAO) Tactical Action Officer

(UAS) Unmanned Aerial System

(UAV) Unmanned Aerial Vehicle

(UPT) Undergraduate Pilot Training

(VC) Composite Squadron

(VTUAV) Vertical Takeoff and Landing Tactical Unmanned Aerial Vehicle

I. INTRODUCTION

A. AREA OF RESEARCH

The purpose of this research is to determine air vehicle operator (AVO) requirements for operating Fire Scout Vertical Takeoff and Landing Tactical Unmanned Aerial Vehicle (VTUAV). The goal is to examine Fire Scout AVO alternatives among rated pilots, commissioned officers, and enlisted sailors. In particular, the analysis will focus on the costs and benefits associated with each AVO alternative as well as the required capabilities of the operator. Background research will analyze the specifications and capabilities of Fire Scout as well as its military employment to date. This paper will also examine how the various armed services have determined their AVO requirements. For example, the Army and Marine Corps use enlisted operators for their small unmanned aerial vehicle (UAV) operations, but the Air Force uses rated pilots for their larger, more complex UAV systems. The Navy has allowed enlisted personnel operate their smaller RQ-2 Pioneer and RQ-7 Shadow UAVs, but has utilized rated pilots to operate Fire Scout.

B. RESEARCH QUESTIONS

1. Primary Questions

- Who should operate the Fire Scout VTUAV—rated pilots, commissioned Surface Warfare Officers (SWO), or enlisted Operations Specialist (OS) personnel?
- What are the costs and benefits associated with each type of operator alternative?

2. Secondary Question

- What are the requisite Knowledge, Skills, and Abilities (KSAs) for a Fire Scout air vehicle operator (AVO)?

C. DISCUSSION

UAV technology has advanced rapidly in recent years. Air vehicles have advanced from being remotely piloted aircraft to now being completely autonomous. A remotely piloted vehicle is one that has flight control surfaces manipulated by an operator from a remote location such as a ground control station (GCS). The operator actually *flies* the aircraft by manipulating traditional flight control surfaces. An autonomous vehicle is one that has flight control surfaces manipulated automatically by computer software—the operator merely tells the aircraft where to go and it does so on its own. These two systems are inherently very different. The Fire Scout VTUAV is an autonomous vehicle, not a remotely piloted vehicle. Fire Scout can takeoff, land, and fly a preprogrammed flight path automatically as set by the AVO. If the aircraft loses contact with the GCS, it will orbit as it attempts to regain communications and will fly to a pre-selected landing site if unable to do so. All flight control surfaces are moved automatically with no input from the AVO. It simply does what it is told to do—automatically.

The debate exists to determine who should fly these aircraft. Since the birth of Naval Aviation, the Navy has trained commissioned officers to become rated pilots to fly manned aircraft. For the Navy, a rated pilot is an individual that has completed all formal aviation training requirements as set forth by the Chief of Naval Air Training (CNATRA) and is subsequently designated as a Naval Aviator. In keeping with that tradition, the Navy has thus far chosen to employ commissioned officer rated pilots to fly VTUAVs. But is this really necessary? The Navy has already proven that enlisted operators can successfully operate the RQ-2 Pioneer and RQ-7 Shadow, the Army uses enlisted soldiers to fly various UAVs, and the Marine Corps also uses enlisted soldiers to fly the RQ-7 Shadow. Granted, these fixed-wing UAVs are much smaller than a Fire Scout VTUAV, but they are not autonomous like the Fire Scout—they are remotely piloted UAVs. The Fire Scout VTUAV is completely autonomous. So why is the Navy spending vast amounts of money to train a commissioned officer to

become a rated pilot just to fly an autonomous vehicle that can takeoff, land, and fly all by itself? Rated pilots spend years in training earning their wings and becoming qualified in operational fleet aircraft. The manufacturer of Fire Scout, Northrop Grumman Corporation (NGC), has proven that they can train AVOs for a fraction of the cost. The Navy has even created Navy Enlisted Classifications (NEC) for air vehicle operators (AVO) as well as for mission payload operators (MPO). Yet why does the Navy continue to employ rated pilots as Fire Scout AVOs?

This research will focus on identifying the costs and benefits associated with each type of prospective operator alternative. The research will compare rated pilots, commissioned Surface Warfare Officers (SWO), and Operations Specialist (OS) enlisted personnel. Furthermore, this research will summarize the knowledge, skills, and abilities (KSA) necessary to operate an autonomous vehicle such as Fire Scout, as determined by the U.S. military.

D. BENEFITS OF THE STUDY

This study will provide the Navy with a Cost Benefit Analysis of various types of Air Vehicle Operator (AVO) alternatives. Furthermore, it will summarize the key KSAs necessary to successfully employ the Fire Scout VTUAV.

E. SCOPE

The scope will include: 1) a review of Fire Scout and its capabilities, 2) a historical review of Fire Scout operations in the U.S. Navy, 3) a cost analysis for each type of operator, 4) the benefits associated with each type of operator, and 5) a summary of KSAs necessary to operate Fire Scout.

F. METHODOLOGY

The methodology used in this research will consist of the following steps:

- Conduct a literature review of books, journal articles, magazine articles, the Internet, manufacturer data, and military reviews of the Fire Scout capabilities.

- Conduct a literature review of books, journal articles, magazine articles, the Internet, manufacturer data, and review military usage of Fire Scout to date.
- Examine the cost to train a rated pilot officer.
- Examine the cost to train a Surface Warfare Officer (SWO).
- Examine the cost to train an Operations Specialist (OS).
- Examine the cost to train an air vehicle operator (AVO) utilizing the manufacturer of Fire Scout, Northrop Grumman Corporation (NGC).
- Utilize Human Resources Cost Analysis Tool (HRCAT) to examine the overall lifecycle cost of each type operator to include rated pilots, commissioned Surface Warfare Officers, and Operations Specialist enlisted operators.
- Conduct a thorough review of the benefits associated with each type of operator alternative.
- Utilize the Navy Enlisted Manpower and Personnel Classifications and Occupational Standards (NEOCS) and Military Occupational Specialties (MOS) to summarize the requisite KSAs necessary to be an AVO.

G. THESIS ORGANIZATION

Chapter I: *INTRODUCTION:* Establishes the primary purpose of this thesis. Identifies the primary and secondary research questions, provides a discussion of UAVs in the military, and describes the scope and methodology employed.

Chapter II: *OVERVIEW OF THE FIRE SCOUT VTUAV:* Provides a brief developmental history, budget history, and capabilities of the Fire Scout VTUAV.

Chapter III: *REVIEW OF FIRE SCOUT OPERATIONS IN THE U.S. NAVY*: Provides a brief overview of Fire Scout operational history.

Chapter IV: *COST COMPARISON FOR TYPE OF AIR VEHICLE OPERATOR*: Provides a cost analysis of three types of operator alternatives, to

include rated pilots, commissioned Surface Warfare Officers (SWO), and Operations Specialist (OS) enlisted operators. Cost analysis includes training costs as well as lifecycle costs for each alternative.

Chapter V: *BENEFIT COMPARISON FOR TYPE OF AIR VEHICLE OPERATOR*: Identifies training, manning, physiological, cultural, and safety benefits associated with each type of operator alternative.

Chapter VI: *SUMMARY OF CURRENT KNOWLEDGE, SKILL, AND ABILITY (KSA) REQUIREMENTS FOR A MILITARY AIR VEHICLE OPERATOR*: Provides a brief review of UAV KSAs as identified by the U.S. military.

Chapter VII: *SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS:* Provides proposed answers to the primary and secondary questions. Offers recommendations as to who should fly the Fire Scout VTUAV, based on a cost benefit analysis. Provides recommendations for further research and study.

THIS PAGE INTENTIONALLY LEFT BLANK

II. OVERVIEW OF THE FIRE SCOUT VTUAV

A. BACKGROUND

The Northrop Grumman Corporation (NGC) MQ-8B Fire Scout Vertical Take-Off and Landing Tactical Unmanned Aerial Vehicle (VTUAV) is an unmanned autonomous helicopter. Fire Scout is currently being used by the United States Navy aboard small combatants and overland in Afghanistan. The Fire Scout is designed to provide intelligence, surveillance, reconnaissance, situational awareness, and over-the-horizon precision targeting support in order to augment traditional manned helicopter missions. Derived from the Schweizer Aircraft commercial airframe, the Fire Scout utilizes reliable turbine power and shares over 50 percent commonality of mechanical parts with this FAA certified aircraft, which allowed for a short development schedule.[1]

Figure 1. Fire Scout VTUAV (From Northrop Grumman Corporation)[2]

1 Northrop Grumman Corporation. "MQ-8B Fire Scout." *Northrop Grumman.* http://www.as.northropgrumman.com/products/mq8bfirescout_navy/index.html (accessed March 14, 2011).

2 Ibid.

When the Navy was withdrawing RQ-2 Pioneers Unmanned Aerial Vehicles (UAV) from service, it began to seek a second generation UAV with vertical takeoff and landing capabilities. Bell, Sikorsky, and a collaboration of Teledyne Ryan and Schweizer Aircraft competed for the contract as finalists with Ryan-Schweizer selected as the winner in the spring of 2000. Although the project was regarded as satisfactory, the Navy decided it did not meet their needs and cut funding in December 2001. Development continued, however, and Northrop Grumman pitched a range of improved configurations to potential buyers. The new Fire Scout gained interest from the US Army and NGC was awarded a contract in 2003 for seven RQ-8B aircraft. As development continued with the Army, the new Fire Scout program revived interest with the Navy and began providing financial backing again in 2005. The first flight of a Naval MQ-8B Fire Scout took place in late 2006 at NAS Patuxent River.[3]

The Fire Scout's first shipboard landing was accomplished aboard USS Nashville in January 2006. The event marked the first time an unmanned helicopter had landed *autonomously* on a US Navy ship at sea.[4] The Fire Scout's darkest hour occurred in August 2010 when it became unresponsive to commands during testing and entered restricted airspace around Washington D.C. Operators had lost the control link for about 30 minutes before they were able to shift control to another ground control station and regain control of the aircraft.[5]

---

3 Sherri Pineda. "MQ-8B Fire Scout Vertical Unmanned Aircraft System." *Northrop Grumman.* http://www.as.northropgrumman.com/products/mq8bfirescout_navy/assets/fs-fact-sheet.pdf (accessed March 12, 2011).

4 Naval Air Systems Command Public Affairs. "Autonomous Fire Scout UAV Lands on Ship." *Navy.mil.* January 2006. http://www.navy.mil/search/display.asp?story_id=22038 (accessed March 16, 2011).

5 Kristin Quinn. "Fire Scout Incident Called 'Learning Experience'." *Defense News Periodical.* 2010. http://www.defensenews.com/story.php?i=4759558&c=AME&s=AIR (accessed March 16, 2011).

The incident resulted in the grounding of all 6 operational Fire Scouts while an official inquiry was conducted since the aircraft did not return to the originating airfield as designed.[6]

Figure 2. Fire Scout VTUAV landing aboard USS Nashville (From Naval Air Systems Command Public Affairs)[7]

The first deployment of Fire Scout began in October 2009 aboard USS McInerney. Fire Scout completed its first 'blue-water' deployment (2nd deployment overall) in August of 2011 aboard USS Halyburton. In May of 2011, three MQ-8Bs were sent to support operations of Afghanistan. Due to the success of this detachment, Naval Air Systems Command awarded Northrop Grumman a follow-on $18.65 million contract in late September of 2011 in order to maintain the Afghanistan detachment for another year. Additional funding was also received to begin development of weapons systems for the Fire Scout. Fire Scouts' most recent deployment began in January of 2012 aboard USS Simpson and Operational Evaluation is currently scheduled for the spring of 2012.[8]

---

[6] Elisabeth Bumiller. "Navy Drone Violated Washington Airspace." *The New York Times.* August 25, 2010. http://www.nytimes.com/2010/08/26/us/26drone.html?_r=1 (accessed March 16, 2011).

[7] Naval Air Systems Command Public Affairs. "Autonomous Fire Scout UAV Lands on Ship."

[8] David Donald. "Fire Scout Proves Its Value in Middle East Warzones." *AIN Online.* November 15, 2011. http://www.ainonline.com/?q=aviation-news/dubai-air-show/2011-11-14/fire-scout-proves-its-value-middle-east-warzones (accessed December 5, 2011).

After Operational Evaluation is complete, the Navy will craft a formal report to determine whether Fire Scout is suitable for the mission and a full-rate production decision will follow. The US Navy has received 11 aircraft with 19 on contract and has requested a total of 168 Fire Scouts.[9] Should the overall plan come to fruition, each Littoral Combat Ship (LCS) is expected to deploy with 3 Fire Scouts while small deck combatants such as Cruisers, Destroyers, and Frigates will be augmented with Fire Scouts as well.[10] Fire Scout is expected to operate alongside and augment the missions of the traditional small combatant manned helicopter, the MH-60R Seahawk.

B. BUDGET HISTORY

A chronological breakdown of the program acquisition cost is as follows:

FY01: $93.7 million, all Engineering and Manufacturing Development (EMD)
FY05: $59.1 million, all Research, Development, Test, & Evaluation (RDT&E)
FY06: $94.2 million, all RDT&E. Includes 2 VTUAVs
FY07: $142.7 million ($105.1M RDT&E, $36.4M for 4 MQ-8Bs)
FY08: $89 million ($50.2M RDT&E, $38.8M for 3 MQ-8Bs)
FY09: $97.9 million ($22.9M RDT&E, $75.0M for 5 MQ-8Bs plus spares)

Source: Defense Industry Daily (2010) and multiple others.

The gap in spending from FY01 to FY05 was due to the Navy discontinuing the program at the end of 2001, until the Navy regained interest and began reinvesting again in FY05. In May 2007, the US Department of Defense announced that the Fire Scout VTUAV had reached Milestone C in the

[9] Amy Butler. "Fire Scout to Gather Intel, Hunt Pirates." *Aviation Week.* February 9, 2011. http://www.aviationweek.com/aw/generic/story.jsp?id=news/awst/2011/02/07/AW_02_07_2011_p31-286989.xml&channel=defense (accessed March 17, 2011).

[10] Barry. Rosenberg. "LCS Delays Place Fire Scout on Alternate Ship." *Defense News Periodical.* 2008. http://www.defensenews.com/osd_story.php?sh=VSDS&i=3381948 (accessed March 16, 2011).

acquisition process, the first UAV in the Navy and the third UAV of all services to reach this milestone.[11] With Milestone C reached, the US Navy awarded three Low-Rate Initial Production (LRIP) contracts to Northrop Grumman. The first LRIP contract was awarded for the Fire Scout VTUAV program in June 2007. The program met the goals of the first contract, which prompted the Navy to award the LRIP 2 contract in September 2008. The LRIP 3 contract was awarded in early 2009, for an amount not to exceed $40 million, for the procurement of three VTUAV systems.[12] In May 2009, the Navy awarded Northrop Grumman a contractor logistics support contract valued at $5 million for the first year with options for three additional years for a total of $19 million which will provide for a long-term maintenance program for the Fire Scout.[13] The program to date is valued at $2.6 billion and is managed by Naval Air Systems Command.[14]

C. ACQUISITION COST PER UNIT

Trying to determine a precise acquisition price per unit at this stage of development is difficult, but several studies have offered estimated prices. According to a recent *Aviation Week* article, the total contract is $2.6 billion for 168 Fire Scouts, which equates to a $15.5 million per unit cost.[15] Another study

---

[11] Rene Freeland. "MQ-8B Fire Scout to Enter Production: A First for a US Navy Unmanned Air System." *Global Newswire: Northrop Grumman News Release.* May 31, 2007. http://www.irconnect.com/noc/press/pages/news_releases.html?d=120630 (accessed March 16, 2011).

12 Sherri Pineda. "Northrop Grumman Receives US Navy MQ-8B Fire Scout Contract Award for Third Year of Low Rate Initial Production." Global Newswire: Northrop Grumman News Release. February 23, 2009. http://www.irconnect.com/noc/press/pages/news_releases.html?d=160037 (accessed March 16, 2011).

[13] Sherri Pineda. "Northrop Grumman MQ-8B Fire Scout Program Awarded Contractor Logistics Support Contract." *Northrop Grumman New Release.* May 4, 2009. http://www.navair.navy.mil/pma266/pdfs/NR_FS_CLSAward_NAVAIR09-486_4.29.09.pdf (accessed March 17, 2011).

[14] Amy Butler. "Fire Scout to Gather Intel, Hunt Pirates." *Aviation Week.* February 9, 2011. http://www.aviationweek.com/aw/generic/story.jsp?id=news/awst/2011/02/07/AW_02_07_2011_p31-286989.xml&channel=defense (accessed March 17, 2011).

[15] Ibid.

indicates a total production cost of $2.2 billion for 177 Fire Scouts, which equates to about $12.4 million per unit.[16] A third study conducted by *Defense Industry Daily* indicates prices based on the low-rate production models have cost approximately $10.5 to $15 million each, while the ultimate average per unit cost is expected to be about $9.4 million.[17] Each system includes one MQ-8B Fire Scout VTUAV, electro-optical payloads, a ground control station, a light harpoon grid, a UAV common automatic recovery system, and 2 portable electronic displays.

The Fire Scout is considerably less expensive than the manned helicopter it will operate alongside, the MH-60R Seahawk. The price per unit if an MH-60R Seahawk is more easily attained due to the number already built and delivered. Studies conducted while analyzing the FY12 Pentagon Spending Request estimate cost per unit of an MH-60R Seahawk to be $47.5 million with a total program cost of $14,241 million.[18] Based on the most conservative Fire Scout figures, this means that a Fire Scout currently costs a third of a MH-60R and could be as low as a fifth of the cost as the program matures and more Fire Scouts are built.

---

[16] Daegel.com. "Fire Scout VTUAV." *Daegel.com.* March 10, 2011. http://www.deagel.com/Tactical-Unmanned-Rotorcrafts/RQ-8A-Fire-Scout_a000557001.aspx (accessed March 17, 2011).

[17] Defense Industry Daily. "The Fire Scout VTUAV Program: By Land and Sea." *Defense Industry Daily.* August 30, 2010. http://www.defenseindustrydaily.com/the-fire-scout-vtuav-program-by-land-and-by-sea-updated-01316/ (accessed March 17, 2011).

[18] Chris Hellman. "Analysis of the Fiscal Year 2012 Pentagon Spending Request." *National Priorities Project.* February 13, 2011. http://newprioritiesnetwork.org/resources/analysis-of-the-fiscal-year-2012-pentagon-spending-request (accessed March 17, 2011).

Figure 3. Fire Scout VTUAV alongside H-60 (From sUAS News)[19]

D. OPERATIONAL COSTS

According to Captain Tim Dunigan, Fire Scout Program Manager at the time of the article, the Fire Scout is able to provide the same radar coverage as its manned counterpart but uses 3.7 times less fuel and 14.5 times less maintenance man-hours.[20] For comparison, a Fire Scout requires 2 maintenance-hours per flight compared to mid-twenties for an H-60 according to Dunigan. Most of the savings comes from systems that the Fire Scout does not have, such as crew support, hydraulics, instruments, fire suppression, auxiliary drive gear boxes, auxiliary power unit, retractable landing gear, actuated doors, electronic countermeasures and wheels/tires/brakes/anti-skid. Dunigan claims that the total cost to fly a Fire Scout is 75 percent less than an H-60.[21]

---

19 sUAS News. *Fire Scout Set to Operate from USS Halyburton.* http://www.suasnews.com/2010/12/3078/firescout-set-to-operate-from-uss-halyburton/ (accessed February 8, 2012).

20 Ann Jefferson. "Prey Station." *All Hands - Magazine of the US Navy*, September 2009.

21 Ibid

E. CAPABILITIES

The Fire Scout is designed to be comparable with current H-60 manned helicopter capabilities in regards to Intelligence, Surveillance, and Reconnaissance (ISR) missions.[22] Fire Scout has a service ceiling of 20,000 feet with speeds of 115+ knots. Endurance with a maximum payload is over 5 hours and can be as high as 8 hours with a baseline payload at 110 nautical miles.[23] For comparison, an MH-60R has a service ceiling of 13,000 feet with dash speeds of 135 knots and typically averages just over 3 hours of endurance with about 1 hour of on-station time during a 125 nautical mile mission radius.[24] Like the MH-60R manned helicopter, the Fire Scout mission systems suite includes Infrared Imaging, Electro Optical Imaging, Communication Relay, Maritime Radar, and a Laser Designator. The Fire Scout is also capable of more covert operations than the H-60 Seahawk due to its small size and quieter operation. According to personnel aboard USS McInerney, the Fire Scout flew within a mile of the ship at an altitude of 500 feet and was not seen or heard by topside personnel.[25]

---

[22] Sherri Pineda. "MQ-8B Fire Scout Vertical Unmanned Aircraft System." *Northrop Grumman.* http://www.as.northropgrumman.com/products/mq8bfirescout_navy/assets/fs-fact-sheet.pdf (accessed March 12, 2011).

[23] Northrop Grumman Corporation. "MQ-8B Fire Scout." *Northrop Grumman.* http://www.as.northropgrumman.com/products/mq8bfirescout_navy/index.html (accessed March 14, 2011).

[24] Sikorsky Corporation. "MH-60R Helicopter." *Sikorsky.com.* http://wwww.sikorsky.com/Products (accessed March 12, 2011).

[25] Richard Burgess. "Headed for the Med: Navy's Fire Scout gears up foroperational evauluation, full deployment." *The Fleet.* 2010. http://www.navair.navy.mil/pma266/pdfs/HeadedForTheMed.pdf (accessed March 17, 2011).

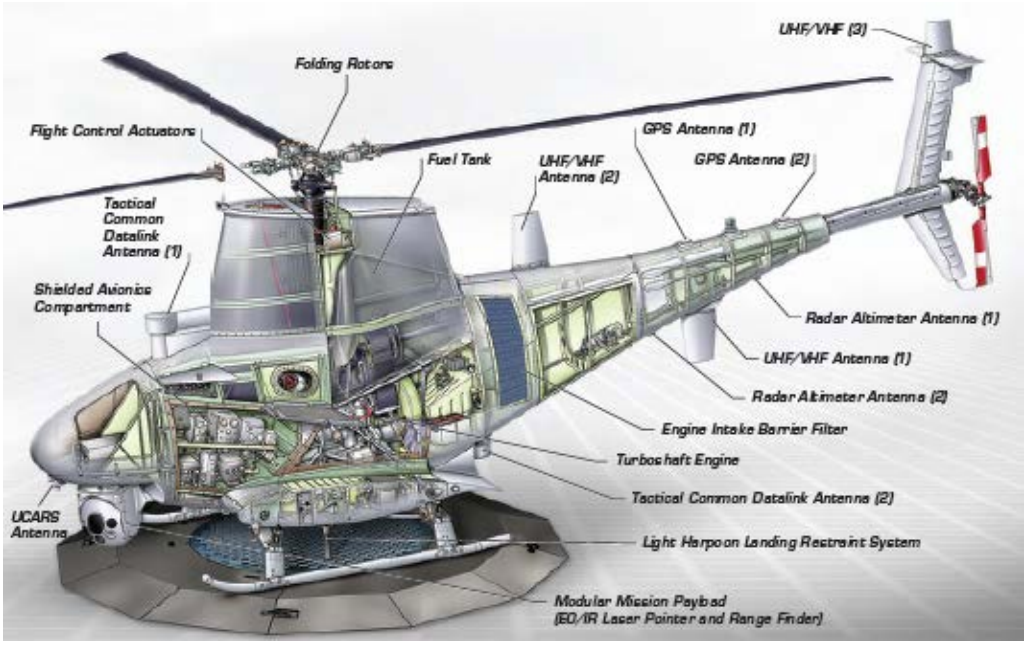

Figure 4. Fire Scout Cutaway (From Northrop Grumman Corporation)[26]

[26] Northrop Grumman Corporation. "MQ-8B Fire Scout." *Northrop Grumman Corporation.* http://www.as.northropgrumman.com/products/mq8bfirescout_navy/assets/firescout-new-brochure.pdf (accessed February 14, 2012).

Figure 5. Fire Scout VTUAV Specifications (From Northrop Grumman Corporation)[27]

F. HUMAN INTERFACE COSTS

The debate regarding who will fly the Fire Scout, a rated pilot versus commissioned officer or enlisted VTUAV operators, is expected to intensify before being resolved. Captain Tim Dunigan, a pilot himself, says, "It has no pilot. It is controlled by an air vehicle operator, which has more commonality with an air traffic controller than a pilot."[28] That being said, rated pilots are still flying Fire Scout at this time.

---

[27] Northrop Grumman Corporation. "MQ-8B Fire Scout." *Northrop Grumman Corporation.* http://www.as.northropgrumman.com/products/mq8bfirescout_navy/assets/firescout-new-brochure.pdf (accessed February 14, 2012).

[28] Ann Jefferson. "Prey Station." *All Hands—Magazine of the US Navy*, September 2009.

The main driver for this debate is money versus ability. It is well documented that the cost per sailor in the Navy has risen sharply over the past decade and this issue hits right at the heart of the problem.[29] A 1999 study by the United States General Accounting Office found that according to DOD, the cost to train each military pilot through basic flight training is about $1 million, while the cost to fully train a pilot with the requisite operational experience can be more than $9 million.[30] These costs vary significantly depending on the type of aircraft and include costs over time to include such things as pilot retention bonuses. Training an enlisted UAV operator would cost just a fraction of that.[31]

The Navy is not the only service battling with this issue. A 2009 article in *Air Force Times* cited an Air Force audit that estimated the Air Force could save $1.5 billion over the next 6 years by having airmen fly UAVs instead of rated pilots. The report claims that it costs more than $2.6 million to train a fighter pilot and about $600,000 to train an airlift pilot. The audit claims that that a UAV pilot can be trained for a little more than $135,000 per pilot.[32] Even using the most conservative figures, this means training a UAV pilot would cost less than a quarter of a rated pilot. These savings are even more significant when pay, retention, and retirement pays are factored in to the total cost.

This thesis will use a slightly different approach to determine operator costs. Through the use of the Human Resources Cost Analysis Tool (HRCAT) and previous research studies, this paper will quantify and compare the life cycle manpower costs of a rated pilot versus a commissioned Surface Warfare Officer (SWO) versus an Operations Specialist (OS) enlisted operator. This thesis will

---

[29] Kevin Heiss et al. *Navy Manpower & Personnel.* PowerPoint Presentation. Monterey: Naval Postgraduate School, February 28, 2011.

[30] United States General Accounting Office. "Military Personnel: Actions Needed to Better Define Pilot Requirements and Promotion Retention." 1999. http://www.gao.gov/archive/1999/ns99211.pdf (accessed March 12, 2011).

[31] Ann Jefferson. "Prey Station." *All Hands - Magazine of the US Navy*, September 2009.

[32] Michael Hoffman. "UAV Pilot Career Field could save $1.5B." *Air Force Times.* March 1, 2009. http://www.airforcetimes.com/news/2009/03/airforce_uav_audit_030109/ (accessed March 17, 2011).

also provide a benefit comparison of the aforementioned alternatives. Ultimately, recommendations will be made as to who should operate the Fire Scout based on a cost benefit analysis approach.

III. REVIEW OF FIRE SCOUT OPERATIONS IN THE U.S. NAVY

A. USS MCINERNEY (FFG 8)

The first deployment of Fire Scout began in October 2009 aboard USS McInerney. When Fire Scout deployed with USS McInerney, the Detachment provided one extra rated pilot to operate their two Fire Scouts.[33] Fire Scout scored its first "mission kill" during a routine test flight in April 2010 when Fire Scout detected a "go-fast" speedboat engaged in smuggling cocaine in the Eastern Pacific. Fire Scout tracked the smugglers for hours thus allowing the ship to pursue and ultimately confiscate 60kg of cocaine and detain several suspects.[34]

During the deployment, the Navy conducted a trial training program for Enlisted Air Vehicle Operators (AVO) in order to help determine who will ultimately fly Fire Scout in the long run.[35] The trial was conducted with two sailors, a Senior Chief Petty Officer and a very junior Airman Air Traffic Controller fresh out of A-school. The Navy chose different levels of experience to help officials evaluate the skill level and maturity necessary to operate Fire Scout. The Navy was to scrutinize the training process as well as their performance in hopes of determining if actual rated pilots are required to fly Fire Scout. For the Navy, a rated pilot is an individual that has completed all formal aviation training requirements as set forth by the Chief of Naval Air Training (CNATRA) and is subsequently designated as a Naval Aviator. Up to that time, only H-60 Seahawk pilots and Northrop Grumman Corporation (NGC) civilians had piloted

---

[33] Richard Burgess. "Headed for the Med: Navy's Fire Scout gears up foroperational evauluation, full deployment." *The Fleet.* 2010. http://www.navair.navy.mil/pma266/pdfs/HeadedForTheMed.pdf (accessed March 17, 2011).

[34] U.S 4th Fleet Public Affairs. "Fire Scout Scores First Drug Bust with McInerney." *Navy.mil.* April 7, 2010. http://www.navy.mil/search/display.asp?story_id=52461 (accessed March 16, 2011).

[35] Andrew Tilghman. "Fire Scout Program could open door for Enlisted." *Navy Times.com.* August 15, 2009. http://www.navytimes.com/news/2009/08/navy_enlisted_uav_081509w/ (accessed March 17, 2011).

Fire Scout for the Navy, but now these two sailors were able to perform the same task under close supervision after obtaining their private pilot license and completing a five-week course on the Fire Scout.[36] The results of this study have not been publicly released, but the Senior Chief Petty Officer was utilized once again to operate Fire Scout in a deployment aboard USS Halyburton.

Figure 6. Fire Scout VTUAV landing aboard USS McInerney (From Northrop Grumman Corporation)[37]

B. USS HALYBURTON (FFG 40)

Fire Scout completed its first 'blue-water' deployment (2nd deployment overall) in August of 2011 while supporting counter-piracy missions and operations in Libya aboard USS Halyburton. A 'blue water' certification means it can fly without a land divert requirement.[38]

---

[36] Andrew Tilghman. "Fire Scout Program could open door for Enlisted." *Navy Times.com.* August 15, 2009. http://www.navytimes.com/news/2009/08/navy_enlisted_uav_081509w/ (accessed March 17, 2011).

[37] Northrop Grumman Corporation. *MQ-8B Navy Fire Scout Images.* http://www.as.northropgrumman.com/products/mq8bfirescout_navy/gallery.html (accessed February 8, 2012).

[38] NAVAIR PMA-266. "HSL-42 Det 'Motley Two' poised to make history with Fire Scout UAV." *NAVAIR.* http://www.navair.navy.mil/pma266/pdfs/HSL.pdf (accessed March 17, 2011).

This deployment found Fire Scout very involved in real-world operations. During ISR and targeting operations in Libya, pro-Ghaddafi forces shot down a Fire Scout.[39] During this deployment, Fire Scout also conducted counter-piracy operations in the Gulf of Aden and conducted ISR missions in support of Operation Unified Protector. The deployment also marked the first simultaneous employment of a manned H-60 and Fire Scout during transits in the Straits of Hormuz and Bab Al Mandeb.[40]

The same Senior Chief Petty Officer that deployed on USS McInerney as a Fire Scout AVO once again deployed with USS Halyburton. Although he will not have a say in whether or not enlisted personnel will operate Fire Scout in the future, others offered positive indications regarding the possibility. Paul Achille, the deputy program manager for the Fire Scout Program office, was quoted as saying, "I think Senior Chief Diets demonstrated an ability to do it."[41] Rear Admiral William Shannon, the program executive officer for unmanned aviation and strike weapons, said, "very, very capable enlisted sailors should eventually fly UAVs or he and other in his office have absolutely failed in our jobs."[42] Upon return from the deployment, Senior Chief Diets was quoted as saying:

---

[39] David Donald. "Fire Scout Proves Its Value in Middle East Warzones." *AIN Onlie.* November 15, 2011. http://www.ainonline.com/?q=aviation-news/dubai-air-show/2011-11-14/fire-scout-proves-its-value-middle-east-warzones (accessed December 5, 2011).

[40] NAVAIR PMA-266. "Halyburton, Embarked Fire Scouts Return From Demanding Deployment." *NAVAIR.* August 4, 2011. http://www.navair.navy.mil/pma266/pdfs/HalyburtonFireScoutReturn.pdf (accessed February 9, 2012).

[41] Joshua Stewart. "Senior chief a test case for enlisted pilots." *Navy Times.* November 6, 2011. http://www.navytimes.com/news/2011/11/navy-senior-chief-blazes-trail-enlisted-uav-pilots-110611w/ (accessed February 9, 2012).

[42] Ibid.

I felt honored and privileged to be the Navy's sole enlisted operator for the Fire Scout. It is a great responsibility and I do believe other enlisted guys can do it too. Having been part of the fleet liaison office at the Fire Scout program office in Patuxent River, Md., I was picked to do this and be the test case to determine what requirements were needed for an enlisted Sailor to operate the system. Also, I was selected for this role because of my experience in working with the Pioneer unmanned air vehicle a few years back in the late nineties.[43]

C. AFGHANISTAN DETACHMENT

The first overland deployment of the Fire Scout began in April of 2011 in Kunduz, Afghanistan. Three Fire Scouts deployed in response to a Department of Defense (DoD) ISR Task Force request to provide intelligence, surveillance, and reconnaissance services in northern Afghanistan. The detachment is a government owned/contractor operated deployment that relied heavily on civilian contractor support and manning from Northrop Grumman Corporation and was comprised of 21 contractors and 7 military personnel.[44]

[43] Stephen Diets. "Navy's only enlisted operator shares Fire Scout deployment experience." *Navy Live.* August 4, 2011. http://navylive.dodlive.mil/2011/08/04/navy's-only-enlisted-operator-shares-fire-scout-deployment-experience/ (accessed February 9, 2012).

[44] U.S. Navy. "Fire Scout UAV Supports Operations in Afghanistan." *Defence Talk.* June 16, 2011. http://www.defencetalk.com/fire-scout-uav-supports-operations-in-afghanistan-34974/ (accessed February 9, 2012).

Figure 7. Fire Scout being loaded into C-17 transport at Naval Air Station Patuxent River (From sUAS News)[45]

Within a month of arrival, the detachment was able to commence flight operations and flew over 80 sorties and 200 hours of flight time in the first month, and is contracted to be able to support 300 hours per month.[46] After six months of solid performance as a go-to ISR asset, the Navy extended the service contract for another year with an $18.65 million contract awarded that will keep the detachment in Afghanistan for most of 2012. According to Rick Pagel, Fire Scout operations lead for NGC, the detachment flew over 400 flights and 1500 hours in the first five months of operations.[47] The success of this deployment serves as proof that civilian contractors, vice rated pilots, are able to successfully employ Fire Scout as AVOs.

---

[45] Gary Mortimer. "U.S. Navy Extends Afghan Tour of Duty for Northrop Grumman-Built Fire Scout." *sUAS News.* November 8, 2011. http://www.suasnews.com/2011/11/9952/u-s-navy-extends-afghan-tour-of-duty-for-northrop-grumman-built-fire-scout/ (accessed February 9, 2012).

[46] U.S. Navy. "Fire Scout UAV Supports Operations in Afghanistan."

[47] Gary Mortimer. "U.S. Navy Extends Afghan Tour of Duty for Northrop Grumman-Built Fire Scout."

Figure 8. Det Kunduz (From Jurta, et al.)[48]

D. USS SIMPSON (FFG 56)

Fire Scout began its most recent deployment in January 2012 aboard USS Simpson. The deployment will mark the first time that reservists will operate and maintain Fire Scout. Also for the first time, Fire Scout will deploy solo without any other manned helicopters on board.[49] HSL-60 personnel began preparing for deployment in early August by receiving training for operating and maintaining the drone. Simpson is scheduled to participate in exercises in the Mediterranean and near West Africa.

[48] Daniel Jurta et al. *MQ-8B Fire Scout UAV Manning Cost Benefit Analysis.* EMBA Project Report, Naval Postgraduate School, Monterey: Naval Postgraduate School, 2011.

[49] Joshua Stewart. "Reservists deploy to operate Fire Scout drone." *Navy Times.* February 6, 2012. http://www.navytimes.com/news/2012/02/navy-reservists-deploy-operate-fire-scout-drone-helicopter-020612w/ (accessed February 9, 2012).

This deployment is part of an ongoing effort to determine manning for Fire Scout. According to Captain Patrick Smith, Fire Scout program manager, a “mixed bag” of reservists, active duty sailors, and contractors is being considered for when the drone is fully operational.[50]

[50] Joshua Stewart. "Reservists deploy to operate Fire Scout drone." *Navy Times.* February 6, 2012. http://www.navytimes.com/news/2012/02/navy-reservists-deploy-operate-fire-scout-drone-helicopter-020612w/ (accessed February 9, 2012).

THIS PAGE INTENTIONALLY LEFT BLANK

IV. COST COMPARISON FOR TYPE OF AIR VEHICLE OPERATOR

A. COST COMPARISON DESCRIPTION

For the purposes of cost comparison, six active duty service member lifecycle costs will be analyzed. The comparison groups are comprised of two ranks, one junior and one senior, for each category—rated pilots, commissioned Surface Warfare Officers (SWO), and Operations Specialist (OS) enlisted personnel. Two ranks were chosen in order to illustrate the cost difference between a junior and senior operator alternative in each category. The three categories—rated pilots, SWOs, and OS enlisted personnel—were chosen as they are logical Air Vehicle Operator (AVO) alternatives for Fire Scout. Rated pilots were chosen because Fire Scout has been flown predominantly by helicopter pilots aboard small surface combatants and are currently the targeted group to become Fire Scout operators. Surface Warfare Officers were chosen as a category because they are the most abundant type of officer aboard small surface combatants. Operations Specialist enlisted personnel were chosen because they are very familiar with helicopter missions aboard small surface combatants. The purpose for these comparisons is to provide cost alternatives for Fire Scout AVOs.

1. Human Resources Cost Analysis Tool (HRCAT)

The tool utilized for this cost comparison is the Navy's Human Resources Cost Analysis Tool (HRCAT). The description of this tool is provided on the HRCAT home webpage:

> *Human Resources Cost Analysis Tool (HRCAT) is a cost analysis tool designed to help Navy leaders determine the most cost-effective manpower mix for the Navy. Navy manpower planners will be able to make better sourcing decisions for manpower with HRCAT's improved personnel cost estimates. The web-based tool is easy to use, asking the user to determine specific parameters concerning a military billet, such as specialty, grade, length of service, and location. The model will determine total annual cost for the billet.*[51]

The model is very inclusive of costs for each type of service member. Detailed descriptions of cost calculations can be found in Appendix A of this report. Itemized values for each cost, including everything from basic pay, special pay, bonuses, training costs, sea pay, and even PCS and recruiting costs for each type of service member are displayed in Tables 1–6. The model is designed to provide *total amortized annual costs* for each service member as defined in the parameters. Adjustable parameters include pay grade, years of service, locality, dependents, designator, and subspecialty. By utilizing this tool, total annual costs can be estimated for each type of Fire Scout operator alternatives.

B. RATED PILOT COSTS

1. Cost to Train Military Pilots

a. Accession and Flight School training

The cost to train rated pilots is broken down into accession cost and flight training cost. Accession costs are described in Appendix A, but generally include commissioning source costs such as Naval Reserve Officer Training Corps (NROTC), Officer Training School (OCS), or the Naval Academy. Typical flight training pipeline for a rated pilot Naval Aviator includes Aviation Preflight Indoctrination (API), primary flight training, advanced flight training, and specific fleet platform training. A 1999 study by the United States General Accounting Office (USGAO) estimated these costs to be about $1 million through basic flight training and more than $9 million for a fully trained pilot with requisite

[51] HRCAT Manpower Costing. *What the HRCAT Manpower Costing Tool is...* http://hrcat.serco-na.com/ (accessed December 8, 2011).

operational experience.[52] As displayed in Tables 1 and 2, HRCAT estimates the *amortized annual* flight training cost to be $78,100.30 for rated pilots and accession cost to be $20,340.48. When adjusted for HRCAT's calculated average naval aviator career length of 10 years, HRCAT's flight training cost calculation is comparable with the USGAO flight training calculation of approximately $1 million. This is also comparable with an Air Force audit that claims it costs more than $2.6 million to train a fighter pilot and about $600,000 to train an airlift pilot.[53]

2. HRCAT Results

Table 1. Rated Pilot—Lieutenant (From HRCAT website)

	Military Pay Type	Annual
MPN	Base Pay	$59,388.00
MPN	Retired Pay Accrual (RPA)	$17,460.07
MPN	BAH	$26,664.00
MPN	Social Security (Employer)	$3,682.06
MPN	Medicare (Employer)	$861.13
MPN	Aviation Career Incentive Pay	$2,472.00
MPN	Basic Allowances for Subsistence (BAS)	$2,676.48
MPN	Career Sea Pay	$3,120.00
MPN	Career Sea Pay - Premium	$1,200.00
MPN	Hazardous Duty Incentive Pay (Other)	$91.00
MPN	Miscellaneous	$702.21
MPN	PCS	$5,123.00
MPN	Special Pay: Other	$288.00
OTHR	Training Costs (Accession)	$20,340.48
OTHR	Training Costs (Flight)	$78,100.30
OTHR	Health Benefit	$5,560.00
OTHR	Recruiting Costs	$2,058.70

Grade: O-3
YOS: 6 Year(s) of Service.
Locality: CA - SAN DIEGO, CA (INCLUDES CORONADO ISLAND)
Dependents (BAH): With Dependents
Designator: 131x - An Unrestricted Line Officer who is qualified for duty involving flying
SubSpec: None

Military Annual (MPN): $123,727.95

Military Annual (Total): $229,787.43

[52] United States General Accounting Office. "Military Personnel: Actions Needed to Better Define Pilot Requirements and Promotion Retention." 1999. http://www.gao.gov/archive/1999/ns99211.pdf (accessed March 12, 2011).

[53] Michael Hoffman. "UAV Pilot Career Field could save $1.5B." *Air Force Times.* March 1, 2009. http://www.airforcetimes.com/news/2009/03/airforce_uav_audit_030109/ (accessed March 17, 2011).

Table 2. Rated Pilot—Lieutenant Commander (From HRCAT website)

	Military Pay Type	Annual
MPN	Base Pay	$72,288.00
MPN	Retired Pay Accrual (RPA)	$21,252.67
MPN	BAH	$29,568.00
MPN	Social Security (Employer)	$4,481.86
MPN	Medicare (Employer)	$1,048.18
MPN	Aviation Career Continuation Pay	$25,000.00
MPN	Aviation Career Incentive Pay	$7,800.00
MPN	Basic Allowances for Subsistence (BAS)	$2,676.48
MPN	Career Sea Pay	$3,720.00
MPN	Career Sea Pay - Premium	$1,200.00
MPN	Command Responsibility Pay	$600.00
MPN	Hazardous Duty Incentive Pay (Other)	$91.00
MPN	Miscellaneous	$702.21
MPN	PCS	$5,123.00
MPN	Special Pay: Other	$288.00
OTHR	Training Costs (Accession)	$20,340.48
OTHR	Training Costs (Flight)	$78,100.30
OTHR	Health Benefit	$5,560.00
OTHR	Recruiting Costs	$2,058.70

Grade: O-4
YOS: 10 Year(s) of Service.
Locality: CA - SAN DIEGO, CA (INCLUDES CORONADO ISLAND)
Dependents (BAH): With Dependents
Designator: 131x - An Unrestricted Line Officer who is qualified for duty involving flying
SubSpec: None

Military Annual (MPN): $175,839.40

Military Annual (Total): $281,898.88

3. Description of Costs to Retain Military Pilots[54]

a. Flight Pay: Aviation Career Incentive Pay (ACIP)

Section 301a: Financial incentive for officers to serve as military aviators throughout a military career. Payment ranges from $125 to $840 per month, determined by years of aviation service as an officer. Entitlement pay.

b. Bonuses: Aviation Continuation Pay (ACP)

Section 301b: Financial incentive to retain qualified, experienced officer aviators who have completed their Active Duty Service Obligation (ADSO) to remain on active duty for a specified period of additional service.

54 Under Secretary of Defense, Personnel and Readiness. "Special and Incentive Pay." *Military Compensation.* http://militarypay.defense.gov/pay/specialindex.html#301aa (accessed December 8, 2012).

Services may pay up to $25K for each year of service agreement, regardless of the length of contract; through 25 years of aviation service; and to aviators in grade 0–6. Discretionary Pay.

C. COMMISSIONED OFFICER COSTS

1. Cost to Train Surface Warfare Officers (SWO)

a. Accession and SWO training

As with pilots, SWO training costs are broken down by accession and SWO training pipeline costs. HRCAT estimates the SWO *amortized annual* accession cost to be the same as rated pilots, $20,340, as displayed in Tables 3 and 4. The *amortized annual* pipeline training costs, however, are significantly less for SWOs, $11,953.89 for a Lieutenant and $22,837.72 for a Lieutenant Commander.

2. HRCAT Results

Table 3. Surface Warfare Officer—Lieutenant (From HRCAT website)

	Military Pay Type	Annual
MPN	Base Pay	$59,388.00
MPN	Retired Pay Accrual (RPA)	$17,460.07
MPN	BAH	$26,664.00
MPN	Social Security (Employer)	$3,682.06
MPN	Medicare (Employer)	$861.13
MPN	Basic Allowances for Subsistence (BAS)	$2,676.48
MPN	Career Sea Pay	$3,120.00
MPN	Career Sea Pay - Premium	$1,200.00
MPN	Hazardous Duty Incentive Pay (Other)	$91.00
MPN	Junior Surface Warfare Officer Critical Skills Retention Bonus (JR SWO CSRB)	$8,333.00
MPN	Miscellaneous	$702.21
MPN	PCS	$5,123.00
MPN	Special Pay: Other	$288.00
MPN	Surface Warfare Officer Continuation Pay (SWOCP)	$10,000.00
OTHR	Training Costs (Accession)	$20,340.48
OTHR	Training Costs (Pipeline)	$11,953.89
OTHR	Health Benefit	$5,560.00
OTHR	Recruiting Costs	$2,058.70

Grade: O-3
YOS: 6 Year(s) of Service.
Locality: CA - SAN DIEGO, CA (INCLUDES CORONADO ISLAND)
Dependents (BAH): With Dependents
Designator: 111x - Surface Warfare Officer
SubSpec: None

Military Annual (MPN): $139,588.95

Military Annual (Total): $179,502.02

Table 4. Surface Warfare Officer—Lieutenant Commander (From HRCAT website)

	Military Pay Type	Annual
MPN	Base Pay	$72,288.00
MPN	Retired Pay Accrual (RPA)	$21,252.67
MPN	BAH	$29,568.00
MPN	Social Security (Employer)	$4,481.86
MPN	Medicare (Employer)	$1,048.18
MPN	Basic Allowances for Subsistence (BAS)	$2,676.48
MPN	Career Sea Pay	$3,720.00
MPN	Career Sea Pay - Premium	$1,200.00
MPN	Command Responsibility Pay	$600.00
MPN	Hazardous Duty Incentive Pay (Other)	$91.00
MPN	Miscellaneous	$702.21
MPN	PCS	$5,123.00
MPN	Special Pay: Other	$288.00
OTHR	Training Costs (Accession)	$20,340.48
OTHR	Training Costs (Pipeline)	$22,837.72
OTHR	Health Benefit	$5,560.00
OTHR	Recruiting Costs	$2,058.70

Grade: O-4
YOS: 10 Year(s) of Service.
Locality: CA - SAN DIEGO, CA (INCLUDES CORONADO ISLAND)
Dependents (BAH): With Dependents
Designator: 111x - Surface Warfare Officer
SubSpec: None

Military Annual (MPN): $143,039.40

Military Annual (Total): $193,836.30

3. Description of Costs to Retain Surface Warfare Officers[55]

a. Special Warfare Officer Continuation Pay

Section 318: Financial incentive for qualified, experienced Special Warfare Officers to remain on active duty beyond their initial ADSO. Up to $15K per year payable to eligible officers. Discretionary pay; only Navy uses this pay authority.

b. Surface Warfare Officer (SWO) Continuation Pay

Section 319: Financial incentive for SWOs selected for Department Head (DH) to agree to remain on active duty to complete that tour. Up to $50K total payable to eligible officers. Discretionary pay; Navy use this pay authority.

[55] Under Secretary of Defense, Personnel and Readiness. "Special and Incentive Pay." *Military Compensation.* http://militarypay.defense.gov/pay/specialindex.html#301aa (accessed December 8, 2012).

c. Critical Skills Retention Bonus (CSRB) or Bonus for Assignment to High Priority Unit

Section 355: Financial incentive to address skill-specific retention problems. Up to $200K total ($100K for reserve component members) is payable in CSRB to an eligible member over a career. Discretionary pay—all Services use this pay authority.

D. ENLISTED PERSONNEL COSTS

1. Cost to Train Operations Specialist (OS) Enlisted Personnel

a. Accession and Operations Specialist (OS) "A" school and "C" School costs

As with the commissioned officers, cost to train an Operations Specialist is broken down into accession costs and training costs. As expected, these costs are significantly less than those calculated for rated pilots and SWOs. HRCAT estimates the *amortized annual* accession cost to be $925.21 and C-school training cost to be $2066.83 for Operations Specialist enlisted personnel, as displayed in Table 5.

2. HRCAT Results

Table 5. Operations Specialist—Petty Officer 3rd Class (From HRCAT website)

	Military Pay Type	Annual
MPN	Base Pay	$25,524.00
MPN	Retired Pay Accrual (RPA)	$7,504.06
MPN	BAH	$22,800.00
MPN	Social Security (Employer)	$1,582.49
MPN	Medicare (Employer)	$370.10
MPN	Basic Allowances for Subsistence (BAS)	$3,886.44
MPN	Career Sea Pay	$3,480.00
MPN	Career Sea Pay - Premium	$1,200.00
MPN	Hazardous Duty Incentive Pay (Other)	$115.00
MPN	Miscellaneous	$1,718.85
MPN	PCS	$1,824.00
MPN	Special Pay: Other	$548.00
OTHR	Training Costs (Accession)	$925.21
OTHR	Training Costs (C-school)	$2,066.83
OTHR	Health Benefit	$5,560.00
OTHR	Recruiting Costs	$831.65

Grade: E-4
YOS: 5 Year(s) of Service.
Locality: CA - SAN DIEGO, CA (INCLUDES CORONADO ISLAND)
Dependents (BAH): With Dependents
EMC: None
NEC: 0326:Operations Systems Specialist

Military Annual (MPN): $70,552.94

Military Annual (Total): $79,936.63

Table 6. Operations Specialist—Chief Petty Officer (From HRCAT website)

	Military Pay Type	Annual
MPN	Base Pay	$42,744.00
MPN	Retired Pay Accrual (RPA)	$12,566.74
MPN	BAH	$25,908.00
MPN	Social Security (Employer)	$2,650.13
MPN	Medicare (Employer)	$619.79
MPN	Basic Allowances for Subsistence (BAS)	$3,886.44
MPN	Career Sea Pay	$6,120.00
MPN	Hazardous Duty Incentive Pay (Other)	$115.00
MPN	Miscellaneous	$1,718.85
MPN	PCS	$1,824.00
MPN	Special Pay: Other	$548.00
OTHR	Health Benefit	$5,560.00
OTHR	Recruiting Costs	$831.65

Grade: E-7
YOS: 12 Year(s) of Service.
Locality: CA - SAN DIEGO, CA (INCLUDES CORONADO ISLAND)
Dependents (BAH): With Dependents
EMC: None
NEC: 0326:Operations Systems Specialist

Military Annual (MPN): $98,700.95

Military Annual (Total): $105,092.60

3. Description of Costs to Retain Operations Specialists Enlisted Personnel[56]

a. Enlistment Bonus (EB)

Section 309: To provide incentive for persons to enlist in the armed forces. The maximum payable by law is $40K. Discretionary bonus—all Services use this bonus authority.

b. Selective Reenlistment Bonus (SRB)

Section 308: To provide incentive for an adequate number of qualified enlisted members to reenlist in designated critical military specialties where retention levels are insufficient to sustain a steady readiness posture imperative for the individual Service to accomplish its mission. The statutory maximum payable is $90K for a minimum 3-year reenlistment. Discretionary pay—all Services use this pay authority.

c. Hazardous Duty Incentive Pays

Section 301(a): Entitlement pays; payable to enlisted members and officers

E. NORTHROP GRUMMAN CORPORATION OPERATOR TRAINING COSTS

Since the Navy has not completed its own Fire Scout training program, Northrop Grumman Corporation (NGC) is currently training all Air Vehicle Operators (AVO) and Mission Payload Operators (MPO) for Fire Scout.

[56] Under Secretary of Defense, Personnel and Readiness. "Special and Incentive Pay." *Military Compensation.* http://militarypay.defense.gov/pay/specialindex.html#301aa (accessed December 8, 2012).

The exact cost of this training is difficult to ascertain, but a Naval Postgraduate School Executive MBA (EMBA) Capstone Project completed in September 2011 determined training cost by examining existing NGC contracts and consulting with NGC personnel in order to translate the data.[57]

According to their findings, the cost to train AVOs and MPOs varies depending on the source of the trainee. As described in Appendix H of the report, the cost to train a contractor or 3rd party AVO or MPO ranged from $43,717 to $48,077.[58] The cost to train a military AVO or MPO was more difficult to ascertain. The cost was determined by calculating salary, travel, per diem, and NGC instructor costs for classes of three AVOs and three MPOs with the ranks of Commander and two Lieutenants. The cost to train an AVO was calculated to be $67,038, and the cost to train a MPO was $24,628, as displayed in Appendix G.[59]

For standardization of the overall *annual* cost comparison in Table 7, the AVO and MPO training costs were *amortized* over the average career service length as determined by HRCAT—10.48 years for officers and 7.88 years for enlisted personnel. Since the report did not contain any costs to train SWOs or enlisted personnel, the cost to train a 3rd party contractor AVO/MPO was used, $48,077. The cost used for rated officer pilots was the average of the AVO and MPO training cost, which equates to $45,833.

F. OVERALL COST COMPARISON RESULTS SUMMARY

A summation of *annual* manpower costs for each type of operator alternative is displayed in Table 7. For comparison purposes, the Lieutenant rated pilot was chosen as the baseline cost in order to determine savings for the other AVO alternatives.

---

[57] Daniel Jurta et al. *MQ-8B Fire Scout UAV Manning Cost Benefit Analysis.* EMBA Project Report, Naval Postgraduate School, Monterey: Naval Postgraduate School, 2011.

[58] Ibid.

[59] Ibid.

Table 7. Total Amortized Annual Cost per Operator Alternative

	Pay plus Incentives and Pipeline Training	Amortized NGC training cost for AVO/MPO	Total Amortized Annual Cost	Dollar Savings from Baseline	Percent Savings from Baseline
Pilot Lieutenant (Baseline)	$229,787.43	$45,833/10.48 = $4373.38	$234,160.81	Baseline	Baseline
SWO Lieutenant	$179,502.02	$48,077/10.48 = $4587.50	$184,089.52	$50,071.29 less	21% less
Operations Specialist CPO	$105,092.60	$48,077/7.88 = $6101.14	$111,193.74	$122,967.07 less	53% less
Operations Specialist PO3	$79,936.63	$48,077/7.88 = $6101.14	$86,037.77	$148,123.04 less	63% less

The cost savings for *not* utilizing rated pilots are significant, as represented in Table 7. For example, the cost of one Lieutenant rated pilot is nearly three times more expensive *per year* than an Operations Specialist 3rd Class Petty Officer. Assuming the Navy purchases 168 Fire Scouts as currently planned, and each Fire Scout has three AVOs and three MPOs to ensure 24-hour coverage, the *annual cost increase* for the Navy by using Lieutenant rated pilots instead of Petty Officer 3rd Class Operations Specialists is over $149 million. Multiply this annual cost increase times the average career service length of an officer and the extra cost incurred by the Navy is over $1.4 billion. Granted, not all 168 Fire Scouts will be deployed at the same time nor will all require 3 crews, but this example illustrates the enormous potential cost savings

by utilizing enlisted personnel to operate Fire Scout vice rated pilots. As another example, if only half of the Fire Scouts were deployed with 2 crews each comprised of Operations Specialist Chief Petty Officers, the savings would still equate to almost half a billion dollars over the average officer career service length. Manpower costs over a 10-year period for various AVO alternative, as well as number of Fire Scout crews, are displayed in Table 8. These figures are comparable to an Air Force audit cited in the *Air Force Times* that estimated the Air Force could save $1.5 billion over the next 6 years by having airmen fly UAVs instead of rated pilots.[60]

Table 8. Total Manpower Cost Comparison Over 10-Year Period

	168 Fire Scouts 3 crews each	84 Fire Scouts 2 crews each
Pilot Lieutenant (baseline cost)	$2.3 billion	$786 million
SWO Lieutentant	$1.8 billion ($500 million less)	$618 million ($168 million less)
Operations Specialist 3rd Class Petty Officer	$867 million ($1.4 billion less)	$289 million ($497 million less)

[60] Michael Hoffman. "UAV Pilot Career Field could save $1.5B." *Air Force Times.* March 1, 2009. http://www.airforcetimes.com/news/2009/03/airforce_uav_audit_030109/ (accessed March 17, 2011).

V. BENEFIT COMPARISON FOR TYPE OF AIR VEHICLE OPERATOR ALTERNATIVE

A. LENGTH OF TRAINING

Current training pipelines for rated pilot Naval Aviators take years to complete and varies by platform. For example, the training pipeline for a fully qualified fighter pilot can take as long as four years. In contrast, Northrop Grumman Corporation (NGC) can qualify Air Vehicle Operators (AVO) and Mission Payload Operators (MPO) in just weeks. According to a 2009 EMBA Project Report published by the Naval Postgraduate School, rated pilots can be trained to be Fire Scout AVOs in just 5 weeks and MPOs can be trained in just 3 weeks.[61] The training for the Navy's sole enlisted operator took 21 days longer because he obtained his private pilot license before completing his AVO training alongside his rated pilot brethren.[62] The Federal Aviation Administration (FAA) currently requires UAV operators to obtain private pilot licenses even though UAVs are not allowed to operate in national airspace alongside manned aircraft at this time.[63] Even with the private pilot license time factored in for non-rated pilots, however, the time requirements are still substantially less than what is required to fully train a rated pilot. It takes only weeks to train a non-pilot AVO vice years for a rated pilot.

B. MANNING CONSTRAINTS AVERTED

The military is downsizing. One needs only watch the news or read the headlines and it is clear that budgetary constraints are taking its toll on military

---

[61] Michael Gerhart et al. *MQ-8B Fire Scout Program Support Analysis.* EMBA Project Report, Monterey: Naval Postgraduate School, 2009, 14.

[62] Joshua Stewart. "Senior chief a test case for enlisted pilots." *Navy Times.* November 6, 2011. http://www.navytimes.com/news/2011/11/navy-senior-chief-blazes-trail-enlisted-uav-pilots-110611w/ (accessed February 9, 2012).

[63] Jeremiah Gertler. *U.S. Unmanned Aerial Systems.* CRS Report, Congressional Research Service, 2012, 25.

manning. The 2013 Defense Budget reveals plans to cut 100,000 troops.[64] Numerous studies indicate that the price of manning the military is growing exponentially and must be reined in. To address this issue, new ships such as the Littoral Combat Ship (LCS) are being designed with reduced crew sizes and smaller berthing areas. This reduction in crew size will likely lead to remaining personnel assuming more tasks and responsibility. Allowing enlisted personnel to operate Fire Scout on ships such as the LCS could not only reduce manning requirements by allowing non-aviators to operate Fire Scout, but could also provide a great deal of operational flexibility.

In his 2007 thesis, Matthew Stracker provides a compelling argument to allow non-aviation rates to operate Fire Scout.[65] Stracker argues that a combined Fire Scout and H-60 detachment will exceed the LCS manpower requirements by nine personnel. Furthermore, he argues that an enlisted Aviation Administrationman (AZ), an aviation rate, is no more qualified to operate Fire Scout than an Operations Specialist (OS), which is a non-aviation rate. He cites that the U.S. Army has already proven that they can take brand new enlisted soldiers with no aviation experience and train them to successfully operate the Hunter and Shadow UAV systems. To take this argument one step further, one could argue that a Surface Warfare Officer (SWO) would also make a likely candidate to be a Fire Scout Mission Commander (MC), AVO or MPO. SWOs and OSs are already quite familiar with helicopter operations aboard surface combatants since they oversee and control tactical employment of manned H-60 helicopters from the Combat Information Center (CIC). By allowing a SWO and OS to operate Fire Scout, it eliminates the requirement for having rated pilots on board altogether, which would ease berthing constraints on small surface combatants, such as LCS. Another benefit for allowing SWOs and

---

[64] David Alexander. "Lawmaker skeptical of cuts in 2013 defense budget." *Reuters.* February 14, 2012. http://www.reuters.com/article/2012/02/14/us-usa-defense-panetta-idUSTRE81D20220120214 (accessed February 15, 2012).

[65] Matthew Stracker. An Operational Manpower Analysis of the RQ-8 Fire Scout Vertical Take-Off Unmanned Aerial Vehicle (VTUAV). Thesis, Monterey: Naval Postgraduate School, 2007.

OSs to operate Fire Scout is the ability to conduct “lily pad” operations to ships without an air detachment embarked. This capability would greatly aid mission radius and extend on-station times by allowing Fire Scout to land and refuel or be controlled by multiple ships.

The Navy has demonstrated their desire to deploy Fire Scout without H-60s on board with the recent deployment of USS Simpson. For the first time, Fire Scout deployed on a surface ship without an H-60 manned helicopter alongside.[66] Although this deployment employs reservist rated pilots operating Fire Scout, it illustrates the Navy’s desire to operate and deploy with only Fire Scout VTUAVs on board surface ships. By allowing SWOs and OSs to operate Fire Scout, the Navy would be able to employ Fire Scout with current operators on board and eliminate the requirement to bring extra rated pilot AVOs. Although this would not alleviate the requirement to bring extra Fire Scout maintainers on board, it would eliminate the requirement for extra AVOs. Perhaps the Navy may want to look at training existing shipboard personnel to maintain Fire Scout and eliminate even more extra personnel, but that is beyond the scope of this thesis.

C. PHYSIOLOGY CONSTRAINTS AVERTED

The U.S. Navy has stringent physical constraints for becoming a Naval Aviator. Naval aircraft operate in challenging environments in which aviators must deal with physiological conditions such as vertigo, blackout, sinus blocks, nausea, as well as being able to physically fit into small cockpits. In order to qualify, an applicant must pass an aviation physical examination to determine aeronautical adaptability that tests for things such as eyesight with normal color and depth perception, specific physical dimensions, and valsalva ability to name a few.

[66] Joshua Stewart. "Reservists deploy to operate Fire Scout drone." *Navy Times.* February 6, 2012. http://www.navytimes.com/news/2012/02/navy-reservists-deploy-operate-fire-scout-drone-helicopter-020612w/ (accessed February 9, 2012).

A 2000 thesis published by the Naval Postgraduate School found that 14 percent of Officer Candidate School (OCS) candidates were found not physically qualified and almost 10 percent of Naval Reserve Officer Training Corps (NROTC) aviation candidates that passed their pre-commissioning flight physical failed the follow-on Naval Operational Medicine Institute (NOMI) physical.[67]

Figure 9. F-18 Cockpit (From U.S. Navy)[68]

In contrast, physical requirements for Unmanned Aerial Systems (UAS) are much less stringent given that the operating environments for the operator are drastically different. Rather than operating in the cockpit of an aircraft, Fire Scout AVOs will operate from a ground control station (GCS). This environment obviously eliminates most of the physiological and psychological factors that a manned aircraft pilot experiences.

---

[67] Stephen Fuchs. "Cost and Benefit Analysis of Alternatives to the Naval Reserve Officer Training Corps Flight Physical Screening Process." *DTIC Online.* September 2000. http://www.dtic.mil/cgi-bin/GetTRDoc?AD=ADA384315 (accessed February 14, 2012).

[68] U.S. Navy. *US Military Aviation.* http://www.salimbeti.com/aviation/images2.htm (accessed February 14, 2012).

Figure 10. Fire Scout Ground Control Station (From Northrop Grumman Corporation)[69]

The U.S. Army determines UAV operator requirements by use of the PULHES score. P stands for physical capacity, U stands for upper extremities, L stands for lower extremities, H stands for hearing, E stands for eyes, and S stands for psychiatric. Each category is graded on a scale of 1 to 4, with 1 being the highest ability and 4 being the lowest. The current PULHES score required for an Army UAV operator is 222221.[70] As can be seen by this score, the Army puts more emphasis on psychiatric ability than physical and physiological abilities. One can expect that the U.S. Navy might require even less stringent physical requirements than the Army since the GCS will be located aboard a ship, unlike Army soldiers who operate UAVs from the field. Less stringent physiological requirements will open the doors for many more individuals that would not otherwise qualify as a rated pilot. Furthermore, a larger sample size to select from lessens recruiting difficulty and eases retention issues.

---

[69] Northrop Grumman Corporation. "MQ-8B Fire Scout." *Northrop Grumman Corporation.* http://www.as.northropgrumman.com/products/mq8bfirescout_navy/assets/firescout-new-brochure.pdf (accessed February 14, 2012).

[70] U.S. Army. "MOS 15W - Unmanned Aerial Vehicle Operator." *Army Portal.* http://www.army-portal.com/jobs/aviation/15w.html (accessed February 14, 2012).

D. CULTURE

Numerous studies indicate that culture is a factor when rated pilots are forced to fly UAVs. A 2012 report by the Congressional Research Service indicates that the Air Force has been having troubles recruiting and retaining rated pilots to fly UAVs for years.[71] The Air Force was forced to offer such things as preferred follow-on orders and allowing flight time in manned aircraft in order to coax their rated pilots into flying UAVs. The report goes on to indicate that operating UAVs might actually attract reservists or improve enlisted recruiting *if* they were allowed to fly them. Reservists may find that operating UAV from a U.S. based GCS is more attractive than deploying overseas to do similar missions and that enlisted personnel may be motivated to be pilots.[72] Another study found that rated pilots might consider UAS operations as a secondary mission that might cause a negative stigma within the squadron.[73] Most rated pilots chose to fly aircraft because of the personal satisfaction that actual flight provides. Forcing these same individuals to stay on the ground and "fly a computer" does not provide the appeal that lured them into aviation in the first place.

By allowing enlisted personnel to be Fire Scout operators, they are afforded an appealing opportunity to operate an aircraft. This would also allow rated pilots to remain in manned aircraft where most prefer to be. A 2005 *All Hands* article quoted a Pioneer UAV enlisted operator as saying, "We are the only enlisted personnel who get to call ourselves pilots. I have a strong pride in what I do."[74] Allowing enlisted personnel to become AVOs provides a win-win culture solution for both rated pilot officers and enlisted personnel. Culture is such a problem in the Air Force that the Air Force Chief of Staff was quoted as

---

[71] Jeremiah Gertler. *U.S. Unmanned Aerial Systems.* CRS Report, Congressional Research Service, 2012, 26.

[72] Ibid.

[73] Jeremy Bardin et al. *BAMS UAS Manning and Fleet Integration Strategy.* EMBA Project Report, Monterey: Naval Postgraduate School , 2010, 28.

[74] Todd Frantom. "Eyes in the Sky." *All Hands*, March 2005.

saying that the Air Force "must promote a strong and healthy [UAV] community, not a leper colony."[75] Allowing non-pilots to be AVOs would create a win-win culture of pride for both non-pilots as well as rated pilots.

Figure 11. U.S. Navy RQ-2 Pioneer (From CRUSER)[76]

E. SAFETY

Some research suggests rated pilots may have more trouble learning to fly a UAV than sailors who do not have pilot training. A 2009 Navy Times article cited that the Federal Aviation Administration (FAA) found higher rates of human-error crashes among Air Force Predators, which are flown by winged pilots, than Army Shadows, which are operated by enlisted soldiers.[77] While one could argue that these mishaps were caused by factors other than *who* was flying the aircraft, others believe that *flying* an aircraft is much different than *managing* a UAV. A 2009 Aviation Week article quoted Missy Cummings, a former fighter pilot and current Massachusetts Institute of Technology (MIT) researcher, as saying UAV operators are "…more like air traffic controllers. Anyone should be

[75] Anna Mulrine. "UAV Pilots." Airforce-magazine.com. January 2009. http://www.airforce-magazine.com/MagazineArchive/Pages/2009/January%202009/0109UAV.aspx (accessed March 1, 2012).

[76] CRUSER. *NPS Cosortium for Robotics and Unmanned Systems Education and Research.* https://wiki.nps.edu/display/CRUSER/UAV (accessed February 14, 2012).

[77] Andrew Tilghman. "Fire Scout Program could open door for Enlisted." *Navy Times.com.* August 15, 2009. http://www.navytimes.com/news/2009/08/navy_enlisted_uav_081509w/ (accessed March 17, 2011).

able to operate a UAV with minimal training….these vehicles can fly themselves; what we need are people to manage these vehicles."[78] Perhaps a paradigm shift is in order to determine what makes a good pilot versus a good UAV operator. Military and FAA human factor experts need to identify what the key ingredients are for a good AVO, just as they have done for identifying what it takes to be a good pilot.

Forcing rated pilots to operate Fire Scout is going to limit their time in the cockpit of manned aircraft. As a result, currency in manned aircraft is going to suffer or completely lapse for rated pilots. It is well documented that lapses in currency and proficiency in aircraft leads to an increased rate of mishaps. If rated pilots are going to fly both manned aircraft and Fire Scout simultaneously, currency is going to suffer in both platforms because of time-sharing. Allowing non-pilots to become Fire Scout AVOs alleviates the currency problem, as AVOs and rated pilots will be only be focused on one platform vice two.

[78] Bill Sweetman and Paul McLeary. "Some UAV Makers Do Better Than Others." *Aviation Week.* September 10, 2009. http://www.aviationweek.com/aw/generic/story_generic.jsp?channel=defense&id=news/UAVs091009.xml&headline=Some%20UAV%20Makers%20Do%20Better%20Than%20Others (accessed February 14, 2012).

VI. SUMMARY OF CURRENT KNOWLEDGE, SKILL, AND ABILITY (KSA) REQUIREMENTS FOR A MILITARY AIR VEHICLE OPERATOR

A. INTRODUCTION

Determining the actual Knowledge, Skills, and Abilities (KSA) required to operate an unmanned aerial system (UAS) is well beyond the scope of this thesis. The Federal Aviation Administration (FAA) and the U.S. military have been struggling with this issue for years. The FAA has established a UAS Aviation Rulemaking Committee to deal with this complex issue. This committee is comprised of FAA officials and stakeholders in the UAS community to define operational and certification requirements.[79] The U.S. Air Force is conducting a beta program to try to identify what it takes to create an Unmanned Aerial Vehicle (UAV) operator from scratch.[80] Many scholars and researchers have also attempted to tackle this issue, but a widely accepted solution has yet to be provided. Instead, this thesis will focus on what the military currently uses to define UAV operators.

B. U.S NAVY ENLISTED CLASSIFICATIONS (NEC)

1. Introduction

The U.S. Navy has already established Navy Enlisted Classifications (NEC) for both fixed-wing UAVs as well as for the rotary-winged MQ-8B Fire Scout. Figures 12 and 13 are sourced from the 2012 Navy Enlisted Manpower and Personnel Classifications and Occupational Standards (NEOCS). The NECs for fixed-wing UAVs such as the RQ-2 Pioneer and RQ-7 Shadow are shown in

[79] Federal Aviation Administration. "Fact Sheet. Unmanned Aircraft Systems (UAS)." *Federal Aviation Administration.* July 2011. http://www.faa.gov/about/initiatives/uas/media/UAS_FACT_Sheet.pdf (accessed February 29, 2012).

[80] Anna Mulrine. "UAV Pilots." Airforce-magazine.com. January 2009. http://www.airforce-magazine.com/MagazineArchive/Pages/2009/January%202009/0109UAV.aspx (accessed March 1, 2012).

Figure 12, and the NEC for the rotary-winged MQ-8B Fire Scout VTUAV is shown in Figure 13.

2. NEC for Unmanned Aerial Vehicle (UAV) External and Internal Pilot

Enlisted personnel with paygrades ranging from E4 to E7 are authorized to be UAV pilots, as displayed in Figure 12. Enlisted personnel successfully flew the RQ-2 Pioneer and RQ-7 Shadow from 1986 to 2008 as UAV internal and external pilots.[81] In 2008, VC-6 was praised by the Chief of Naval Operations for being the top rated Shadow UAV operators in Iraq by the Army's Department of Evaluation and Standards.[82]

8362 - Unmanned Aerial Vehicle (UAV) External Pilot

UAV External Pilot directly controls the flight of the UAV during launch and recovery operations by visual reference to the UAV.

Source Rating: AS, AM, AE, AT, AWF, AWO, AWR, AWS, AWV	Billet Paygrades: E5-E6	Personnel Paygrades: E4-E7
Course: Mandatory	CIN: C-104-0641 C-104-0642	CDP: 3164 3162
Sequence Code: 4		NR Ind: N
Component NEC:	Related NEC:	Open to Women: Yes
Primary Advisor: OPNAV N889	Technical Advisor: NAVAIR	ECM: BUPERS-32

NOTES:
1. Flight physical must be completed prior to arrival in accordance with aeromedical reference and waiver guide and also NAVMED P117.
2. Physical Qualification – Class Two Physical.

8363 - Unmanned Aerial Vehicle (UAV) Internal Pilot

Operates and navigates UAV during the enroute, mission, and return phase of flight.

Source Rating: AS, AM, AE, AT, AZ, AWF, AWO, AWR, AWS, AWV	Billet Paygrades: E5-E6	Personnel Paygrades: E4-E7
Course: Mandatory	CIN: C-104-0642	CDP: 3162
Sequence Code: 3		NR Ind: N
Component NEC:	Related NEC:	Open to Women: Yes
Primary Advisor: OPNAV (N88)	Technical Advisor: NAVAIR	ECM: BUPERS-32

NOTES:
1. Flight physical must be completed prior to arrival in accordance with aeromedical reference and waiver guide and also NAVMED P117.
2. Physical Qualification – Class Two Physical.

Figure 12. NEC 8362 and 8363: Unmanned Aerial Vehicle External and Internal Pilot (From Bureau of Naval Personnel)[83]

[81] Thompson Coleman. "Fleet Composite Squadron 6 Deactivates." *Navy.mil.* August 8, 2008. http://www.navy.mil/search/display.asp?story_id=38993 (accessed February 29, 2012).

[82] Rick Thompson. "A month later, VC-6 unit's homecoming just as sweet." *dcmilitary.com.* February 21, 2008. http://ww2.dcmilitary.com/stories/022108/southpotomac_28121.shtml (accessed February 29, 2012).

[83] Bureau of Naval Personnel. *Manual of Navy Enlisted Manpower and Personnel Classifications and Occupational Standards.* Vol. II. United States Navy, 2012.

Upon review of the source ratings, it is apparent that the UAV pilot NEC is limited to aviation source ratings. In his 2007 thesis, Mathew Stracker makes a compelling argument regarding the source ratings for operating Fire Scout.[84] He compared the qualifications of an Aviation Administrationman (AZ) to an Operations Specialist (OS), and argued that an OS is better suited to operate Fire Scout than an AZ. He argued that the AVO source rating should not be limited to aviation ratings only.

3. NEC for MQ-8B Air Vehicle Operator (AVO)

In 2009, the Navy established a new NEC for the MV-8B Fire Scout. The MQ-8B Fire Scout AVO is authorized to be operated by enlisted personnel paygrades ranging from E4 to E8, as displayed in Figure 12. It should be noted, however, that with the exception of the sole enlisted operator utilized for the McInerney and Halyburton deployments, the Navy has required rated pilot officers to fly Fire Scout aboard ships. Furthermore, unlike the UAV pilot NECs, note that the source ratings for being a Fire Scout AVO are limited to just AWR and AWS. This imposes even greater limitations as to who can operate the air vehicle. Given the success of enlisted fixed-wing UAV pilots, these requirements seem overly restrictive.

[84] Matthew Stracker. An Operational Manpower Analysis of the RQ-8 Fire Scout Vertical Take-Off Unmanned Aerial Vehicle (VTUAV). Thesis, Monterey: Naval Postgraduate School, 2007.

8368 - MQ-8B Air Vehicle Operator (AVO)

Develops and inputs Air Vehicle flight plan. Directs, monitors, and provides input changes to Air Vehicle in-flight.

Source Rating: AWR, AWS	Billet Paygrades:		Personnel Paygrades: E4-E8
Course: See Note 1	CIN:		CDP:
Sequence Code: 4	ESTB Date: 7/15/09	REV Date:	NR Ind: A
Component NEC:	Related NEC:		Open to Women: Yes
Primary Advisor: OPNAV N889	Technical Advisor: NAVAIR		ECM: BUPERS-32

NOTES:
1. NEC may be awarded through cadre training pending establishment of formal training.
2. Flight Physical must be completed prior to arrival in accordance with aero-medical reference and waiver guide and NAVMED P117.
3. Physical Qualification-Class Two Physical.

Figure 13. NEC 8368: MQ-8B Air Vehicle Operator (From Bureau of Naval Personnel)[85]

C. U.S MARINE CORPS MILITARY OCCUPATIONAL SPECIALITIES (MOS)

1. Introduction

The U.S. Marine Corps has established a military occupational specialty (MOS) for UAV operators and currently employs enlisted soldiers to operate the RQ-7 Shadow. Enlisted Marines between the ranks of Private to Master Gunnery Sergeant are authorized to be UAV operators, and Marines between the rank of Sergeant and Master Gunnery Sergeant are authorized to be External UAV operators, as displayed in Figures 14 and 15. Enlisted Marines have been successfully operating UAVs since 1990, including the RQ-2 Pioneer, the SE-15 Scan Eagle, and the RQ-7 Shadow.[86] Enlisted Marines continue to operate the RQ-7 Shadow UAV to this day.

[85] Bureau of Naval Personnel. *Manual of Navy Enlisted Manpower and Personnel Classifications and Occupational Standards.* Vol. II. United States Navy, 2012.

[86] Marine Unmanned Aerial Vehicle Squadron 1. "Marine Unmanned Aerial Vehicle Squadron 1 History." *3D Marine Aircraft Wing.* http://www.3maw.usmc.mil/external/3dmaw/macg38/vmu1/history/history.jsp (accessed February 29, 2012).

2. MOS for Unmanned Aerial Vehicle (UAV) Operator

MOS 7314, Unmanned Aerial Vehicle (UAV) Air Vehicle Operator (MGySgt to Pvt) PMOS

a. Summary. The air vehicle operator executes the proper techniques and procedures to maintain the planned flight profile of the UAV. They communicate through various networks with the payload operator, mission commander, and others as appropriate. They are responsible for execution of the payload mission(s) during UAV flights. Reports imagery viewed and when appropriate, performs standard call for fire procedures to direct weapon towards designated targets. Make effective use of the UAV payload through proper planning techniques, and crew coordination.

b. Prerequisites

(1) Must possess a GT score of 105 or higher.
(2) Must have normal color vision.

c. Requirements

(1) Must meet the physical requirements per NAVMED P-117 (Manual of the Naval Medical Department), section IV, article 15-65, paragraph 1.15.
(2) Complete the Unmanned Aerial Vehicle Operator Common Core, 243-96U10 or Unmanned Aerial Vehicle Operator (Shadow RQ-7A), or other UAS training sites and courses designated by HQMC.
(3) Familiarity with intelligence and call for fire report formats.
(4) Knowledge of airspace command and control agencies and procedures.
(5) Knowledge of supporting arms command and control agencies and procedures.
(6) Basic preventative maintenance skills.

d. Duties. For a complete listing of duties and tasks, refer to MCO 1510.82A, Individual Training Standards.

e. Related DOT Classification/DOT Code. No civilian equivalent.

f. Related Military Skill. None.

Figure 14. MOS 7314: Unmanned Aerial Vehicle Operator (From Commandant of the Marine Corps)[87]

[87] Headquarters United States Marine Corps. *Military Occupational Specialities (MOS) Marine Corps Manual.* Washington , DC: Department of the Navy, 2008.

MOS 7316, External Unmanned Aerial Vehicle (UAV) Operator (MGySgt to Sgt)
NMOS (7314)

a. Summary. External UAV operators execute the initial takeoff and final landing phases of UAV operations. They are also an integral part of all mission planning, takeoff and landing sequences, and crew coordination aspects of UAV flight.

b. Prerequisites. See requirements.

c. Requirements

(1) This MOS is to be assigned as a skill designator MOS to qualified Air Vehicle Operators (MOS 7314) who have successfully completed formal training at Ft. Huachuca, AZ in external UAV operations.
(2) Superior adaptability to three-dimensional spatial relationships.
(3) Must meet all the physical requirements per NAVMED P-117 (Manual of the Naval Medical Department), section IV, article 15-65, paragraph 1.15, as MOS 7314, with the following addition: Depth Perception-AFVT A-D.

d. Duties. For a complete listing of duties and tasks, refer to MCO 1510.82A, Individual Training Standards.

e. Related DOT Classification/DOT Code. No civilian equivalent.

f. Related Military Skill. None.

Figure 15. MOS 7316: External Unmanned Aerial Vehicle Operator (From Commandant of the Marine Corps)[88]

D. U.S ARMY MILITARY OCCUPATIONAL SPECIALITIES (MOS)

1. Introduction

The U.S. Army currently employs enlisted soldiers to operate the RQ-7 Shadow. The 2nd Battalion, 13th Aviation Regiment trains UAV operators for the Army, Navy, Air Force, Marines, as well as foreign military servicemen.[89] The school just graduated student number ten thousand, and currently trains more than 2000 operators per year for the RQ-5 Hunter, RQ-7 Shadow, MQ-1B

88 Headquarters United States Marine Corps. *Military Occupational Specialities (MOS) Marine Corps Manual.* Washington , DC: Department of the Navy, 2008.

89 Amy McLaughlin. "2-13th Aviation Battalion graduates 10,000th recorded student." *Army.mil.* February 1, 2012. http://www.army.mil/article/72934/2_13th_Aviation_Battalion_graduates_10_000th_recorded_student/ (accessed March 1, 2012).

Warrior, and the MQ-1C Grey Eagle.[90] Before the Army cancelled their own Fire Scout program, all duties from piloting to maintenance were performed by enlisted personnel.[91]

2. MOS for Unmanned Aerial Vehicle Operator

MOS 15W—Unmanned Aerial Vehicle Operator

Qualifications for initial award of MOS 15W, Unmanned Aerial Vehicle Operator:

PULHES: 222221	Enlistment Bonus: Level 5
Physical Demands Rating: medium	Security Clearance: Secret
Required ASVAB Score: SC: 102	U.S. Citizenship: Required

AIT Length / Location: 9 weeks, 2 days at Ft Huachuca, Arizona

Unmanned Aerial Vehicle Operator (MOS 15W) Description / Major Duties:
The UAV operator supervises or operates the UAV, to include mission planning, mission sensor/payload operations, launching, remotely piloting and recovering the aerial vehicle.

Other Requirements for Award of MOS 15W:
(1) Normal color vision.
(2) The Soldier must meet SECRET security eligibility requirements prior to attendance/arrival to training. An interim SECRET security access granted by CCF meets this requirement.
(3) The Soldier must meet and annually maintain Army Class III medical physical. Soldiers must complete and pass medical physical prior to arrival at training base. Soldiers are not required to complete or pass the Type II decompression sickness/chamber training requirement. Soldiers found medically disqualified will follow procedures outlined in AR 40-501.
(4) Never been a member of the U.S. Peace Corps, except as specified in AR 614-200 (para 3-2).
(5) No information in military personnel, Provost Marshal, intelligence, or medical records that would prevent the granting of security eligibility under AR 380-67 (3.401.a).
(6) No record of conviction by court-martial.
(7) No record of conviction by a civil court for any offense other than minor traffic violations.
(8) Meet career management and development criteria contained in AR 614-200 and DA Pam 351-4.

(9) Formal training (completion of MOS 15W common core course and one UAV specific ASI Track conducted under the auspices of the USAAWC, Ft Huachuca, AZ) mandatory.

Figure 16. MOS 15W: Unmanned Aerial Vehicle Operator (After U.S Army)[92]

[90] Ibid

[91] Michael Raymer. *A Comparative Analysis of the Army MQ-8B Fire Scout Vertical Takeoff Unmanned Aerial Vehicle and Navy MQ-8B Manpower & Training Requirements.* Thesis, Monterey: Naval Postgraduate School, 2009, 33.

[92] U.S Army. "MOS 15W - Unmanned Aerial Vehicle Operator." *Army-Portal.com.* http://www.army-portal.com/jobs/aviation/15w.html (accessed March 1, 2012).

E. U.S AIR FORCE

1. Introduction

The U.S. Air Force is the only service that has historically allowed only rated pilots to fly their UAVs. They argue that their UAS are "more technologically and operationally sophisticated than other UAS, and a trained pilot is required to employ these UAS most effectively."[93] But even the Air Force is reconsidering this requirement. A beta testing program began in 2009 at Holloman Air Force Base that began to train undergraduate pilots as well as non-pilot UAV operators.[94] The test program is aimed at non-pilot Air Force Captains who have four to six years of experience.[95] The beta candidates will be screened for the same personality traits and physical requirements as traditional pilots, but some requirements will be less stringent, such as eyesight as physical dimensions. Part of the impetus for this paradigm shift is because the Air Force expects to train more drone pilots this year than fighter and bomber pilots combined.[96]

2. Air Force Pilot Candidate Selection Method (PCSM)

Since the Air Force still requires officers to fly their UAS, there is not an Air Force equivalent to the Navy NEC or Army and Marine Corps MOS description. Air Force pilots and UAV operators are selected by competing on a Pilot Selection Board based on the Pilot Candidate Selection Method (PCSM).[97] The PCSM is an index that quantifies a pilot candidate's aptitude for success at

---

93 Jeremiah Gertler. *U.S. Unmanned Aerial Systems.* CRS Report, Congressional Research Service, 2012, 25-27.

94 Anna Mulrine. "UAV Pilots." *Airforce-magazine.com.* January 2009. http://www.airforce-magazine.com/MagazineArchive/Pages/2009/January%202009/0109UAV.aspx (accessed March 1, 2012).

95 CBS News. "Air Force Makes Push For Drone Operators." *CBS New U.S.* February 11, 2009. http://www.cbsnews.com/2100-201_162-4540269.html (accessed March 1, 2012).

96 Rachel Martin. "Drone Pilots: The Future of Aerial Warfare." *npr.* November 29, 2011. http://www.npr.org/2011/11/29/142858358/drone-pilots-the-future-of-aerial-warfare (accessed March 1, 2012).

97 Military.com. "Become an AF UAV Operator." *Military.com.* October 13, 2008. http://www.military.com/military-report/become-an-af-uav-operator (accessed March 1, 2012).

Undergraduate Pilot Training (UPT). Factors contributing to a competitive PCSM score are displayed in Figure 17.

PCSM takes into account several measurements associated with success at UPT and combines them into one measurement.

- Previous flying hours (Experience)
- AFOQT Pilot Score (Knowledge)
- Test of Basic Aviation Skills (TBAS) Scores (Aptitude)

The TBAS generates 9 measurements of pilot aptitude considering these main areas

- Cognitive - Short Term Memory
- Psychomotor Scores - Hand/Eye Coordination

Figure 17. Pilot Candidate Selection Method (After U.S. Air Force)[98]

[98] U.S Air Force. "Pilot Candidate Selection Method." https://pcsm.aetc.af.mil/index.html (accessed March 1, 2012).

THIS PAGE INTENTIONALLY LEFT BLANK

VII. SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

A. SUMMARY

This research examined who should fly the Fire Scout Vertical Takeoff and Landing Tactical Unmanned Aerial Vehicle (VTUAV)—whether it be rated pilots, commissioned Surface Warfare Officers (SWO), or Operations Specialist (OS) enlisted sailors. The examination provided the costs and benefits associated with each type of Air Vehicle Operator (AVO) alternative. The cost comparison revealed significant lifecycle cost savings by allowing enlisted personnel to operate Fire Scout, vice continuing to have rated pilots fly Fire Scout. Training costs were found to be reduced from millions for rated pilots to tens of thousands for enlisted AVOs, while amortized annual manning costs were cut by more than half, and overall cost savings were calculated to be on the order of billions of dollars over ten years. The research also revealed both tangible and intangible benefits by allowing enlisted personnel to operate Fire Scout. Tangible benefits included shortened length of training as well as reduced manning requirements, which are especially beneficial for small surface combatants with limited berthing such as the Littoral Combat Ship (LCS). Intangible benefits included cultural, motivational, and proficiency issues that could be averted by allowing enlisted to be Fire Scout AVOs. Additionally, a summary of knowledge, skills, and abilities (KSA) required by each service was provided for comparison. The KSA comparison revealed that AVO requirements need not be as stringent as those of rated pilots. In conclusion, the Navy should create a pilot program to train enlisted personnel to become Fire Scout AVOs.

B. CONCLUSIONS AND RECOMMENDATIONS

1. Primary Research Questions

a. Who should operate the Fire Scout VTUAV—rated pilots, commissioned Surface Warfare Officers (SWO), or Operations Specialist (OS) enlisted personnel?

Conclusion: The framework has been laid and the precedence has been set for enlisted personnel to operate Fire Scout. The Navy has already created a Navy Enlisted Classification (NEC) for the MQ-8B Fire Scout–NEC 8368: MC-8B Air Vehicle Operator (AVO). Furthermore, enlisted personnel have already proven they can effectively operate UAVs—Navy enlisted personnel successfully operated the RQ-2B Pioneer and RQ-7B Shadow for over 20 years. The Army and Marine Corps are still utilizing enlisted operators for their UAVs to this this day. The Army has already utilized enlisted personnel to operate Fire Scout, but that program ended with the termination of acquisition of the aircraft. Furthermore, the Army is currently producing thousands of enlisted UAV operators each year from their combined service training facility. Although the Air Force as not yet allowed enlisted personnel to operate their UAVs, they have begun a program to train non-rated pilots to be UAV operators. Indications are that enlisted personnel are poised and capable of operating Fire Scout. Even senior officials in the Fire Scout program have indicated that enlisted personnel should be capable of operating this new generation of autonomous UAVs such as Fire Scout.

Recommendation:

- The U.S. Navy should create a pilot program that trains enlisted personnel to be Fire Scout AVOs.
- Make the source ratings for NEC 8368 less restrictive. Open up the source ratings to include non-aviation rates, such as Operations Specialists (OS).

b. What are the costs and benefits associated with each type of operator alternative?

Conclusion: The cost savings by allowing enlisted personnel to operate Fire Scout vice rated pilots are significant. According to calculations utilizing the Human Resources Cost Analysis Tool (HRCAT) and various other sources, the cost savings are on the order of hundreds of millions to billions of dollars over a ten-year period. Training costs were reduced from millions for rated pilots to tens of thousands for non-pilot AVOs. These calculations are on par with more extensive research conducted by an Air Force audit that determined $1.5 billion could be saved over a period of 6 years by allowing airmen to fly UAVs vice rated pilots. The savings not only include vastly reduced training costs, but also lifecycle costs such as basic pay, specialty pay, retention bonuses, and retirement pay.

The research determined that both tangible and intangible benefits exist by allowing enlisted personnel to operate Fire Scout vice rated pilots. Tangible benefits include greatly reduced length of training and reduced manning requirements aboard surface combatant ships. Northrop Grumman Corporation (NGC) can train AVOs in a matter of weeks as compared to the years that are required to train a fully qualified military rated pilot. By allowing enlisted personnel to be Fire Scout AVOs, manning requirements aboard ship are reduced by eliminating the need to bring additional rated pilots to operate Fire Scout. This eases the burden of berthing-constrained ships such as the Littoral Combat Ship (LCS) and Frigates. This solution also provides for greater operational flexibility by allowing Fire Scout to operate from ships without an aviation detachment on board. Non-pilot AVOs would also reduce the stringent medical and physiological requirements that are necessary for rated pilots. This would create more qualified applicants that otherwise would not qualify for flight duty. This would create a larger selection pool, which could reduce recruiting and retention issues.

Intangible benefits include averting culture and safety issues. Numerous studies indicate that rated pilots do not desire to fly UAVs and prefer to remain in manned aircraft. The Air Force has been forced to offer enticements in order to fill UAV positions with rated pilots and has had issues with retention. Enlisted personnel, however, have demonstrated great pride and motivation conducting UAV operations. Indications are that enlisted personnel will seek UAV operator positions if afforded the opportunity due to the job enrichment that UAV operations provide them. Additionally, flight currency and proficiency suffer by forcing rated pilots out of the cockpit to be AVOs, which can create safety issues. Proficiency and currency will lapse if rated pilots fly only Fire Scout, or they will be forced to reduce flight time due to time-sharing with multiple aircraft. By allowing enlisted personnel to be Fire Scout AVOs, rated pilots are able to stay in the cockpit and maintain proficiency in just one airframe.

Recommendation:

- The U.S. Navy should create a pilot program that trains enlisted personnel to be Fire Scout AVOs.
- Allow rated pilots to remain focused solely on manned aircraft expertise in order to enhance safety by maximizing proficiency.

2. Secondary Research Question

a. What are the requisite Knowledge, Skills, and Abilities (KSAs) for a Fire Scout air vehicle operator (AVO)?

Conclusion: Determining the actual KSAs required to operate a UAV is well beyond the scope of this thesis. The Federal Aviation Administration (FAA) and the U.S. military have been struggling with this issue for years. UAV technology is relatively new and rapidly evolving, which has contributed to the difficulty in determining UAV-specific KSAs. Some studies indicate that being a autonomous UAV operator is more similar to being an air traffic controller than a rated pilot and that the AVO essentially *manages* the air vehicle vice actually *flying* it.

Until UAV-specific KSAs have been identified and widely accepted, the U.S. military Navy Enlisted Classifications (NEC) and Military Occupational Specialties (MOS) for UAVs will need to suffice. The Navy has created multiple NECs and the Marine Corps and Army have developed numerous MOSs relating to UAV operations. The Air Force is the only service that has not created enlisted job descriptions relating to UAV operations, but relies on their rated pilot selection method instead.

Recommendation:

- The U.S. Navy should continue work with other services and the civilian sector in order to fine tune KSAs specific to UAV operations.

C. AREAS FOR FURTHER RESEARCH AND STUDY

- Restricting source ratings to only aviation ratings is overly stringent and unnecessary. Identify appropriate new source ratings for NEC 8368: MQ-8B Air Vehicle Operator (AVO).
- Restricting source ratings to only aviation ratings is overly stringent and unnecessary. Identify appropriate new source ratings for NEC 8367: MQ-8B Mission Payload Operator (MPO).
- Identify appropriate new source ratings for NEC 8366: MQ-8B Organizational Maintenance Technician. Restricting source ratings to only aviation ratings is overly stringent and unnecessary.
- The Federal Aviation Administration (FAA), researchers, and the military are still struggling to identify KSAs specific to UAV operations. Recommend dedicated research of the civilian and military sectors to determine KSAs specific to UAV operations.
- Research and development for Fire Scout weapons systems has already begun. Recommend policy review to determine if a commissioned officer is required to be in the operational chain of command for weapons release authority for UAVs.

THIS PAGE INTENTIONALLY LEFT BLANK

APPENDIX A. EXCERPTS FROM HRCAT USERS MANUAL

According to the HRCAT Users Manual, the following descriptions are provided:[99]

The model is corrected for amortization:

Most pay and compensation elements that require amortization are amortized over the average career years of service. The Enlisted average years of service is 7.88 years and the Officer average years of service is 10.48 years of service. The list below details the pay elements amortized in the manpower costing tool.
1. Military Training (Accession) – amortized over average career length
2. Military Training (Flight) – amortized over average career length
3. Military Training (Pipeline) – amortized over 4 years
4. Military Training (Pipeline) – amortized over average career length
5. Military Recruiting – amortized over average career length.

Officer accession cost calculations:

Officer accession training costs for NROTC and OCS are taken from the FY04 NAVEDTRACOM Cost Factors Handbook. Naval Academy costs were obtained from the DOD Accession Policy Office. For costing purposes, the USNA, NROTC and OCS costs were averaged 40/40/20 with the USNA at 40%, NROTC at 40% and OCS at 20%. The model applies this weighted average to billets for Unrestricted Line Officers because they enter the Navy mainly from these sources and in these proportions.

Enlisted accession cost calculation:

Enlisted accession training costs are calculated based upon the FY04 NAVEDTRACOM Cost Factors Handbook. Initial boot camp and "A" school costs have been included in the calculation and all FY04 training costs have been adjusted 3% per year.

Flight Training calculations:

[99] HRCAT Manpower Costing. "HRCAT Manpower Costing Tool User Manual Revision 8.1." August 31, 2007. http://hrcat.serco-na.com/PersonnelCostingToolManual.html (accessed February 2, 2011).

Pipeline costs for pilots and naval flight officers are based on the FY04 NAVEDTRACOM Cost Factors Manual. The model calculates this cost based on a weighted average for each aviation designator based on the proportion of jet, prop, and helo aviation officer billets in the Navy. Costs are amortized over the average career length–10 years.

Pipeline Training calculations:

Officer pipeline training costs (initial training) are currently available for the Surface Warfare and Submarine communities. Costs for other officer communities will be implemented as they are determined.
Pipeline costs are based on the FY04 NAVEDTRACOM Cost Factors Manual. The model calculates this cost based on cumulative course costs. Costs are applied based on the average YOS of course attendance and amortized over 4 years.

Enlisted Training Calculations:

Enlisted C-School training costs are applied by NEC and calculated based upon the FY04 NAVEDTRACOM Cost Factors Handbook. All FY04 training costs have been adjusted 3% per year.

LIST OF REFERENCES

Alexander, David. "Lawmaker skeptical of cuts in 2013 defense budget." Reuters. February 14, 2012. http://www.reuters.com/article/2012/02/14/us-usa-defense-panetta-idUSTRE81D20220120214 (accessed February 15, 2012).

Bardin, Jeremy, Dan Covelli, James Malvasio, Matt Olson, Daniel Speer, and Frank Wood. BAMS UAS Manning and Fleet Integration Strategy. EMBA Project Report, Monterey: Naval Postgraduate School , 2010, 28.

Bumiller, Elisabeth. "Navy Drone Violated Washington Airspace." The New York Times. August 25, 2010. http://www.nytimes.com/2010/08/26/us/26drone.html?_r=1 (accessed March 16, 2011).

Bureau of Naval Personnel. Manual of Navy Enlisted Manpower and Personnel Classifications and Occupational Standards. Vol. II. United States Navy, 2012.

Burgess, Richard. "Headed for the Med: Navy's Fire Scout gears up for operational evaluation, full deployment." The Fleet. 2010. http://www.navair.navy.mil/pma266/pdfs/HeadedForTheMed.pdf (accessed March 17, 2011).

Butler, Amy. "Fire Scout to Gather Intel, Hunt Pirates." Aviation Week. February 9, 2011. http://www.aviationweek.com/aw/generic/story.jsp?id=news/awst/2011/02/07/AW_02_07_2011_p31-286989.xml&channel=defense (accessed March 17, 2011).

CBS News. "Air Force Makes Push For Drone Operators." CBS New U.S. February 11, 2009. http://www.cbsnews.com/2100-201_162-4540269.html (accessed March 1, 2012).

Coleman, Thompson. "Fleet Composite Squadron 6 Deactivates." Navy.mil. August 8, 2008. http://www.navy.mil/search/display.asp?story_id=38993 (accessed February 29, 2012).

CRUSER. NPS Cosortium for Robotics and Unmanned Systems Education and Research. https://wiki.nps.edu/display/CRUSER/UAV (accessed February 14, 2012).

Daegel.com. "Fire Scout VTUAV." Daegel.com. March 10, 2011. http://www.deagel.com/Tactical-Unmanned-Rotorcrafts/RQ-8A-Fire-Scout_a000557001.aspx (accessed March 17, 2011).

Defense Industry Daily. "The Fire Scout VTUAV Program: By Land and Sea." Defense Industry Daily. August 30, 2010. http://www.defenseindustrydaily.com/the-fire-scout-vtuav-program-by-land-and-by-sea-updated-01316/ (accessed March 17, 2011).

Diets, Stephen. "Navy's only enlisted operator shares Fire Scout deployment experience." Navy Live. August 4, 2011. http://navylive.dodlive.mil/2011/08/04/navy's-only-enlisted-operator-shares-fire-scout-deployment-experience/ (accessed February 9, 2012).

Donald, David. "Fire Scout Proves Its Value in Middle East Warzones." AIN Online. November 15, 2011. http://www.ainonline.com/?q=aviation-news/dubai-air-show/2011-11-14/fire-scout-proves-its-value-middle-east-warzones (accessed December 5, 2011).

Federal Aviation Administration. "Fact Sheet. Unmanned Aircraft Systems (UAS)." Federal Aviation Administration. July 2011. http://www.faa.gov/about/initiatives/uas/media/UAS_FACT_Sheet.pdf (accessed February 29, 2012).

Frantom, Todd. "Eyes in the Sky." All Hands, March 2005.

Freeland, Rene. "MQ-8B Fire Scout to Enter Production: A First for a US Navy Unmanned Air System." Global Newswire: Northrop Grumman News Release. May 31, 2007. http://www.irconnect.com/noc/press/pages/news_releases.html?d=120630 (accessed March 16, 2011).

Fuchs, Stephen. "Cost and Benefit Analysis of Alternatives to the Naval Reserve Officer Training Corps Flight Physical Screening Process." DTIC Online. September 2000. http://www.dtic.mil/cgi-bin/GetTRDoc?AD=ADA384315 (accessed February 14, 2012).

Gerhart, Michael, Kyle Peitzmeier, William Vann, and Frank Wood. MQ-8B Fire Scout Program Support Analysis. EMBA Project Report, Monterey: Naval Postgraduate School, 2009, 14.

Gertler, Jeremiah. U.S. Unmanned Aerial Systems. CRS Report, Congressional Research Service, 2012, 25-27.

Headquarters United States Marine Corps. Military Occupational Specialities (MOS) Marine Corps Manual. Washington, DC: Department of the Navy, 2008.

Heiss, Kevin, Mike Bissell, Juli Schmidt, Case Madson, and Tara Hernandez. Navy Manpower & Personnel. PowerPoint Presentation. Monterey: Naval Postgraduate School, February 28, 2011.

Hellman, Chris. "Analysis of the Fiscal Year 2012 Pentagon Spending Request." National Priorities Project. February 13, 2011. http://newprioritiesnetwork.org/resources/analysis-of-the-fiscal-year-2012-pentagon-spending-request (accessed March 17, 2011).

Hoffman, Michael. "UAV Pilot Career Field could save $1.5B." Air Force Times. March 1, 2009. http://www.airforcetimes.com/news/2009/03/airforce_uav_audit_030109/ (accessed March 17, 2011).

HRCAT Manpower Costing. "HRCAT Manpower Costing Tool User Manual Revision 8.1." August 31, 2007. http://hrcat.serco-na.com/PersonnelCostingToolManual.html (accessed February 2, 2011).

HRCAT Manpower Costing. What the HRCAT Manpower Costing Tool is... http://hrcat.serco-na.com/ (accessed December 8, 2011).

Jefferson, Ann. "Prey Station." All Hands - Magazine of the US Navy, September 2009.

Jurta, Daniel; Pettigrew, Bryan; Dye, Adam; Hodge, Joshua; Mullen, James; Schweikert, Grant; Wood, Chip. MQ-8B Fire Scout UAV Manning Cost Benefit Analysis. EMBA Project Report, Naval Postgraduate School, Monterey: Naval Postgraduate School, 2011.

Marine Unmanned Aerial Vehicle Squadron 1. "Marine Unmanned Aerial Vehicle Squadron 1 History." 3D Marine Aircraft Wing. http://www.3maw.usmc.mil/external/3dmaw/macg38/vmu1/history/history.jsp (accessed February 29, 2012).

Martin, Rachel. "Drone Pilots: The Future of Aerial Warfare." npr. November 29, 2011. http://www.npr.org/2011/11/29/142858358/drone-pilots-the-future-of-aerial-warfare (accessed March 1, 2012).

McLaughlin, Amy. "2-13th Aviation Battalion graduates 10,000th recorded student." Army.mil. February 1, 2012.

http://www.army.mil/article/72934/2_13th_Aviation_Battalion_graduates_10_000th_recorded_student/ (accessed March 1, 2012).

Military.com. "Become an AF UAV Operator." Military.com. October 13, 2008. http://www.military.com/military-report/become-an-af-uav-operator (accessed March 1, 2012).

Mortimer, Gary. "U.S. Navy Extends Afghan Tour of Duty for Northrop Grumman-Built Fire Scout." sUAS News. November 8, 2011. http://www.suasnews.com/2011/11/9952/u-s-navy-extends-afghan-tour-of-duty-for-northrop-grumman-built-fire-scout/ (accessed February 9, 2012).

Mulrine, Anna. "UAV Pilots." Airforce-magazine.com. January 2009. http://www.airforce-magazine.com/MagazineArchive/Pages/2009/January%202009/0109UAV.aspx (accessed March 1, 2012).

NAVAIR PMA-266. "Halyburton, Embarked Fire Scouts Return From Demanding Deployment." NAVAIR. August 4, 2011. http://www.navair.navy.mil/pma266/pdfs/HalyburtonFireScoutReturn.pdf (accessed February 9, 2012).

NAVAIR PMA-266. "HSL-42 Det 'Motley Two' poised to make history with Fire Scout UAV." NAVAIR. http://www.navair.navy.mil/pma266/pdfs/HSL.pdf (accessed March 17, 2011).

Naval Air Systems Command Public Affairs. "Autonomous Fire Scout UAV Lands on Ship." Navy.mil. January 2006. http://www.navy.mil/search/display.asp?story_id=22038 (accessed March 16, 2011).

Northrop Grumman Corporation. "MQ-8B Fire Scout." Northrop Grumman. http://www.as.northropgrumman.com/products/mq8bfirescout_navy/index.html (accessed March 14, 2011).

Northrop Grumman Corporation. "MQ-8B Fire Scout." Northrop Grumman Corporation. http://www.as.northropgrumman.com/products/mq8bfirescout_navy/assets/firescout-new-brochure.pdf (accessed February 14, 2012).

Northrop Grumman Corporation. MQ-8B Navy Fire Scout Images. http://www.as.northropgrumman.com/products/mq8bfirescout_navy/gallery.html (accessed February 8, 2012).

Pineda, Sherri. "MQ-8B Fire Scout Vertical Unmanned Aircraft System." Northrop Grumman. http://www.as.northropgrumman.com/products/mq8bfirescout_navy/assets/fs-fact-sheet.pdf (accessed March 12, 2011).

Pineda, Sherri. "Northrop Grumman MQ-8B Fire Scout Program Awarded Contractor Logistics Support Contract." Northrop Grumman New Release. May 4, 2009. http://www.navair.navy.mil/pma266/pdfs/NR_FS_CLSAward_NAVAIR09-486_4.29.09.pdf (accessed March 17, 2011).

Pineda, Sherri. "Northrop Grumman Receives US Navy MQ-8B Fire Scout Contract Award for Third Year of Low Rate Initial Production." Global Newswire: Northrop Grumman News Release. February 23, 2009. http://www.irconnect.com/noc/press/pages/news_releases.html?d=160037 (accessed March 16, 2011).

Quinn, Kristin. "Fire Scout Incident Called 'Learning Experience'." Defense News Periodical. 2010. http://www.defensenews.com/story.php?i=4759558&c=AME&s=AIR (accessed March 16, 2011).

Raymer, Michael. A Comparative Analysis of the Army MQ-8B Fire Scout Vertical Takeoff Unmanned Aerial Vehicle and Navy MQ-8B Manpower & Training Requirements. Thesis, Monterey: Naval Postgraduate School, 2009, 33.

Rosenberg, Barry. "LCS Delays Place Fire Scout on Alternate Ship." Defense News Periodical. 2008. http://www.defensenews.com/osd_story.php?sh=VSDS&i=3381948 (accessed March 16, 2011).

Sikorsky Corporation. "MH-60R Helicopter." Sikorsky.com. http://wwww.sikorsky.com/Products (accessed March 12, 2011).

Stewart, Joshua. "Reservists deploy to operate Fire Scout drone." Navy Times. February 6, 2012. http://www.navytimes.com/news/2012/02/navy-reservists-deploy-operate-fire-scout-drone-helicopter-020612w/ (accessed February 9, 2012).

Stewart, Joshua. "Senior chief a test case for enlisted pilots." Navy Times. November 6, 2011. http://www.navytimes.com/news/2011/11/navy-senior-chief-blazes-trail-enlisted-uav-pilots-110611w/ (accessed February 9, 2012).

Stracker, Matthew. An Operational Manpower Analysis of the RQ-8 Fire Scout Vertical Take-Off Unmanned Aerial Vehicle (VTUAV). Thesis, Monterey: Naval Postgraduate School, 2007.

sUAS News. Fire Scout Set to Operate from USS Halyburton. http://www.suasnews.com/2010/12/3078/firescout-set-to-operate-from-uss-halyburton/ (accessed February 8, 2012).

Sweetman, Bill, and Paul McLeary. "Some UAV Makers Do Better Than Others." Aviation Week. September 10, 2009. http://www.aviationweek.com/aw/generic/story_generic.jsp?channel=defense&id=news/UAVs091009.xml&headline=Some%20UAV%20Makers%20Do%20Better%20Than%20Others (accessed February 14, 2012).

Thompson, Rick. "A month later, VC-6 unit's homecoming just as sweet." dcmilitary.com. February 21, 2008. http://ww2.dcmilitary.com/stories/022108/southpotomac_28121.shtml (accessed February 29, 2012).

Tilghman, Andrew. "Fire Scout Program could open door for Enlisted." Navy Times.com. August 15, 2009. http://www.navytimes.com/news/2009/08/navy_enlisted_uav_081509w/ (accessed March 17, 2011).

U.S 4th Fleet Public Affairs. "Fire Scout Scores First Drug Bust with McInerney." Navy.mil. April 7, 2010. http://www.navy.mil/search/display.asp?story_id=52461 (accessed March 16, 2011).

U.S Air Force. "Pilot Candidate Selection Method." https://pcsm.aetc.af.mil/index.html (accessed March 1, 2012).

U.S Army. "MOS 15W - Unmanned Aerial Vehicle Operator." Army-Portal.com. http://www.army-portal.com/jobs/aviation/15w.html (accessed March 1, 2012).

U.S. Navy. "Fire Scout UAV Supports Operations in Afghanistan." Defence Talk. June 16, 2011. http://www.defencetalk.com/fire-scout-uav-supports-operations-in-afghanistan-34974/ (accessed February 9, 2012).

U.S. Navy. US Military Aviation. http://www.salimbeti.com/aviation/images2.htm (accessed February 14, 2012).

Under Secretary of Defense, Personnel and Readiness. “Special and Incentive Pay.” Military Compensation. http://militarypay.defense.gov/pay/specialindex.html#301aa (accessed December 8, 2012).

United States General Accounting Office. "Military Personnel: Actions Needed to Better Define Pilot Requirements and Promotion Retention." 1999. http://www.gao.gov/archive/1999/ns99211.pdf (accessed March 12, 2011).

THIS PAGE INTENTIONALLY LEFT BLANK

INITIAL DISTRIBUTION LIST

1. Defense Technical Information Center
   Ft. Belvoir, Virginia

2. Dudley Knox Library
   Naval Postgraduate School
   Monterey, California

3. Professor Yu-Chu Shen
   Naval Postgraduate School
   Monterey, California

4. Bill Hatch
   Naval Postgraduate School
   Monterey, California

5. Professor Ben Roberts
   Naval Postgraduate School
   Monterey, California

6. Professor Frank R. “Chip” Wood
   Naval Postgraduate School
   Monterey, California

7. Captain Jeff Kline
   Naval Postgraduate School
   Monterey, California

8. Captain Doug Otte
   Naval Postgraduate School
   Monterey, California

9. Commander Daniel Jurta
   Alexandria, Virginia

10. Commander Andrew Moulis
    VTUAV FIT & LCS Aviation Integration
    NAS North Island, California