CORONET VS. CARGO: A STUDY INTO INCREASING THE USAGE OF TANKER ASSETS FOR CARGO MOVEMENT ON CORONET POSITIONING AND DE-POSITIONING LEGS

GRADUATE RESEARCH PROJECT

Timothy J. Stuart, Major, USAF

AFIT/IMO/ENS/10-13

DEPARTMENT OF THE AIR FORCE

AIR UNIVERSITY

AIR FORCE INSTITUTE OF TECHNOLOGY

Wright-Patterson Air Force Base, Ohio

AFIT/IMO/ENS/10-13

CORONET VS. CARGO: A STUDY INTO INCREASING THE USAGE OF TANKER ASSETS FOR CARGO MOVEMENT ON CORONET POSITIONING AND DE-POSITIONING LEGS

GRADUATE RESEARCH PROJECT

Presented to the Faculty

Department of Operational Sciences

Graduate School of Engineering and Management

Air Force Institute of Technology

Air University

Air Education and Training Command

In Partial Fulfillment of the Requirements for the

Degree of Master of Science in Logistics

Timothy J. Stuart, BS, MAS
Major, USAF

June 2010

AFIT/IMO/ENS/10-13

CORONET VS. CARGO: A STUDY INTO INCREASING THE USAGE OF TANKER ASSETS FOR CARGO MOVEMENT ON CORONET POSITIONING AND DE-POSITIONING LEGS

Timothy J. Stuart, BS, MAS

Major, USAF

Approved:

//SIGNED// 10 JUNE 2010

James T. Moore, Ph.D (Advisor) Date

AFIT/IMO/ENS/10-13

Abstract

The Air Mobility Command (AMC) tanker force is heavily tasked moving fighter units on Coronets (missions to and from exercises, deployments and redeployments). Many of these missions have legs that are not utilized by the fighter units and that leave the tanker flying intratheater without off loading any fuel or carrying any cargo. In this age of decreased resources and increased workload, AMC needs to have a process in place that can take advantage of these unused legs to the maximum extent. By changing the way that Coronets are planned and by adding cargo hubs as stops in these "empty legs," AMC may be able to reduce the number of cargo aircraft required in the mobility system and reduce the number of underutilized flying hours on the tanker.

This research utilizes data from Tanker Activity Reports that are filled out and submitted after each leg of a mission. This data is used to validate the theory that AMC is not fully utilizing tankers to their maximum capabilities. The research also analyzes the current planning process for Coronet, Channel and Contingency missions in an attempt to link them into one process that maximizes each of their capabilities.

After reviewing all of the data, processes and costs associated with operating various mission types, the research provides recommendations for adjusting the current scheduling process. This research shows a trend in the underutilization of the tanker's ability to carry cargo. This lost pool of resources will continue to grow as the KC-135 is phased out of service and the enhanced capabilities of the KC-X are brought online. These are vital capabilities AMC and USTRANSCOM need to utilize.

AFIT/IMO/ENS/10-13

Acknowledgements

I owe a great deal of thanks to a number of people for helping me complete this project throughout the year. The guidance and advice of my AFIT advisor throughout this project was extremely appreciated. Additionally, the invaluable editorial skills of my uncle were immensely supportive. I also owe a debt of gratitude to several of my ASAM classmates for advice and assistance with not only the research, but the entire GRP process. Finally, and most importantly, thanks to my very patient and lovely wife and my two sons for their patience and understanding throughout not only this past year, but for my entire Air Force career.

Table of Contents

List of Figures

List of Tables

CORONET VS. CARGO: A STUDY INTO INCREASING THE USAGE OF TANKER ASSETS FOR CARGO MOVEMENT ON CORONET POSITIONING AND DE-POSITIONING LEGS

I. Introduction

Since the beginning of Operation Enduring Freedom (OEF) and Operation Iraqi Freedom (OIF), the U.S. Air Force has been sustaining incredibly high operations tempos in both airlift and air refueling missions. These levels are likely to continue at increased rates for the foreseeable future, and changes will have to be made to current equipment, planning processes, and utilization rates to sustain the fight. In an address at the Airlift/Tanker Association's 2009 symposium, the Chief of Staff of the Air Force, Gen. Norton Schwartz stated; "KC-X clearly is the number-one priority for our Air Force." (Schwartz, 2009) This is due not only to the ever-increasing age of our current tanker fleet, but also to the capabilities that the KC-X is expected to add to U.S Transportation Command (USTRANSCOM) and Air Mobility Command (AMC).

Although today's tanker fleet is highly capable and continues to accomplish the mission worldwide every day, it may not always be used to its maximum capability. In this era of increasing demand and decreasing budgets, AMC needs to be able to get the most "bang for their buck." By raising the level of incorporation of the tanker fleet into the traditional airlift fleet, there are efficiencies to be gained. Tankers are a limited high-value asset, but due to the nature of receivers not being collocated with tanker assets, there are often missions flown simply to get the right planes into the right areas. Minimizing these "wasted" opportunities for airlift of passengers or cargo will not only save taxpayer dollars, but free up traditional airlift assets for other required missions.

Research Objectives and Questions

This research answers the question, "Can the effectiveness of the tanker's airlift capabilities be improved on Coronet positioning and de-positioning legs?" The first objective in answering this question is to determine what methods are currently used in scheduling Coronet missions. The second objective is to determine the current cargo utilization on Coronet positioning and de-positioning legs. In addressing these problems, this paper focuses on the following sub questions:

1) How does the 618 Tanker/Airlift Control Center (TACC) directorates currently schedule Coronet and Channel cargo missions?
2) What are the capabilities of the current tanker fleet?
3) What potential capabilities will the KC-X bring?
4) How often are current Coronet missions utilized in the cargo role?

Overall this research establishes that there are improvements that can be implemented to increase the usage of tanker assets for cargo movement on Coronet positioning and de-positioning legs.

Background and Research Focus

The AMC tanker force is currently heavily tasked moving fighter units on Coronets (missions to and from exercises, deployments and redeployments). Many of these missions often have legs that are not utilized by the fighter units and that leave the tanker flying intertheater without offloading any fuel or carrying any cargo. In this age of decreased resources and increased workload, these "empty" legs impose an unnecessary burden on the entire AMC fleet and our commercial partners. AMC needs to have a process in place that can take advantage of these unused legs to the maximum extent and to ensure the most efficient allocation of aircraft to transportation requirements. The overall planning and scheduling of all of these missions is done at the 618th TACC through the Coronet, Channel, and Contingency shops. Execution is through a section called "the Barrel". (Brigantic, 2004, 581) The interaction between all of these offices during the entire allocation and planning cycle is the focus of his research.

Most Coronets operate through airfields that are not frequently visited by the typical cargo routes. As a result, there is often little to no cargo or passengers on hand that are not already allocated to missions and that can take advantage of these empty aircraft. The author surmises that by changing the way that Coronets are planned and by adding cargo hubs as stops in these empty legs, AMC may be able to reduce the number of cargo aircraft required in the system as well as the number of underutilized flying hours on the tanker. Even if there is no cargo/pax going to the same location as the Coronet starting point, utilizing the tanker to move cargo and pax into the same general area of the globe induces a much shorter flight time for the empty positioning leg.

Methodology

In order to understand the extent to which tanker aircraft can be utilized in roles other than air refueling, it is necessary to understand their capabilities. The literature review portion of this research paper contains background on not only the capabilities of the current tanker fleet, but also on the projected capabilities of the KC-X competitors. Since the competition for this award is currently ongoing, there is also discussion about how the procurement process will work and about some of the capabilities being considered as non-mandatory bonuses on the next generation of tankers. Although neither of the likely competitors has officially published the capabilities of the U.S. tanker versions of these airframes, they are assumed to be very similar to the commercial capabilities and to those of the tanker versions that have been produced for other countries.

Data for all missions flown between 1 August 2008 and 31 July 2009 by tanker aircraft as part of a Coronet mission was obtained from the 618th TACC Data Division (618 TACC/XOND). This data was compiled from the Tanker Activity Reports that all tanker crews are required to fill out and submit after each leg of a mission. The data was initially filtered down to missions that did not take off and land at the same location (out-n-backs) and to only flights that originated or terminated at overseas locations (OCONUS). All training sorties were also filtered out due to the restriction on most training activities when cargo or passengers are onboard. The remaining sorties are further broken down to show those missions that either began or ended at McGuire (KWRI) AFB. This was done due to the fact that KWRI is a stateside cargo hub that cargo channel missions transit. This data appears to validate the theory that AMC is not fully utilizing tankers to their maximum capabilities.

The research also analyzed the current planning process for Coronet, Channel and Contingency missions in an attempt to link them to maximize each of their capabilities. This was done by contacting each of the respective divisions and having their POC describe the planning process and timeline.

Assumptions and Limitations

One of the largest limitations of this research is the accuracy of the data. Since tanker crews must manually input this data after the flight, there are likely instances of missing or incorrect data. This could mean that there were a greater percentage of flights that actually did carry cargo or passengers, but this information was never input by the crew. The research makes the assumption that the majority of this data was input correctly. Additionally, no deployed flight information is used in this research due to its classified nature and the fact that very few Coronet missions are flown using deployed tanker assets. (Dally, 2009)

The research is limited to only those Coronet legs that arrive or depart from KWRI and are going to or coming from a European OCONUS location. This is a self-imposed limitation in order to minimize the number of additional cargo or aircraft movements that would be required to match up movable cargo with an available aircraft. This study could be expanded to include Travis AFB (KSUU) as a West Coast hub, which would also limit the number of positioning legs required for cargo movement by tankers in the Pacific Theater.

The research makes the assumption that any cargo load less than one short ton (STon) is likely either a baggage or maintenance pallet and therefore not considered cargo moved for the purposes of this paper. All legs that show less than 1 STon aboard are counted as zero cargo.

In order for any recommendation to be implemented for dual role missions, it is assumed that TACC will be able to multi-code or change mission numbers to provide a means for it to be correctly billed to the user. It is unlikely that a fighter unit would pay any additional cost to move someone else's cargo requirement; therefore, there has to be the ability to bill the correct user.

The research is also limited strictly to the positioning and de-positioning legs of Coronet tasked missions. There may be more opportunities to increase the cargo moved by tankers on other missions, such as off-station trainers, DV movements or other taskings that are beyond the scope of this research. The research does not consider utilizing the dual-role capabilities of tankers due to limits placed on cargo due to changing fuel requirements and timing while on active legs of fighter movements. This capability is sometimes used by the fighter unit that the tanker is moving, but the research does not look into those movements as areas for improvement.

Implications

Replanning even 10 percent of these empty legs to utilize their potential makes it feasible that TACC will gain the equivalent of 23 sorties a year. If the process can be implemented for a higher percentage, there would be an even greater gain in capabilities. Any improvement will potentially save huge amounts of money by making possible the hiring of fewer commercial carriers and by potentially reducing the load on the traditional grey tail airlift fleet. The goal would be to have any new process in place prior to the introduction of the KC-X into the mobility system in order to fully utilize the enhanced capabilities it will offer.

Summary

This paper is divided into six primary chapters. Chapter 1 is a summary that includes the objectives, background, assumptions, limitations and potential implications of the research. Chapter 2 presents a literature review of the capabilities of the current tanker fleet along with a look at the capabilities that the KC-X may bring to the Air Force. Chapter 3 discusses the current methodology used by TACC to schedule coronet and cargo missions. Chapter 4 reviews the data acquired on the current utilization of tanker assets for cargo capabilities along with costs for associated missions. Chapter 5 answers the research questions and discusses possible methods to improve the current processes and Chapter 6 provides a brief summary and conclusion.

The general theme found throughout this paper shows a trend in the underutilization of the tanker's ability to carry cargo. This lost pool of resources will continue to grow as the KC-

135 is phased out of service and the enhanced capabilities of the KC-X are brought online. These are vital capabilities AMC and USTRANSCOM should learn to utilize in today's environment of shrinking resources and expanding demands.

II. Literature Review

Current tanker fleet capabilities, procurement of the KC-X, and potential KC-X capabilities

This portion of the paper is broken into four sections: current tanker fleet capabilities, requested capabilities for the KC-X, a brief summary of how the procurement process works, and the expected capabilities of the prospective bidder's airframes. There is also discussion not only of the air refueling portion of a tanker's mission, but also its ability to perform numerous secondary missions, such as cargo movement and aeromedical evacuation.

1. Capabilities of Current Tanker Fleet

The USAF currently operates 59 KC-10A Extenders (Figure 1) and 384 KC-135 Stratotankers in its Active, Reserve and Guard tanker fleet for air refueling, cargo and aeromedical evacuation missions. Although this paper will not discuss the extent to which the Air Force uses each tanker in each mission area beyond Coronet positioning and de-positioning legs, it is necessary to discuss all their capabilities in order to provide a foundation of knowledge on how they can be better utilized.

1.1 McDonnell Douglas KC-10A Extender

Figure 1: KC-10 Refueling F-16s (USAF)

The KC-10A design is based off the civilian wide body DC-10 that has been adapted for refueling military aircraft and airlifting cargo and support personnel (DOAF, 1C-10(K)A-1, 2008, 1.1-3). The KC-10A entered service with the AF in March of 1981 (DOAF, KC-10 Fact Sheet, Sept 08). The KC-10 allows planners to utilize what is known as a dual role capability in that it can move a fighter unit's personnel and equipment in conjunction with refueling its fighters en-route to deployed locations. This capability is further enhanced by the KC-10's ability to be in-flight refueled from any boom-equipped U.S. or allied tanker, thus extending its range almost indefinitely. The minimum crew complement required to operate the aircraft is four for duty days up to 16 hours and seven for duty days up to 24 hours. The flight deck is configured to seat a maximum of five crewmembers in-flight and has four crew rest facilities in the cargo compartment. The KC-10 is typically flown in one of two interior configurations known as a Bravo or a Delta configuration (Figure 2). The Bravo configuration allows for 16 seats in the forward cabin area and 23 pallet position equivalents (PPEs). The Delta configuration allows for 75 seats and 17 PPEs (DOAF, 1C-10(K)A-1, 2008, 1.1-3). In the aeromedical evacuation role, the KC-10 can be configured for 63 personnel, 6 litters and 17 PPEs or for 51 personnel, 12 litters and 17 PPEs (DOAF, 1C-10(K)A-9, 2007, 2-22). These capabilities are summarized in Table 1.

In regards to the KC-10's cargo carrying capacity, pallets are often limited in weight and size depending on where they are loaded. Pallet weight limits can be 5,400 lbs., 6,500 lbs., or 10,000 lbs. depending on their load location, but in no case can the total cargo load be more than 170,000 lbs. (DOAF, 1C-10(K)A-9, 2007, 2-15). The pallets are also limited in height to no more than 96 inches and are required to be contoured to fit inside the cargo compartment (DOAF, 1C-10(K)A-9, 2007, 4-11). These limitations often mean that pallets have to be broken

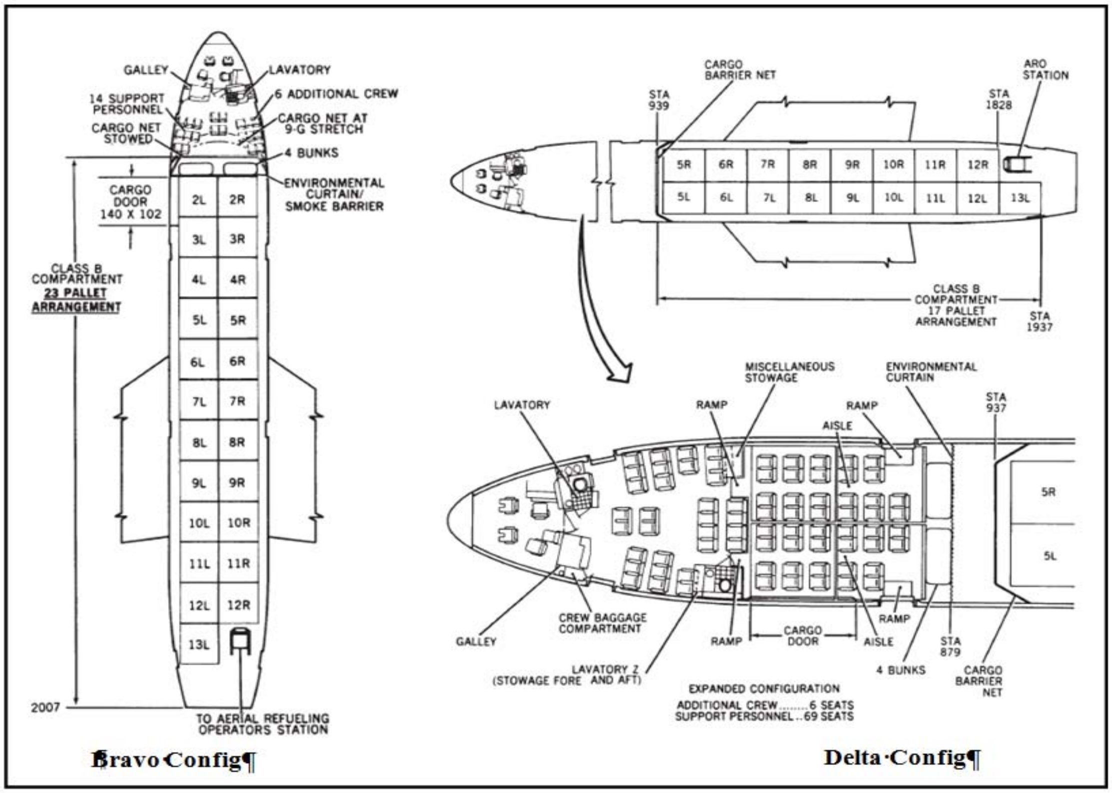


Figure 2: Standard KC-10 Configurations (DOAF, 1C-10(K)A-1, 2008)

down and reconfigured when they come off other modes of transportation prior to being loaded into the KC-10.

While the KC-10 has significant airlift capability, the majority of KC-10s are dedicated to air refueling missions. The eight fuel tanks on a KC-10 can hold 356,000 lbs of fuel (DOAF, KC-10 Fact Sheet, Sept 08) and can offload approximately 233,500 lbs with a 500nm mission radius or 78,700 lbs with a 2500nm mission radius (DOAF, AFPAM 10-1403, Dec 03, 17). All KC-10s are configured to refuel receivers requiring either boom or hose/drogue systems on the same flight, but not simultaneously. Additionally 20 of the aircraft have been modified to carry Wing Air Refueling Pods (WARPs), which allow the KC-10 to refuel two drogue equipped receivers simultaneously (DOAF, KC-10 Fact Sheet, Sept 08). This combination of unique capabilities makes the KC-10 a much-sought-after asset both in the war-fighting arena and throughout the mobility system.

Table 1. McDonnell Douglas KC-10 Specifications (DOAF, 1C-10(K)A-1, 2008 and DOAF AFPAM10-1043, Dec 03)

Length	181 ft. 7 in
Wingspan	165 ft. 4 in
Height	57 ft. 7 in
Max Takeoff Gross Weight	590,000 lbs.
Max Landing Weight	436,000 lbs.
Max Zero Fuel Weight	414,000 lbs.
Fuel Capacity	356,000 lbs. Maximum
Pallet Positions	27 max, 17-23 Typical
Max Cargo Weight	170,000 lbs. (85 STons)
Passenger Capability	75 max in Delta Config (20 Typical)
Aeromedical	6-12 litters, 51-63 pax, and 17 PPEs

1.2 Boeing KC-135 Stratotanker

Figure 3: KC-135 Refueling F-16s (USAF)

The basic design of the KC-135 (Figure 3) is modeled after Boeing's 707 commercial airliner and was produced for the Air Force from 1957 to 1965. (DOAF, KC-135 Fact Sheet, Sept 08) All of the airframes remaining in the inventory have been modified from their original A model to E, R and T models that have greatly enhanced capabilities, including a few of the airframes, known as AAR capable, which were modified to be refueled in-flight. All of these AAR airframes are stationed at McConnell AFB and are used for special operations refueling missions. Since the majority of the fleet are KC-135Rs and Ts, this paper focuses on their specific capabilities which are summarized in Table 2.

The KC-135 crew complement is 3 for duty days up to 16 hours and 5 for duty days up to 24 hours. Certain special missions require the addition of a Navigator to the minimum crew complement raising these to 4 and 7 crewmembers, respectively. Although the aircraft is capable of operating in contingency situations with only two crewmembers, a pilot and co-pilot, the typical minimum complement adds a boom operator. Without the boom operator, the aircraft cannot carry passengers, cargo or perform aerial refueling.

The KC-135 is capable of carrying 57 passengers on sidewall seats along the length of the cargo compartment. Although it also has the capability to load palletized seating kits, this is not considered a standard configuration and is typically only used for special missions. In its aeromedical evacuation role, the KC-135 can carry 18 litters and 26 personnel. The 26 personnel can be broken into any combination of ambulatory patients and aeromedical evacuation crewmembers.

In its cargo role, the KC-135 is capable of carrying six PPEs that are loaded slightly off center down the length of the cargo compartment. The maximum pallet weight is 6,000 lbs, which limits the total allowable cargo load to 18 STons, and each pallet is limited to 65 inches in height. The pallet also has to be contoured on the right side starting at 50 inches in order to accommodate the curvature of the fuselage. (DOAF, 1C-135(K) -9, 2008) Much like the KC-10, pallets often have to be broken down and reconfigured to meet the restrictions of the KC-135 after they have been offloaded from other modes of transportation. This additional workload and time requirement often means that the KC-135's cargo capability does not get utilized.

For aerial refueling operations, the KC-135 utilizes two main body tanks that can be replenished by the wing fuel tanks to offload a maximum of 122,200 lbs of fuel with a 500 nm mission radius. The max offload available drops to 30,700 lbs. with a 2500nm mission radius (DOAF, AFPAM 10-1403, Dec 03, 17). Using tank fuel pumps, the KC-135 is capable of offloading any of its fuel in flight as the situation dictates. Some of the aircraft have been modified to carry Multipoint Refueling System (MPRS) pods that are similar to the WARPs on the KC-10. These are the only KC-135s that have the ability to refuel either boom or drogue equipped aircraft on the same flight and only when the MPRS pods are installed. All of the aircraft have a boom that can be configured prior to takeoff, with a drogue attachment that allows refueling of drogue receivers in-flight, but then the KC-135 is no longer capable of boom refueling until after reconfiguration. Although this increases the overall capabilities of the KC-135, it greatly limits planners' ability to make mission adjustments without significant advance notice.

Table 2. Boeing KC-135 Specifications (DOAF, 1C-135(K) -1, 2008 and DOAF AFPAM10-1043, Dec 03)

Length	136 ft. 3 in.
Wingspan	130 ft. 10 in.
Height	41 ft. 8 in.
Max Takeoff Gross Weight	322,500 lbs.
Max Landing Weight	200,000 lbs.
Max Zero Fuel Weight	195,000 lbs.
Fuel Capacity	180,000 lbs.
Pallet Positions	6
Max Cargo/Pax Weight	36,000 lbs. (18 STons) of palletized max
Passenger Capability	57
Aeromedical	18 liters, 26 pax and 6 PPEs

2. What Capabilities Will the KC-X Have?

The Air Force Materiel Command (AFMC) released a draft Request for Proposal (RFP) on September 29th, 2009 that outlined the minimum requirements for any airframe to be considered in the competition to award the contract for the KC-X. This draft RFP states that the KC-X program is the first of three types of aircraft that will be procured to replace the current tanker fleet and the planned purchase will be approximately 180 aircraft. The draft RFP Systems Requirements Document lays out the concept of operations of the KC-X mission as:

> *The primary mission of the KC-X is to provide worldwide, day and night, adverse weather aerial refueling (AR) on the same sortie to receiver capable United States (US), allied, and coalition military aircraft (including unoccupied aircraft). AR Aircraft (ARA) provide robust, sustained AR capability to support strategic operations, global attack, air-bridge, deployment, sustainment, employment, redeployment, homeland defense, theater operations, and special operations. Secondary missions for KC-X include emergency aerial refueling, airlift, communications gateway, aeromedical evacuation (AE), forward area refueling point (FARP), combat search and rescue (CSAR), and treaty compliance. ARA may allow for mixing secondary missions in a manner not to significantly impact the primary AR mission. KC-X will accomplish these missions primarily through the aerial refueling of other aircraft and airlift capability, exploiting its adaptability and expeditionary capabilities.* (AFMC, KC-X TMP-DRFP, Section J, Attachment 1, para1.2.1, 24 Sept 2009)

In order to fulfill these incredibly diverse mission requirements, the RFP breaks them down into 373 mandatory and non-mandatory requirements and weights with each one based on the operational value of each capability. The requirements are broken down into six general areas. They are aerial refueling, airlift, information management, operational utility, survivability, and product support. Each of these areas is further broken down into three additional sub-areas to further explain each requirement. As an example, Figure 4 (AFMC, KC-X TMP-DRFP, Section L, Attachment 4, 24 Sept 2009) shows that if an airframe's fuel offload capability compared to its unrefueled range increases above the minimum required, it will increase the airframe's operational value in the competition. Only the 93 non-mandatory

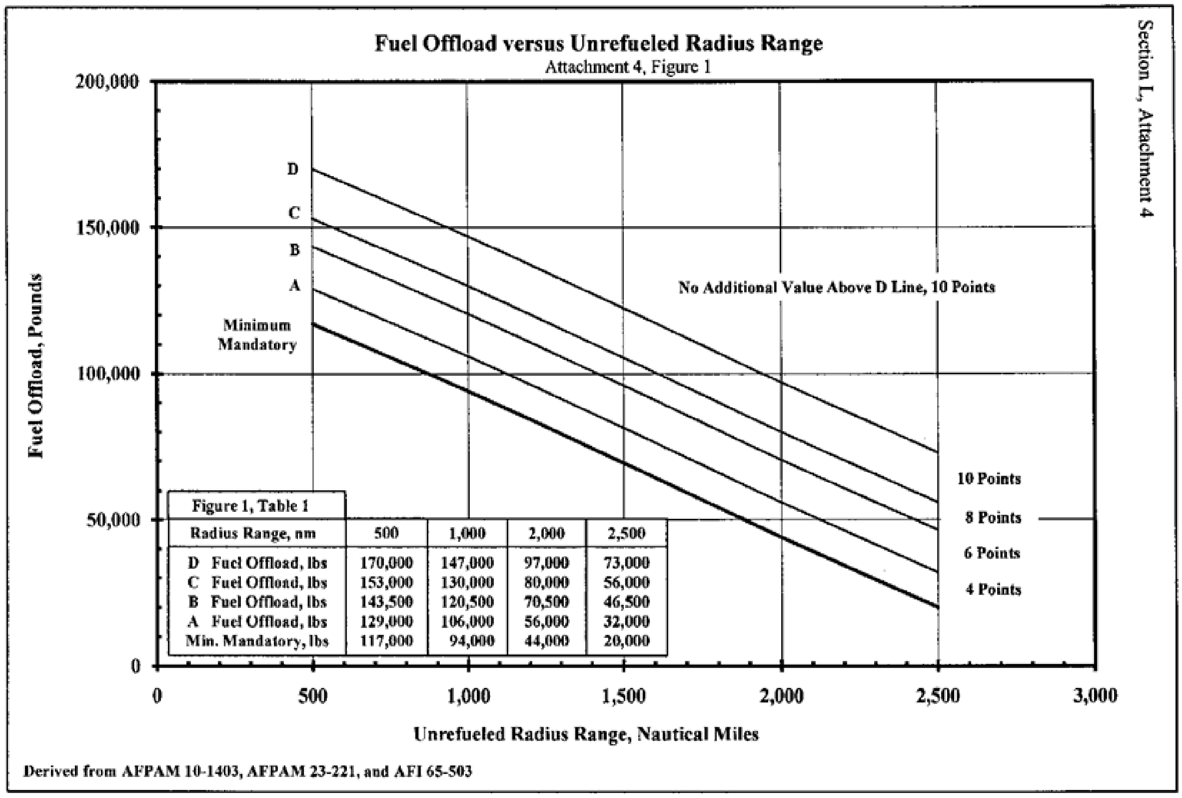


Figure 1, Table 1				
Radius Range, nm	500	1,000	2,000	2,500
D Fuel Offload, lbs	170,000	147,000	97,000	73,000
C Fuel Offload, lbs	153,000	130,000	80,000	56,000
B Fuel Offload, lbs	143,500	120,500	70,500	46,500
A Fuel Offload, lbs	129,000	106,000	56,000	32,000
Min. Mandatory, lbs	117,000	94,000	44,000	20,000

Figure 4: KC-X Fuel Offload vs. Range Contract Point Weight Graph

requirements have point values with each mandatory requirement being graded as either acceptable or unacceptable.

Although the KC-X is commonly thought of as a replacement for the KC-135, it does not necessarily mean that the Air Force desires a one-for-one replacement of capabilities. Many of the minimum requirements called for are actually closer to the capabilities of a KC-10 than those of a KC-135. Some of the major requested increases in capability over the KC-135 are described below and are broken down into the same six general requirements sections as in the RFP.

2.1 Aerial Refueling

2.1.1 The KC-X is required to provide both a boom and centerline drogue refueling capability on the same flight. (Sec J, Attach 1, para 3.1.1.12)

2.1.2 The Aerial Refueling Operators, commonly called the Boom Operators, will have a seated work station unlike the KC-135, where they are required to lie down on their stomach and operate the refueling equipment. (Sec J, Attach 1, para 3.1.1.15) This configuration allows for a more comfortable work environment and may lead to less fatigue and human-error-related issues.

2.1.3 The ability to isolate some internal fuel tanks to accommodate a secondary fuel type allows the KC-X to carry either specialized fuel for in-flight transfer or ground offload. (Sec J, Attach 1, para 3.1.122) An example of the need for this kind of requirement is the SR-71 Blackbird. Since it requires a specialized fuel for its mission, any tanker refueling the SR-71 has to have the ability to isolate certain tanks so the fuel would not damage the tanker’s engines. Additionally, the KC-X will be able to carry and offload diesel fuel to ground units at forward operating locations. (Sec J, Attach 1, para 3.1.3.3.2)

2.1.4 Although a non-mandatory requirement, the KC-X RFP calls for the addition of a second backup centerline drogue system. (Sec J, Attach 1, para 3.1.1.24.1.1) This capability should provide for a much higher mission capable rate for drogue refueling missions.

2.1.5 The KC-X will have the ability to carry two WARPs to allow for simultaneous refueling of two drogue receivers. (Sec J, Attach 1, para 3.1.1.24.3)

2.1.6 To enhance the KC-X’s range and mission capabilities, all of them will be capable of being in-flight refueled from any boom-equipped tanker. (Sec J, Attach 1, para 3.1.2.2)

2.1.7 To reduce the crew workload, the KC-X will have the ability to automatically transfer and sequence fuel offload to maintain the aircraft within its center of gravity envelope. (Sec J, Attach 1, para 3.1.3.1)

2.2 Airlift

2.2.1 The speed of cargo loading and unloading operations should be greatly increased with the requirement for an integral cargo handling system. (Sec J, Attach 1, para 3.2.1.2.3) This will allow for all cargo to be moved to and from the loader to its final position in the aircraft without manual labor from ground handlers.

2.2.2 As an AE platform, the KC-X must have the minimum capability of carrying 50 patients (24 litter and 26 ambulatory) for a 16-hour mission. (Sec J, Attach 1, para 3.2.2.4.2) This is a greatly enhanced capability over the KC-135.

2.2.3 Unlike either the KC-135 or KC-10, the KC-X will be able to utilize its entire cargo compartment to carry passengers on palletized seats. (Sec J, Attach 1, para 3.2.2.5.2)

2.3 Information Management

2.3.1 Although many of the current tanker fleet have already been upgraded with advanced avionics, radios, and flight management systems, the KC-X will further enhance these features with the newest hardware available throughout the flight deck and passenger compartment.

2.3.2 In order to allow for the KC-X to act as a command and control platform, it will have the ability to transmit, receive, process and display numerous net-centric operations in the cargo compartment. (Sec J, Attach 1, para 3.3.2.1) These include but are not limited to classified e-mail, web access and all current and future communication systems.

2.4 Operational Utility

2.4.1 To enhance the aircraft's ground maneuverability, the KC-X RFP has a non-mandatory requirement for the KC-X to back up under its own power. (Sec J, Attach 1, para 3.4.2.5.4) Although neither the KC-10 nor KC-135 has this capability, the C-17 and C-130 do and have proven the advantages of this capability when operating from bare bases.

2.4.2 Much like most current commercial airliners, the KC-X will have standard 115V power outlets for passenger use a minimum of every other pallet position throughout the cargo compartment. (Sec J, Attach 1, para 3.4.3.9.3)

2.5 Survivability

2.5.1 The KC-X will be equipped with aircraft Defensive Systems (DS) to allow for operations in hostile environments. (Sec J, Attach 1, para 3.5.1) This includes the installation of Large Infra-Red Counter Measure (LAIRCM) turrets for protection against Man Portable Aircraft Defensive Systems (MANPADS).

2.5.2 Unlike most current aircraft that require additional armor plating to be installed prior to operations in hostile environments, the KC-X will be equipped with some sort of integral ballistic protection for crew and flight critical systems protection. (Sec J, Attach 1, para 3.5.1.4)

2.6 Product Support

2.6.1 The KC-X must have a Mission Capability (MC) rate of at least 92 percent after 50,000 accumulated hours on the fleet of aircraft. (Sec J, Attach 1, para 3.6.1.2) This is significantly higher than the current MC rates of the current tanker fleet.

2.6.2 To facilitate faster maintenance turn times, the aircraft must be configured with automatic health monitoring and reporting systems for data collection. (Sec J, Attach 1, para 3.6.3.7)

3. Procurement Process

The government has stated that the acquisition of the KC-X will be a best-value source selection based on mission capability, cost/price, and, if required, additional nonmandatory technical requirements. (AFMC, KC-X DRFP, AESG Solicitation, para 1.1) In order to do this, the source selection team and the Special Selection Authority (SSA) will break each proposal into five subsections to be evaluated.

They will first determine each proposed airframe's Mission Capabilities Factor to determine its technical acceptability. This evaluation takes into consideration all of the mandatory requirements listed in the RFP, and it leads to a grading of either acceptable or unacceptable. If in this step any proposed airframe is rated as unacceptable, the airframe will become ineligible to compete.

The second step is the rating of the 93 nonmandatory technical requirements. For each of these requirements that are met, a point value will be awarded based on a scale published in the RFP. The total of all these points will be used later in the process as needed.

The most important step is the price evaluation. The team will assess the Total Proposed Price (TPP), Integrated Fleet Aerial Refueling Assessment, Fuel usage rate assessment, and MILCON required. All of these factors will be adjusted into a total proposed price in present-value dollars and be presented as a Total Evaluated Price (TEP).

The fourth step in the process could theoretically be the last. The source selection team and SSA will compare the TEPs for the lowest proposal. If none of the acceptable proposals are less than or equal to 101 percent of the predetermined TEP, the contract will be awarded to the lowest proposal. (The predetermined TEP is not available to bidders and is computed prior to the competition.) If any offers are less than the 101 percent, then the team will have additional factors to consider. Additionally, if the lowest TEP proposal is within 1 percent of any other proposal, as is the expected case, the team will have to move on to the next step

The "tie breaker" step is the consideration of all the points accumulated from the review of the 93 nonmandatory technical requirements. This additional process will assist in the Air Force getting more of their "wants" from bidders while still accounting for all the "needs." This step in the review process is one of the areas that substantiated Boeing's protest of the last Airbus award. As an example, although cargo carrying capability is highly desired, the last contract process did not have a way to weigh its value. Without knowing how each of these areas affected the outcome of the award, it was determined that the entire process was unfair and needed to be redone.

4. Possible KC-X Airframes

The competition for the KC-X is an open source contract available on the Federal Business Opportunities website (https://www.fbo.gov/) and as such is open to any business that is capable of producing a product that meets the minimum requirements of the RFP. That being said, there are only two companies that currently have the capability to produce airframes that meet these requirements: Boeing and Airbus. In an effort to minimize the potential political implications of purchasing a foreign-built airframe for military use, Airbus has teamed with Northrop Grumman (Northrop, 2009) for the competition with the KC-45, a derivative of the A330. Boeing has the potential to submit derivatives of either its 767 or its 777 airframes depending on the actual capabilities required.

The Air Force contracted with the RAND Corporation to study alternatives for the recapitalization of the KC-135 fleet. The final report was published in December 2005 and called for a mixed fleet of medium to large tanker aircraft. (RAND, 2006) For their analysis, RAND defines a medium-size tanker as having a 300,000 to 550,000 pound maximum gross takeoff weight and a large-size tanker as a 550,000 to 1,000,000 pound maximum takeoff weight. (RAND, 2006, 8) Although ultimately having this mixed fleet is beyond the scope of the current KC-X competition, it is important to note that the long-term plan of the KC-X, KC-Y and KC-Z (Figure 5) will bring even more capabilities into the fleet. The following sections discuss the expected capabilities of the three likely airframes that will be competing for the KC-X.

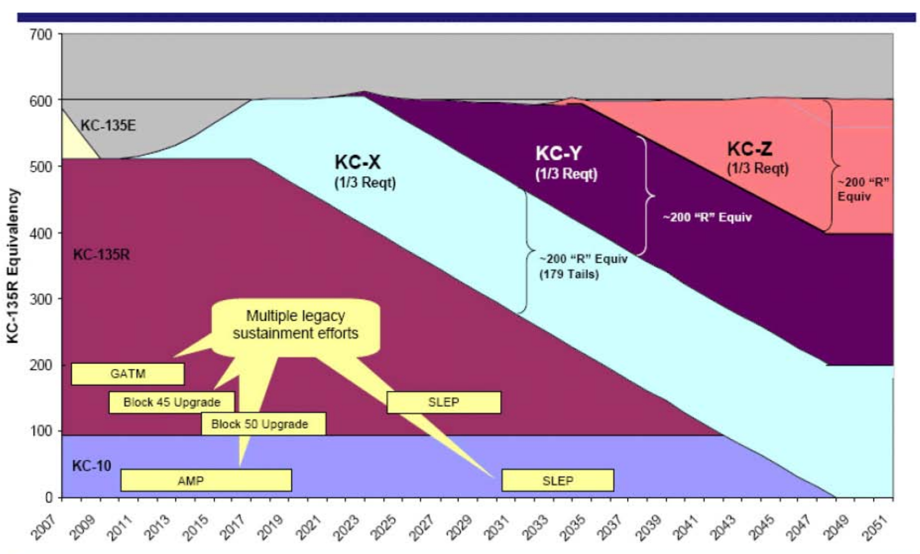


Figure 5: Air Force Tanker Recapitalization Plan (CRS, 2008, 17)

4.1 Northrop Grumman KC-45 (A-330)

Figure 6: A330 Refueling F-18 (Northrop, 2009)

Northrop Grumman's KC-45 Tanker Aircraft is a derivative of the A330 Multi-Role Tanker Transport (MRTT), which is based off the A330-200 wide-body twin engine passenger aircraft. The air forces of Australia, United Kingdom, United Arab Emirates and Saudi Arabia have ordered 28 of the A330 MRTTs (Northrop, 2009) to be used for aerial refueling, cargo, passenger and aeromedical evacuation missions. The KC-45 is equipped with a centerline boom, an integral center line hose and drogue, and can be outfitted with two WARPS. The KC-45, much like the KC-10, is interoperable with U.S. Air Force, Navy, Marine Corps and allied aircraft on the same mission without downtime for ground reconfiguration. (Northrop, 2009)

The KC-45 is capable of carrying approximately 250,000 pounds of fuel, which is about a 25 percent increase over the KC-135R. (Northrop, 2009) Although Northrop has not published the KC-45 offload capabilities, with the increased fuel efficiency of the A330, it is expected to be much greater than a 25 percent increase (Northrop, 2009) over the KC-135. With a conservative estimate of only 30 percent above the KC-135, the KC-45 could potentially offload around 160,000 lbs. of fuel with a 500 nm mission radius, 130,000 lbs. at 1000 nm mission radius, and

40,000 lbs. of fuel with a 2500 nm mission radius. Utilizing its ability to be in-flight refueled from other tankers would further enhance these capabilities.

The KC-45 can be reconfigured into multiple different arrangements for cargo, passenger, and AE missions. The all-cargo, all-passenger and AE-with-passengers configurations are shown in Figure 7. In its all-cargo configuration, the KC-45 can carry 26

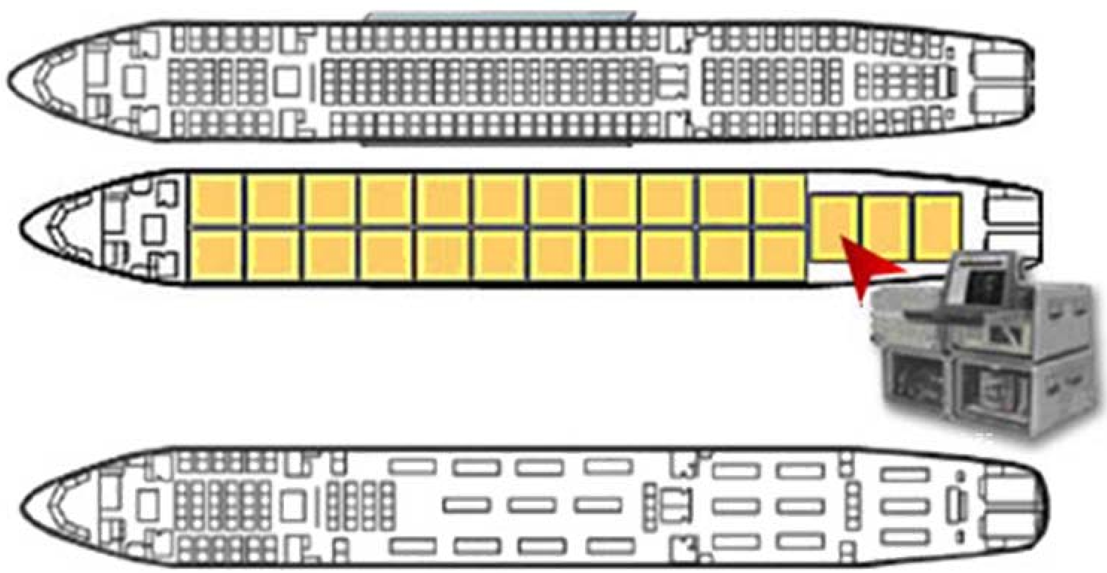


Figure 7: KC-45 Pax, Cargo and AE Configurations (Northrop, 2009)

pallets on the main deck and 6 pallets on the lower deck. (Northrop, 2009) Northrop has not publicly released the cargo weight capabilities of the KC-45, but using the conservative estimate of 6,000 lbs. per pallet (KC-135 weight restriction per PPE), this equates to a 192,000 lbs. cargo capacity. The KC-45 is expected to have similar pallet contouring requirements to the KC-10, but is likely to have a per PPE weight restriction of greater than the KC-135's 6,000 lb. The KC-45 all-passenger configuration is capable of 226 seats on the main deck while still carrying the 6 lower deck pallets. For additional cargo capability with passengers, the main deck area can be divided to accommodate multiple ranges of cargo and seats. The AE configuration pictured at the bottom of Figure 7 shows the layout for 70 litters, 6 intensive care units, and 113 passengers or medical staff. The KC-45s can also be configured in an all-litter arrangement that accommodates 120 litters. The Northrop Grumman KC-45 is considered a medium size tanker, and a summary of its specifications is listed in Table 3.

Table 3. Northrop Grumman KC-45 Specifications (Northrop, 2009 and and Burns & McDonnell, 10th Ed)

Length	192 ft. 11 in.
Wingspan	197 ft. 10 in.
Height	57 ft. 1 in.
Max Takeoff Gross Weight	513,675 lbs. (A330-200)
Max Landing Weight	396,830 lbs. (A330-200)
Fuel Capacity (estimated)	250,000 lbs.
Pallet Positions	32
Passenger Capability	226
Aeromedical	120 liters (or 76 litters/113pax) and 6 PPEs

4.2 Boeing KC-767

Figure 8: Two Italian KC-767s in-flight refueling (Boeing, 2009)

The Boeing KC-767, the smaller of the two possible Boeing KC-X submissions, is modeled around the commercial 767-200 airframe. (Boeing, 2009) Although roughly the same size as the KC-135 (Appendix A), the KC-767's capabilities (Table 4) are much greater, and it is still considered a medium size tanker. Like all of the potential KC-X submissions, the KC-767 is equipped with a centerline boom, an integral center line hose and drogue, and can be outfitted with two WARPS. The KC-767, much like the KC-45 and the KC-10, is interoperable with U.S. Air Force, Navy, Marine Corps and allied aircraft on the same mission without downtime for ground reconfiguration. (Boeing, 2009)

The KC-767 is capable of carrying more than 202,000 lbs. of fuel. (Boeing, 2009) Although Boeing has not yet published all of the KC-767 offload capabilities, they have stated it will be able to offload 23 percent more fuel with a 1,000 nm mission radius over the KC-135. (Boeing, 2009) Utilizing this and the KC-135R offload capabilities from AFPAM 10-1403, the KC-767 should be able to offload about 122,000lbs. for a 1,000 nm mission radius.

The cargo, passenger and AE capabilities of the KC-767 are also a large improvement over the KC-135. For cargo movement the KC-767 is capable of carrying 19 PPEs. (Boeing, 2009) Applying the same 6,000 lb. per pallet limitation as the KC-135, this equates to a cargo capacity of 114,000 lbs. The aircraft can be configured into multiple cargo and passenger carrying combinations and is capable of transporting up to 190 passengers in an all-pax configuration. (Boeing, 2009) Boeing has not published the total litter carrying capability of the KC-767 but has stated that it is capable of carrying 97 patients in its AE role. (Boeing, 2009) It is unknown if this number is all litters or a combination of litters and ambulatory patients.

Table 4. Boeing KC-767 Specifications (Boeing, 2009 and Burns & McDonnell, 10th Ed)

Length	159 ft. 2 in.
Wingspan	156 ft. 1in.
Height	52 ft.
Max Takeoff Gross Weight	315,000 lbs. (B767-200
Max Landing Weight	272,000 lbs. (B767-200)
Fuel Capacity	More than 202,000 lbs.
Pallet Positions	Up to 19
Passenger Capability	Up to 190
Aeromedical	Up to 97 patients

4.3 Boeing KC-777

Figure 9: The 777-based tanker (foreground) refuels a B-2 bomber. (Artist Rendering by Chuck Schroeder) (Boeing, 2009)

The KC-777 is a large-size tanker and is conceptually based off the Boeing 777-200 airframe. (Boeing, 2009) Unlike the other two potential competitors for the KC-X, the KC-777 does not have any models currently in operation or testing. It is still in the design phase but will utilize much of the same equipment as the smaller KC-767. As a large-size tanker, it offers a much greater range of capabilities (Table 6) but also requires a larger footprint for ground operations than the other KC-X competitors. (Appendix A)

The planned fuel capacity of the KC-777 is more than 300,000 lbs., and it will be able to offload around 199,000 lbs. with a 1,000 nm mission radius. (Boeing, 2009) The cargo, passenger, and AE capabilities of the KC-777 are also still in the design phase, but Boeing has stated they expect it to carry up to 38 pallets in an all cargo configuration, up to 320 passengers in an all passenger configuration, and up to 156 patients in an AE role. Although the KC-777 seems like more of an option as a potential KC-Y than the KC-X, it is expected that Boeing will submit it as a bid that compares in footprint size to the KC-45, (Appendix A) while offering greater capabilities.

Table 5. Boeing KC-777 Specifications (Boeing, 2009 and Burns & McDonnell, 10th Ed)

Length	209 ft. 1 in.
Wingspan	200 ft.
Height	60 ft. 8 in.
Max Takeoff Gross Weight	506,000 lbs. (B777-200
Max Landing Weight	455,000 lbs. (B777-200)
Fuel Capacity	More than 300,000 lbs.
Pallet Positions	Up to 38
Passenger Capability	Up to 320
Aeromedical	Up to 156 patients

III. Methodology

1. 618th Tanker/Airlift Control Center Overview

Air Mobility Command (AMC) is one of the US Air Force's ten major commands and is the air transportation component of US Transportation Command (USTRANSCOM). AMC is the sole provider of air mobility, air refueling, and aeromedical evacuation support for the deployment, employment, sustainment and redeployment of US forces worldwide (JP 4-01, 2003: II-4). As the global Air Operations Center (AOC), the 618th Tanker/Airlift Control Center (TACC) located at Scott AFB, IL, is the executive agent which plans, tasks, schedules and provides command and control for all AMC directed airlift and tanker missions (AMCI 11-208, 2000, pg 9). These missions equate to an average of over 1200 aircraft operating more than 825 sorties in over 50 unique countries around the globe daily (AMC Operations Summary, 8 Feb 2010), all of which fall under the control of the TACC.

The 618th is broken down into ten directorates to successfully accomplish this monumental task. The planning directorates initially receive requests and taskings from numerous customers according to the type of support required and its priority of movement. Planners within each directorate then build missions by choosing the appropriate aircraft type and will break down the mission from departure from home station to the on-load location (positioning legs), flight from on-load location to off-load location (active legs), and flight from off-load location back to home station (de-positioning legs). Once the proposed mission is built, the plan moves to the Mobility Management directorate, which manages and allocates all of AMC's airlift resources. Based on available aircraft, aircrews, and the priority of the mission, Mobility Management assigns the mission to specific Airlift Wings or Groups. If assets are not available to accomplish the mission as planned, it will be returned to the planning directorate as not supportable. Often, missions with higher priority have to be allocated resources that were previously committed to other missions. This causes missions that have already been approved to be moved into the not supportable category where the respective planning directorate then notifies the customer and replans the mission as necessary.

2. TACC Coronet Scheduling

The Air Refueling Operations Division (XOOK) falls under the Current Operations Directorate and is the single source in charge of all HQ-directed worldwide air refueling missions. They are responsible for scheduling and planning Coronets, tanker support to Foreign Military Sales, and Dual Role missions, and for coordinating all contingency and short-notice tanker air refueling requests. They are also responsible for allocating air refueling for all AMC aircraft and are AMC's validator for all high priority short-notice air refueling requests. The largest section of XOOK is the Coronet planning division, or XOOKP, which is further broken down into long-range planning and detail planner shops. Per the 618 TACC webpage, the XOOKP Concept of Operations is:

> *Plans and coordinates AMCs KC-10 and KC-135 aircraft in the planning of worldwide missions involving USAF, USN, USMC, and allied aircraft supporting CORONET fighter movements. Advises branch chief on issues pertaining to the professional development, manning, and recognition of enlisted personnel. Implements tanker support for USAF, USN, USMC, and foreign military aircraft. Manages all aspects of CORONET planning. Develops and disseminates electronic mission data to tanker aircrews in the field and directs 24-hour flight following of missions during execution. Coordinates with ACC ensuring timely delivery. Key advisor to TACC, AMC, and USTRANSCOM staffs for both deliberate and time-sensitive concepts, as well as operations plans involving use of all DoD tanker aircraft.* (https://tacc.scott.af.mil)

The planning of a Coronet mission starts off at the Air Combat Command's Air Operations Squadron (ACC/AOS), located on Langley AFB in Virginia. The ACC/AOS acts as the middleman or broker for all fighter movement requests that will require tanker support for air refueling. They submit all Coronet requests on a quarterly basis through the Consolidated Air Mobility Planning System (CAMPS), which is AMC's command and control planning and scheduling system that provides mission planners with tools for deliberate planning, operational planning, short-notice planning, and allocation management. (AMCI 10-202 V6, Aug 04) CAMPS then feeds this information automatically into the Air Refueling Management System (ARMS), which provides the refueling requester community a single entry point into an integrated refueling database. This allows receiver and tanker units to work concurrently with TACC's database allowing all users of CAMPS and ARMS to be able to see the same information. (AMCI 10-202 V6, Aug 04)

Per AFI 11-221, these requests must be in CAMPS/ARMS no later than 60 days prior to the start of the next quarter and must include details such as unit and home station of receiver aircraft, dates and times of movement, numbers and types of receiver aircraft, boom or drogue refueling required, fuel off-load requested, air refueling altitude, and air refueling support priority. The XOOKP Long-Range planners then have a maximum of 30 days (AFI 11-221, 1 Nov 1995) to break out the details of each mission request and to publish a schedule; however, the current Branch Chief, Major James Dally, has an internal office deadline to complete the entire next quarter no later than seven days after receipt of the request. (Dally, 2009)

When the original ARMS request arrives at XOOKP, it is a general, single line of information. The long-range planners examine the request and determine what tanker assets they think are required to move the fighters based on personal knowledge, historical movement information, and planning tools. On this basis, they make a rough cut at a mission overview. The original single line request could end up with 12 or more lines of detailed leg information.

(Dally, 2009) This expansion is due to the fact that the original request may be something as simple as “move eight fighters from Shaw AFB, NC to Al Udeid AB, Qatar.” The planners will then expand this to include the number of tankers and en route fuel stops required and so generate separate missions for each. This example could easily expand into two separate flights that include two tankers and four fighters making three en route fuel stops each for a total of 12 separate mission lines. These initial expansion plans are completed within those first seven days, but detailed leg planning typically does not start until 30 days prior to mission execution. This is due to the fact that historically 30-50 percent of the missions get changed at least once by receiver unit request. (Dally, 2009) These are typically minor changes such as sliding the movement times or days; however, they can often negate any detailed planning that has already been accomplished, so planners delay doing the most detailed planning to prevent having to re-accomplish the work.

As each request is broken out, it is sent to USTRANSCOM for validation. After validation the request goes to the Tanker Allocation Division (XOBK), or barrel, in the Mobility Management Directorate for allocation to individual tanker units. Based on this timeline, USTRANSCOM will receive a mission validation request anywhere from seven weeks prior to execution for missions at the start of the quarter to 19 weeks prior to execution for later missions. In the event that a short-notice mission request is required, XOOKP has the ability to validate a limited number of missions on behalf of USTRANSCOM to ensure the planning process continues to move forward in an expeditious manner.

Coronets are paid for mainly from the Air Force’s Operation and Maintenance (O&M) funds that are allocated at the beginning of each Fiscal Year (FY). O&M provides funds for training personnel, maintaining equipment, and all other activities that are directly related to readiness. The DoD requests funding from Congress by dividing each service's FY O&M budget requests into four budget activities: (1) operating forces, (2) mobilization, (3) training and recruiting, and (4) administration and service-wide activities. DOD further divides its budget activities into various activity groups, then again into sub-activity groups. The cost of operating non revenue generating aircraft is included in one of the Air Force's sub-activity groups based on an estimated number of flight hours required for each FY. (GAO/T-NSIAD-00-98, Feb 2000) Although the supported fighter unit will be billed by way of the Tanker Activity Reports for the fuel that is offloaded from the tanker, the cost to actually operate the tankers is effectively "eaten" by AMC's O&M budget.

3. TACC Channel Scheduling

The Global Channel Operations (XOG) directorate at TACC is the single agency responsible for directing worldwide strategic channel airlift operations for passenger and cargo movement. XOG develops route structures, schedules airlift missions, and provides oversight on channel system performance by working closely with AMC aerial ports and en route locations through five distinct divisions. The Commercial Channel & Offshore Operations Division (XOGC) is responsible for plans, schedules, and direction of all passenger and cargo commercial channels worldwide. (https://tacc.scott.af.mil) Channel missions are primarily used to transport sustainment cargo supporting permanent forward bases or military forces deployed for long-term contingency operations. These missions are usually planned as a round trip from the CONUS to a forward location, allowing cargo and personnel to be transported in both directions. However, due to the unique requirements of military cargo, many of these missions return to CONUS empty.

The process of requesting a channel mission starts with the user determining and justifying a need. The user will determine his or her need for either a frequency or requirements-based channel mission. A frequency channel runs on a predictable schedule to satisfy a recurring requirement for cargo or passenger movement. A requirements channel is unpredictable for actual scheduling of mission timing or location, yet satisfies a need for movement. These are often referred to as an add-on requirement. Once the user has prepared the request, it is sent to USTRANSCOM for validation of the requirement based on need, cost, and options of other modes of travel. When the requirement is validated as requiring recurring movement by air, it is sent to TACC for scheduling. At this point the original requesting user will lose control of the mission itself and it will become open for common user airlift. If the originating customer requires the ability to dictate what cargo will move on a specific mission, he or she is required to submit a Special Assignment Air Mission (SAAM) request and charter a complete aircraft.

Since this research is specifically looking at channel missions flown by Boeing 747s (B-747s) out of McGuire AFB, the rest of the discussion on channel planning is focused on these. The XOGC will typically charter entire B-747s through various commercial air carriers to support channel missions. This is done on an annual, quarterly and monthly basis depending on the general availability of the cargo data for the amounts to be moved via the channel. (Walker, 2010) Once a channel is contracted with the commercial carrier, it can be changed for a fee that is variable with the carriers and the specific contracts. If it is cancelled, TACC will also have to pay an additional fee to the carrier. These fees vary with the contracts themselves and are often dependent on the amount of notice the carrier receives for the cancellation. Channel missions are contracted as round-trip missions that start and end CONUS, or for one-way missions as needed.

Numerous times throughout each day, the CONUS Outbound Operations Division (XOGB) Planners will review the cargo movement requirements for their assigned aerial ports. Based on this review they will look at sliding channel missions to accommodate low cargo requirements or look for additional airlift for requirements above currently scheduled channel missions. (Walker, 2010) Planners have to search through numerous command and control programs to look for available airlift space on currently scheduled missions. This includes the available legs search tool that is propagated throughout TACC planning shops; however, this is not the primary source of finding available airlift. (Walker, 2010) When available space is not found, an add-on request is generated for additional B-747 channel missions.

The available legs search tool provides TACC planners the ability to communicate available cargo or passenger space on currently scheduled missions to other TACC directorates. Each directorate's planning teams have to load information on any legs of a mission they plan that is not being fully utilized with cargo, passengers or air refueling. This allows other users the ability to search for available space on a mission and provides a link for the planners to fully utilize existing airlift and potentially increase payload efficiency. XOGB noted that some of their concerns with trying to utilize KC-10s for this additional movement is the requirement to contour the pallets and the fact that the empty leg tool is not always loaded with all available missions.

Commercially contracted channel missions are initially paid for by AMC through the Transportation Working Capital Fund (TWCF). Reimbursement for the cost of these airlift services is received by the TWCF from customers utilizing the channel through tariff rates charged by AMC based on the type of airlift services provided. These charged services can be any combination of cargo weight, number of personnel, or size of bulk cargo that is moved. Rates are computed annually based on commercial competition or a standard rate per mile. As a result, they often do not recover the full cost of the mission. The difference between the revenue that TWCF receives and costs incurred for airlift services is offset by Air Force O&M funds. Any additional revenue collected above the cost of the commercial contract is kept in the TWCF to also help offset those missions that operate at a loss. When TWCF cargo is carried onboard military aircraft, the funds offset the O&M cost of operation for that aircraft. (AMCI 65-602, Dec 09)

4. Taskable Aircraft

In an effort to balance the very limited supply of aircraft with the incredible demand, AMC leadership established an allocation system named the Aircrew/Aircraft Tasking System (AATS). AATS applies to all AMC owned assets and has two distinct sections: 1) allocating aircrews, and 2) allocating airframes. The initial version of AATS was approved in July of 1999 and focused mainly on the need for aircrew training. (AMC AATS CONOPS, Nov 05) Under this construct, AMC crewmembers were made available for tasking from TACC 112 days (30 percent) of the year. When the operations tempo began to increase exponentially following the tragedy of September 11, 2001, HQ AMC suspended the AATS and shifted to a contingency/war-time operations plan that surged airlift and tanker airframes and crews. This now made aircrew members available to TACC around 183-266 days (between 50 percent - 73 percent) of the year. It soon became apparent that the surge was a marathon instead of the sprints AMC had accomplished in the past. AMC leadership worked with the wings to develop base-line aircrew and aircraft allocations that would strike a balance between wing training needs and TACC requirements. These new “Contingency AATS” were approved in April 2002 and were based on an operations tempo that would keep every available crewmember TDY on average 200 days a year. (AMC AATS CONOPS, Nov 05)

For the purposes of this research, the limiting factor for TACC scheduling is considered to be the number of airframes available, and as such the AATS discussion will limit itself only to that area. This is done with the assumption that tanker-crew ratios will be sufficient in the future to maximize the utilization of the airframes themselves. Although many of the mobility wings are currently limited by aircrews instead of airframes, this is an area for further study concerning crew ratios required to accomplish an airframe's current missions.

The AATS operates over a 16-week cycle, starting with the immediate execution week and extending for an additional 15 weeks. AATS generates an aircraft allocation for the execution week and estimates aircraft availability for each of the next 15 weeks in order to allocate each wing's aircraft between TACC Mobility Management (TACC/XOB) and the wing itself. The process starts with each wing accessing the AATS and inputting the number of aircraft the wing will have available to support flying operations for each week over the 16-week window. AATS will automatically compute aircraft allocations and aircraft estimates on a real-time basis whenever new data is entered. The AATS aircraft allocations are refreshed daily for review and further update from TACC or the wing. TACC/XOB will assign operational missions against the aircraft allocations received from each of the wings and plans missions against future allocations. The wings use their aircraft allocation to support flight and maintenance training requirements and to handle any adjustments. Any remaining aircraft are made available for maintenance to accomplish required checks, upgrades, or preventative maintenance requirements. (AMC AATS CONOPS, Nov 05)

In an effort to appropriately balance the demand for AMC aircrews and aircraft against operational and training requirements, AATS uses the following formula from AMCI 10-202 V6 to calculate the number of aircraft each wing must provide to TACC/XOB:

> TACC Aircraft Allocation = [(Aircraft Possessed – Aircraft Deployed) * (Commitment Threshold)] – Adjustments – Training Aircraft

Adjustments are management inputs to properly account for all AMC aircraft and the number of authorized allocated trainers is set by AMC/A33 and is provided to each unit.

In practical terms this means that from the total airframes that a wing has assigned to it, AATS subtracts all those in maintenance/test/repair minus the number of deployed airframes minus the required number of training aircraft and allows any remaining airframes to be tasked by TACC. Although the number changes daily, there are typically around 20 of the 59 total KC-10s owned by the AF available for TACC tasking. Similarly, out of the 384 Active Duty, Air National Guard and AF Reserve KC-135s, only around 75 are available for tasking on any given day. (AMC Operations Summary, 8 Feb 2010) These limited numbers of actual aircraft available to accomplish the numerous requirements levied on TACC daily for air refueling missions leaves very few tanker airframes available for cargo movement.

IV. Data Analysis

Overview

The data sets used for this research are broken into two subject areas: analysis of Coronet missions, and aircraft operating costs. The quantitative analysis of historical Coronet data is used to justify the claims that tankers have not been used to their full potential for cargo operations. The quantitative analysis of the operating costs for military and commercial contract aircraft shows the potential cost avoidance of increasing the tanker's cargo movement utilization.

1. Coronet Missions

The quantitative data collected is a one-year historical snapshot of all Coronet missions from 1 August 2008 to 31 July 2009 (Appendix B). The primary source of this data is the 618 TACC Data Division (TACC/XOND) thru the 618 TACC Commander's Action Group (TACC/CCX). These organizations are the TACC commander's primary source of data and analysis for all TACC missions. The Data Division obtained much of the information from AF Form 3578 Tanker Activity Reports (Appendix C), which are required to be filed by the crew following each mission.

The original data set consisted only of missions that were tasked to support any leg of a Coronet and does not include training sorties or designated channel cargo missions. This includes not only the positioning and de-positioning legs, but also all active refueling sorties. Data included mission ID numbers, aircraft type, sortie purpose, departure airport, arrival airport, flight time, number of passengers, cargo weight in STons, planned fuel offload, and actual fuel offload. In total there were 2,303 KC-10 and KC-135 sorties associated with Coronets during this one-year time period, which logged 14,428.9 flight hours. To limit the scope of the research to only positioning and de-positioning sorties, the data was first broken down into only sorties that did not include active air refueling by eliminating all sorties with a purpose code of "Refueling Sortie." This eliminated the inclusion of any sorties that would have to be considered "dual role" in order to have cargo on board. Furthermore, all sorties that had an arrival and departure from the same airfield without an intervening stop (known as a round robin) were eliminated since they have no impact on this study of cargo movement. If the sortie departs and arrives at the same location there is no need to have cargo moved back to its origin without any intermediate stops. This equated to 849 sorties flown to get the tanker aircraft to or from a location strictly to start or end a mission. Of these sorties, 90 percent (765) were flown with less than one STon of cargo on board. Those empty legs logged a total of 4,637.9 flight hours and had a mean flight time of 5.95 hours per sortie.

The data was again limited down to sorties that departed or arrived via KWRI to/from the United Kingdom, Germany, Spain and Italy. This was done to minimize the need to position the tanker aircraft to cargo hubs prior to moving cargo as all of these locations are, or are close to, already established cargo hubs. Although there were 36 positioning and de-positioning sorties to/from KWRI to other OCONUS locations, they would have provided little to no cargo capacity due to fuel required for the length of the flight or the location was not near an established cargo hub. This one-year snapshot showed a total of 50 positioning/de-positioning missions between KWRI and Mildenhall Air Base (AB), England (EGUN), Ramstein AB, Germany (ETAR), Spangdahlem AB, Germany (ETAD), Moron AB, Spain (LEMO), and Sigonella AB, Italy (LICZ). Out of these 50 missions, 80 percent (40) were flown with no cargo on board and logged 317.8 hours of unproductive flight time. Of those 40 empty sorties, 37 of them were flown by KC-10s. Assuming all of these KC-10s were in the typical Bravo configuration, this equates to 851 empty pallet positions. Using an assumed average pallet weight of 6,000 lbs., these empty positions equate to 5.1 million pounds of cargo that could have been moved at little to no additional cost.

When the standard aircraft payload planning factor for the KC-10 of 32.6 STons (65,200 lbs) (DOAF, AFPAM 10-1403, Dec 03, 12) is used, there was potential to move 2.4 Million lbs. of cargo. The 10 missions that did transport cargo had an average cargo load of only 7.4 STons (14,800 lbs.). This is well below the 32.6 STon planning capability of the KC-10. (DOAF, AFPAM 10-1403, Dec 03, 12) Accounting for the 37 empty KC-10 sorties that could have moved 32.6 STons of cargo each (1206.2 STons) along with the 10 KC-10 sorties that could have moved an additional 25.2 STons each ([32.6 STons – 7.4 STons] * 10 missions) this equates to a loss of 1458.2 STons or 2.9 Million lbs. of potential cargo movement. The three KC-135 missions had zero cargo loads and could have moved 78,000 lbs. based on a standard aircraft planning load of 13 STons (26,000 lbs.). (DOAF, AFPAM 10-1403, Dec 03, 12) These missed opportunities equate to a total of 2.99 Million lbs. cargo that could have been moved for very low relative cost between the East Coast cargo hub of the United States and European cargo hubs. If planners were able to take advantage of more than just the standard planning factors, this total could be as high as 5.2 Million lbs. of cargo moved with average assumed pallet weight of 6,000 lbs. each. ([851 empty KC-10 pallet positions + 18 empty KC-135 pallet positions] *6,000 lbs per pallet)

2. Operating Costs

Air Mobility Command has numerous rates that it charges customers for using its mobility assets based on how the aircraft is used and the customer's affiliation with the Department of Defense (DoD). This paper limits rate discussions to DoD users and focuses on charter and reimbursable TWCF rates of the KC-10 and KC-135 along with the channel rates for KC-10, KC-135 and Boeing 747 aircraft. TACC will normally charter aircraft based on size requirements for the cargo that needs to be moved, but this paper will limit discussion to only B-747 bookings. The Boeing 747 was chosen for comparison because it is the most common charter aircraft used by AMC for the movement of bulk cargo. The B-747 operates in three versions— the 100, 200, and 400, all of which operate under the same charter rates. (DoD Charters, 01 Oct 09 – Sep 10)

Channel tariffs are calculated based on weight categories and the geographic areas between which the cargo is moved. Cargo rates are calculated between zones on the globe with CONUS being Zone 1 and Europe Zone 6. (DoD Channel Rates, 01 Oct 09 – Sep 10) Rates to move cargo to/from Zone 1 to 6 are given in dollars per pound and are scaled from 0–439 lbs., 440–1099 lbs., 1100–2199 lbs., 2200–3599 lbs., and above 3600 lbs. The FY 2010 cost-per-pound of channel movement cargo from KWRI to EGUN, ETAR or Rota (LERT) NAS, Spain is $3.338, $3.002, $2.673, $2.333, and $2.054 for each of the respective weight categories. (DoD Channel Rates, 01 Oct 09 – Sep 10) Using these rates it will cost a DoD customer $133,920.80 to move 32.6 Stons, the standard planning cargo load of the KC-10, on a channel from KWRI to any of the European locations discussed in this paper.

The first quarter of Fiscal Year 2010 (FY10) showed 47 total B-747 channel missions that transited KWRI. (Appendix E) All 47 of these missions were either coming from or going to European locations and there was a mean cargo load of 55.14 STons. Using the standard channel rate of $2.054 per pound, this equates to an average mission cost of $226,515.12 for the user.

AMC typically charters the entire aircraft for these channel missions instead of paying the per-pound shipping costs. As such, the commercial contract carriers are paid separate charter rates that allow the TACC to task the entire aircraft as needed and allows for more flexibility in scheduling cargo. The fiscal year 2010 charter rates for a B-747 are 81.275 cents per ton mile for a one-way charter and 45.1528 cents per ton mile for a round-trip charter. (DOAF, AFI 65-503, Dec 09) The additional cost associated with a one-way charter is due to the fact that there are typically little to no retrograde opportunities available for these aircraft from other commercial customers. So, the DoD pays the carrier a percentage of the cost to de-position to a location that offers this business. The B-747 aircraft has an Allowable Cabin Load (ACL) of 90 STons (DOAF, AFI 65-503, Dec 09) that is used as a planning weight. Using these charter rates it will cost AMC $284,104.89 for a one-way cargo mission from KWRI to ETAR ($0.81275 * 90 STons * 3884 miles average calculated distance). One of the disadvantages to this system is that the DoD pays that same $284,104.89 whether the aircraft has 1 STon or 90 STons of cargo on board. However, this allows for a fixed channel flight schedule independent of actual cargo requirements.

The rates to charter an entire DoD aircraft through the TWCF are based on flight hours instead of potential cargo capability. The fiscal year 2010 rates are $14,261 per hour for the KC-10 and $11,020 per hour for the KC-135R. (DOAF, AFI 65-503, Dec 09) There is also a minimum activity rate (MAR) charge of two hours for any flight and for anytime the aircraft is not used in a 24-hour period due to user request. The MAR is not typically a factor for the movement of cargo OCONUS and is typically only charged for VIP missions that require the aircraft to wait for users at designated locations. As such, the MAR was not considered a factor for this paper. The KC-10 has a historical average flight time of 7.2 hours from KWRI to ETAR

(Appendix D), which would cost a DoD user $102,679 for an entire aircraft charter. Although the KC-10 has a max ACL of 60 STons, its standard planning capability is 32.6 STons. (DOAF, AFPAM 10-1403, Dec 03, 12) This load would require three KC-10s to accomplish the same 90 STons cargo movement as the single B-747 charter. This brings the cost to $308,037, an increase of $20,805 to move 90 STons of cargo via 3 KC-10s verses a commercial charter B-747. Using the actual average cargo load of the B-747 channels for 1st quarter FY10 of 55.14 STons, only 2 KC-10s are required and provide a savings to the user of $81,965 over the B-747 charter or $21,157.12 of savings over the average mission cost of channel rate cargo.

When the KC-10 flies a leg as a normal channel mission there is not a need for a full aircraft charter. Planning the movement this way allows the user to pay the same per-pound rates that they would have paid using the B-747. Although it does not provide a savings to the user, this use of the KC-10 could potentially provide an O&M cost avoidance to AMC.

V. Results

Many of the current coronet positioning and de-positioning legs do not transit the typical cargo hubs used by AMC; however, there is still potential to utilize these legs in cargo roles. One of the ways this can be done is by adding an on/off load stop in Germany to KC-10 missions traveling to/from Europe. There were 47 KC-10 sorties that traveled to/from Europe during the one-year period studied. Of these 47, 20 went through Germany or England, 16 went through LEMO, 11 went through LICZ and only 10 of them had more than 1 STon of cargo on board. If the Coronet planners are able to load these empty legs into the available legs search tool early enough that the channel planners could have visibility on them prior to contracting with a commercial carrier, they could be used as channel missions. Coronet missions ZJH063Q11096 and ZJH063Q21096 from the data obtained are used as an example. These missions were two KC-10s that flew empty on the same day from KWRI to LEMO and logged 6.9 flight hours each doing so. If these two aircraft where instead flown to ETAR to download cargo and then onto LEMO, they could have moved 65.2 STons of cargo, 10 STons more than the average B-747 Channel mission from KWRI to ETAR. In order to do this, the KC-10 missions would have had to depart KWRI approximately 6.4 hours earlier than originally scheduled in order to still arrive at LEMO at the same scheduled time. This is based on a 7.2 hour historical flight time from KWRI to ETAR, 1.9 hours ETAR to LEMO (Appendix D), and the required 4.2 hour ground time to offload cargo (DOAF, AFPAM 10-1403, Dec 03, 14). This would still keep the crew just below the 16 hour maximum duty day allowed for a basic crew and have the aircraft on the ground at the originally scheduled time in Spain. If LEMO were simply a crew rest location and not the actual start of the Coronet mission, then there would not be a need for the crew to even leave ETAR. They would crew rest at ETAR and depart the next day for whatever location they would have gone to from LEMO.

By planning the missions this way, AMC could have large potential cost avoidances. Assuming the 2 KC-10s carried a total cargo weight equal to the average B-747 channel weight of 55.14 STons, they would generate $226,515 of TWCF. Subtracting out the $205,358 it cost to fly the KC-10 to ETAR (2 Aircraft * 7.2 Flight hours * $14,261 per Flight Hour), this equates to a net gain of $21,157. (Note: This is a conservative estimate because although AMC charges $14,261 per flight hour to charter a KC-10, the actual operating costs are lower.) On top of this gain would be the $284,105 that would no longer have to be paid to a commercial carrier to operate a B-747 to move that cargo, bringing the total net gain of moving the cargo from KWRI to ETAR to $305,262.

An added benefit of scheduling this way would be the lower number of O&M hours that would be required to get the KC-10s to LEMO. The two KC-10s flew a total of 13.8 hours of O&M funded flight time on their trip to Spain. Going through ETAR to drop off the cargo would have logged 14.4 hours of TWCF generating flight time and only 3.8 hours of O&M time. Using the same conservative cost of $14,261 per flight hour to operate the KC-10, this would have saved $142,610 of O&M dollars that could have been used for other readiness areas. This brings the total estimated cost avoidance to $447,872 just from the utilization of only two of the 36 empty legs flown from KWRI to England, Germany and Spain. This method of planning could be used for the 11 missions that transited LICZ as well with almost identical cost avoidance.

It was noted earlier in the paper that the positioning of the KC-10 from KWRI to LEMO is often just for a crew rest stop. For missions where this is the case, the KC-10 could also be used to move the channel cargo even further into the theater. If the KC-10 is actually traveling all the way to the Middle East before it meets up with its receivers, the cargo may not need to go through ETAR. An example would be a mission that flies KWRI to LEMO for crew rest, then onto the Middle East to crew rest and depart with receivers the next day back to somewhere in Europe. If the mission originated out of KWRI slightly earlier, it could be loaded with cargo, still crew rest in LEMO if needed, and then have a off-load stop in the Middle East added prior to its original positioning destination. This option has numerous possible locations that it could transit with Incirlik AB, Turkey, and Al Udeid AB, Qatar being two of the more likely locations. By doing this, AMC could save a large portion of the 13.5 hours (Appendix D) of O&M flight time required to position a KC-10 to the Middle East by making it TWCF generating flight hours and potentially avoid the cost of a B-747 charter for that cargo. This would require more complex scheduling solutions to increase cargo utilization of the KC-10. It also has the potential for the greatest cost avoidance. There are many issues that would have to be closely considered, some of the largest factors would be crew duty day required with the added off-load stop, diplomatic clearances, and aircraft/crew availability if the mission is required to depart home station up to a day earlier than originally planned.

An easier solution than adding a stop into missions would be to utilize the 20 missions that were already going through Germany and England in this same role. Although they did not operate as two-ship missions as often, the use of a single KC-10 for cargo could potentially slip the need for the B-747 charter and eventually end up freeing up one charter to be used for additional cargo movements for every two or three KC-10s utilized. Doing this would produce cost savings equivalent to those mentioned above. However, all hours flown would become TWCF generating, and no O&M-funded hours would be required. Many of the KC-10 missions that transited England were in support of small numbers of fighters that were traveling to/from the states for depot level maintenance work. (Dally, 2009) These missions are typically known well in advance and may slide a day or two based on maintenance completion. These missions also do not typically utilize the entire capability of the KC-10 for fuel offload due to the smaller number of receivers. An easy option for these missions would be to operate them strictly between KWRI and ETAR without landing in England at all. If a KC-10 were dragging the fighters from England to the states, they could carry enough fuel to compensate for the additional 1.1 hours of flight time (Appendix D), thus allowing them to carry cargo from KWRI to ETAR and without the need to re-position to England. This type of scheduling change would also equate to an approximate $308,480 cost avoidance for every two KC-10s utilized and one B-747 charter rescheduled for other cargo requirements. A more complex addition to this option would be to also carry cargo on the return leg while refueling the fighters. This would be considered a dual-role mission and require complex funding coding to determine what user pays for what part of the flight but could potentially allow the KC-10 to do a complete round-trip cargo mission.

It is important to note that although these scheduling changes have the potential for large cost avoidances to AMC, they cannot be implemented on every mission. There are numerous reasons for this such as the short notice in which many missions are generated or the priority of the fighter move is so high that the additional chance of delay by adding an enroute stop is too great. Due to these factors, a very conservative estimate of only utilizing 20 percent of the current empty legs for additional cargo use will be considered. This equates to four KC-10 missions between KWRI and Germany/England and approximately six missions between KWRI and LEMO or LICZ. By changing the way these ten missions are currently scheduled, TACC could provide an approximately $2M (2 * $305,262 + 3 * $447,872) annual cost avoidance to

AMC. This increases to almost $5M if 50 percent of the missions could be adjusted. The additional cargo carrying capability of the new KC-X could further increase these cost avoidances provided the capabilities are utilized.

The intent of this research is to show that there are indeed unused capabilities that could be utilized within the current airlift system. Although the gains described in this paper do not necessarily show a savings to the true customer, the U.S. taxpayer, they still provide large benefits. Utilizing tankers to move a portion of the cargo will allow more cargo to move within the system at no additional cost. This produces an increased effectiveness to all customers while also increasing overall efficiency. Some of the examples stated in this research could be used for limited test cases with today's KC-10 fleet with the ultimate goal of implement new procedures for the much larger KC-X fleet.

VI. Conclusion and Discussion

Research Questions

The basis of this research was, "Can the effectiveness of the tanker's airlift capabilities be improved on Coronet positioning and de-positioning legs?" In order to answer the research question, the following investigative questions were employed with the corresponding results.

1. How does the TACC currently schedule Coronet airlift missions?

Through review of Air Force and Air Mobility Command publications and correspondence with personnel working at the Tanker/Airlift Control Center, it was shown that there are separate directorates that independently plan Coronet and airlift missions in support of numerous customers around the globe. All of the directorates' mission planners typically schedule each mission to originate from home station, proceed to an "on-load" location to meet up with receivers or receive cargo and passengers, proceed to an "offload" location, and return to home station. Fighter movements to or from OCONUS locations often require tanker aircraft to be flown empty for a significant number of hours on positioning or de-positioning legs. Although opportunities often exist to utilize these empty aircraft to move cargo or passengers, there is no formal process within the TACC for the various directorates to share resources. The increased use of the available legs search tool by all of the directorates could potentially increase the number of opportunities utilized.

2. What are the capabilities of the current and future tanker fleets?

The air refueling and cargo carrying capabilities of the current fleet of AF KC-135s and KC-10s was shown through an analysis of pertinent technical data and shows what a tremendous asset they can be for numerous mission types. Although it is still not known what type of airframe the AF will choose as its next tanker, the technical specifications of the three potential competitors was presented. These three airframes all bring unique capabilities that will further enhance both the refueling and cargo capabilities that the current AMC tanker fleet has and could potentially change the way tankers are fundamentally scheduled.

3. How often are current coronet positioning and de-positioning legs utilized for their cargo movement capabilities?

The data obtained from TACC and presented in this paper clearly shows that there is a much greater cargo movement capability than is currently utilized. Although many of these empty legs do not transit the current cargo hubs, the potential of adding a short flight to a cargo hub could have minimal mission impact while avoiding costs to AMC. It was noted that there can never be 100 percent utilization of the tanker fleet's cargo capabilities; however, even small changes can have great potential. The 10 missions noted between KWRI and Europe that would produce $2M in annual cost avoidance is only 1.3 percent of the 765 empty legs flown by tankers over the one year period to position or de-position on coronets.

Discussion

The use of tankers to move fighters to and from the fight has always been driven by the needs of the fighter units. This was an understandable and acceptable practice for many of our nation's conflicts and deployments; however, the nature of today's fight is not the same as it has been. Today's prolonged operations are not decided by the number of fighters in the air, but by our ability to sustain the logistical tail of all of our forward-deployed forces. Because of this, the AF may need to change the way it prioritizes fighter movements. The current methods are effectively wasting the same limited resources that are so badly needed to win a prolonged campaign. As the future of the air refueling fleet changes and its capabilities are increased, fighter moves may need to be scheduled around tankers and their cargo movements. Currently, the fighter units pick the days they want to move. But what if TACC decided what day's tankers would be available to the fighters for their movement? This may require a fighter unit to change its movement date a day or two based on when the tanker was moving cargo. However, the overall effectiveness seen by the DoD as a whole would increase. That is because increased efficiency would produce the same effects at a lower cost during a period when money and resources are decreasing. The current system produces the desired effect for the fighter Squadron customer, but not necessarily for the customer that is just the average grunt on the ground. That customer still has to accept port hold times of their cargo due to insufficient assets available to provide airlift. Once the war fighter states the desired effect, the professional logistician—the TACC planner—not the fighter unit, can determine the most efficient way to achieve it.

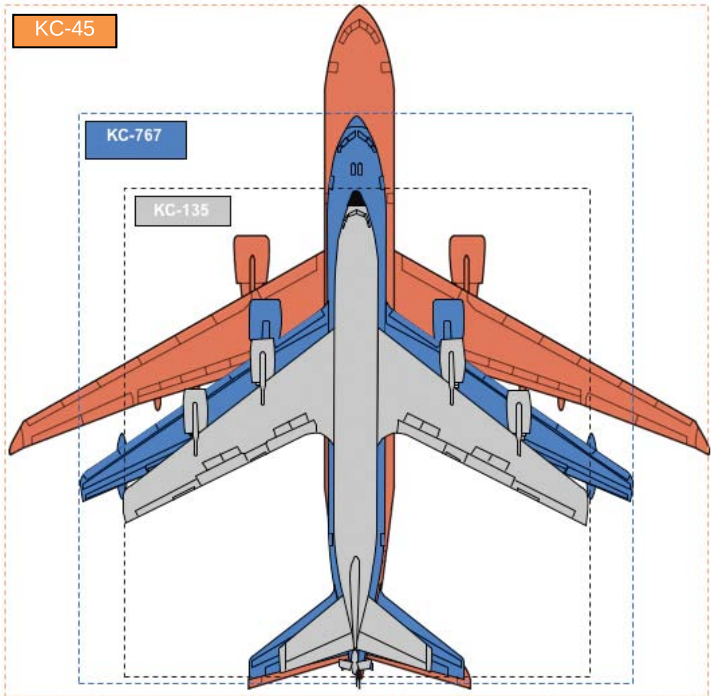
Recommended Areas for Further Study

In the course of this research, many items were highlighted as potential areas for further research. The most obvious of these was the consideration of the Pacific theater of operations. Travis AFB, CA, is much like KWRI in that it is a cargo hub and has KC-10s home stationed there. Further research could potentially show that Travis AFB has the same opportunities to make minimal scheduling changes and produce even greater potential cost avoidances. The second area to be considered for further research is the issue of crew manning in the tanker fleet. Although this research considered the number of aircraft to be the limiting scheduling factor, many of the tanker wings are starting to see crews become the limiting factor. This may be based on the current pilot manning shortage or on the fact that unit manning requirements are based on data of what tankers used to do, not what their current missions are. This issue could become much more important if not addressed prior to the stand-up of KC-X units.

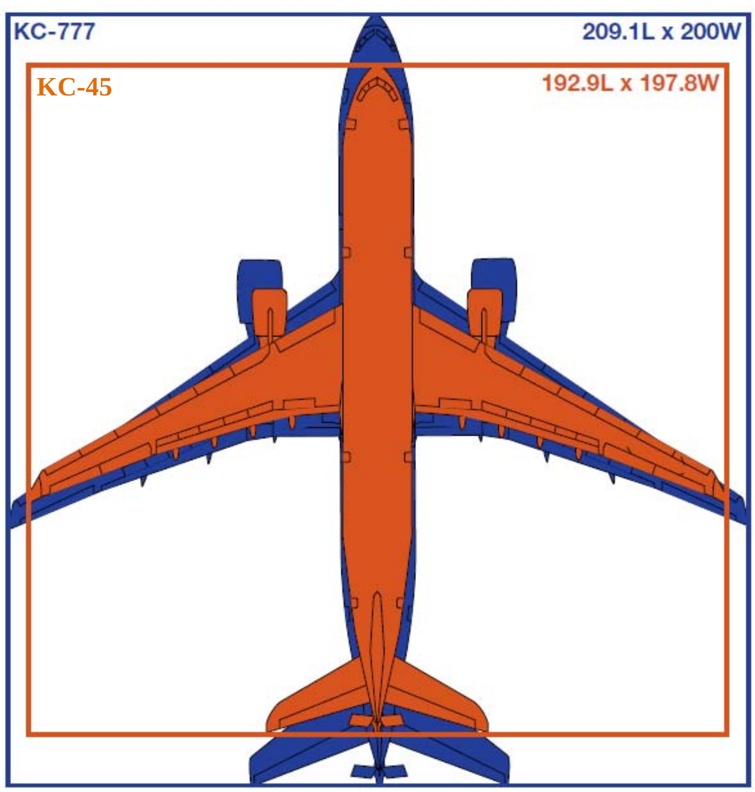
The use of the available legs tool at TACC and potentially designing a new and more efficient process is a research topic worth consideration. It was noted that this is an available tool to the TACC planner; however, it is not utilized as often as it could be. The implementation of a tool, program, or application that is both more user-friendly and more accurate could greatly enhance the findings of this paper's research. This could be further expanded to research the capabilities of operating tankers in more dual role missions and highlighting when these opportunities exist in the available-legs tool. This would require the implementation of mission billing that is dual coded to charge separate users for the same flight.

The last area noted for future research would be what is required at TACC to implement the scheduling changes noted in this research prior to the KC-X becoming operational. This research concentrated on the KC-10 due not only to its large cargo carrying capacity, but also due to the relatively small cargo capacity of the KC-135. The KC-135 would have minimal effect on the overall cargo moved daily throughout the AMC system. Once these aircraft are replaced with the much more capable KC-X, however, the potential for increased efficiency noted in this research would be exponential.

Appendix A: Aircraft Size Comparisons



Size of KC-767 and KC-45 Compared to KC-135 (Boeing)



Size Comparison of KC-45 to KC-777 (Boeing)

Appendix B: Sample of Coronet Data (1 Aug 08 – 31 July 09)

Sample of Original Coronet Data

618th Tanker Airlift Control Center
DATA DIVISION
618 TACC/XOND
COMM: (618) 229-3885 (DSN: 779)
Scott Air Force Base, Illinois

Purpose: Provide a summary of Coronet sorties during the time period of 1 Aug 2008 to 31 Jul 2009.
Prepared For: Maj Timothy Stuart, AMC USAF MOS/ASAM, DSN: 650-7746
Prepared By: 618th TACC/XOND, DSN: 779-3885, Scott AFB, IL. Data current as of 8 Oct 2009.
Note: Data Quality refers to the quality of air refueling data only. A data quality of "Poor" indicates that some or all of the information was unavailable. In this case, we use planned data to populate the actual offload column. Data not available resulting in a grade of poor is generally due to the unit not submitting a Tanker Activity Report after mission closeout. A note of "No_AR_Data" indicates that there was no AR planned and no Tanker Activity report was submitted with AR_Data. A mission number with a second character of 'J' or 'V' in the Mission ID number typically indicates a positioning or depositioning leg. Offloads in thousands of pounds.

CORONET SORTIE SUMMARY - 1 Aug 2008 to 31 Jul 2009

FIRST_MISSION_I	ITIN	MISSION_II	ACTTPI	SORTIE PURPOS	DEP_ICA(	ARR_ICA(	FLYING HOUF	PAX ONLOADI	STnnr ONLOADI	PAX ABOARI	STnnr ABOAI	PAX OFFLOADI	STnnr OFFLOADI	Rcvr_Ty	Sched_Rc	Act_Rc	Sched_Offl	Act_Offl	DataQuali
TR4090478276	300	ZPY115A11126	KC010	REFUELING SORTIE	KBGR	LEMO	6.58	0	0	0	0	0	0	AV008B	5	5	124.0	123.2	Good
TR4090478277	100	ZPY115A21126	KC010	REFUELING SORTIE	KNYL	KBGR	5.77	10	5	10	5	0	0	AV008B	6	6	108.6	112.4	Good
TR4090478277	300	ZPY115A21126	KC010	REFUELING SORTIE	KBGR	LEMO	6.53	0	0	10	5	10	5	AV008B	5	5	124.0	121.4	Good
TR4090478428	100	6PY035E11134	KC010	REFUELING SORTIE	OTBH	LEMO	9.32	0	0	0	0	0	0	EA006B	4	4	97.0	98.6	Good
TR4090478428	300	6PY035E11134	KC010	REFUELING SORTIE	LEMO	LPLA	6.55	0	0	0	0	0	0	EA006B	4	4	80.0	93.7	Good
TR4090478428	500	6PY035E11134	KC010	REFUELING SORTIE	LPLA	KWRI	6.00	0	0	0	0	0	0	EA006B	4	4	97.0	95.4	Good
TR4090601553	50	6PH107Q14167	KC010	REFUELING SORTIE	KWRI	EGUN	7.50	10	0	10	0	10	0	F004F	2	2	100.0	86.2	Good
TR4090601553	300	6VH107Q14168	KC010		EGUN	KWRI	7.82	11	16.6	11	16.6	11	16.6						
TR4090614051	100	ZPH563W11188	KC010	REFUELING SORTIE	RODN	PWAK	6.18	0	0	0	0	0	0	FA018D	6	6	123.6	131.7	Good
TR4090614051	300	ZPH563W11188	KC010	REFUELING SORTIE	PWAK	PHIK	5.00	0	0	0	0	0	0	FA018A	0	6	0.0	102.4	Good
TR4090614103	100	6PH563W21188	KC010	REFUELING SORTIE	RODN	PWAK	6.47	0	0	0	0	0	0						No_AR_Data
TR4090614103	300	6PH563W21188	KC010	REFUELING SORTIE	PWAK	PHIK	5.17	0	0	0	0	0	0						Good
TR4090617051	100	6PH572W11191	KC010	REFUELING SORTIE	KWRI	KNKX	6.38	4	0	4	0	2	0	FA018D	6	6	96.0	93.1	Good
TR4090617051	300	6PH572W11191	KC010	REFUELING SORTIE	KNKX	PHIK	10.28	0	0	2	0	2	0	FA018D	6	4	146.4	97.8	Good
TR4090617051	500	6PH572W11191	KC010	REFUELING SORTIE	PHIK	PWAK	5.00	0	0	0	0	0	0	FA018D	6	6	107.9	112.9	Good
TR4090617051	650	6PH572W11191	KC010	REFUELING SORTIE	PWAK	RODN	6.03	0	0	0	0	0	0	FA018D	6	6	112.4	80.4	Good
TR4090617101	100	6PH572W21191	KC010	REFUELING SORTIE	KWRI	KNKX	6.08	0	0	0	0	0	0	FA018D	6	6	96.0	102.0	Good
TR4090617101	300	6PH572W21191	KC010	REFUELING SORTIE	KNKX	PHIK	6.17	0	0	0	0	0	0	FA018D	6	4	146.4	109.4	Good
TR4090617101	500	6PH572W21191	KC010	REFUELING SORTIE	PHIK	PWAK	5.13	0	0	0	0	0	0	FA018D	6	6	107.9	112.0	Good
TR4090617101	700	6PH572W21191	KC010	REFUELING SORTIE	PWAK	RODN	5.77	0	0	0	0	0	0	FA018D	6	4	112.4	82.5	Good
TR4090693564	100	8PH815S11173	KC135	REFUELING SORTIE	MHLM	KSSC	3.27	0	0	0	0	0	0	F016C	2	2	15.4	15.3	Good
TR4090693564	300	8VH815S11173	KC135		KSSC	KMCF	1.30	0	0	0	0	0	0						
TR4090695515	100	7PH505W11181	KC135	REFUELING SORTIE	PHIK	KLSV	5.43	8	0	8	0	8	0	F015A	2	2	55.0	55.0	Poor
TR4090695515	300	7VH505W11182	KC135		KLSV	PHIK	5.97	0	0	0	0	0	0						
TR4090698466	50	1JH119E11169	KC135		EGUN	LGSA	3.77	0	0	0	0	0	0						
TR4090698522	100	8PH740N11178	KC135	REFUELING SORTIE	PAEI	KSKA	4.65	0	0	0	0	0	0	FA018C	5	8	85.0	38.7	Good
TR4090698964	100	8PH319W01161	KC135		KLSV	KRDR	2.48	0	0	0	0	0	0						
TR4090699064	100	8PH742N11178	KC135	REFUELING SORTIE	PAEI	KIAB	6.77	7	0	7	0	7	0	FA018E	4	4	89.5	87.6	Good
TR4090699164	100	8PH742N12178	KC135	REFUELING SORTIE	PAEI	KRDR	6.30	0	0	0	0	0	0	FA018E	4	4	89.5	91.3	Good
TR4090720951	100	6PH765N11203	KC010	REFUELING SORTIE	KWRI	PAEI	6.87	10	0	10	0	10	0	F016C	4	5	81.4	122.6	Good
TR4090720951	300	6VH765N11204	KC010		PAEI	KWRI	6.65	3	0	3	0	3	0						
TR4090721001	100	ZPH765N21203	KC010		KWRI	KWRI	3.28	0	0	0	0	0	0						
TR4090721658	100	6PH511W11197	KC010	REFUELING SORTIE	RODN	PWAK	6.20	4	0	4	0	0	0	FA018D	6	6	120.0	122.2	Good
TR4090721658	300	6PH511W11197	KC010	REFUELING SORTIE	PWAK	PHIK	4.85	0	0	4	0	0	0	FA018D	6	6	115.0	108.3	Good
TR4090721658	500	6PH511W11197	KC010	REFUELING SORTIE	PHIK	KNKX	5.18	6	0	10	0	0	0	FA018D	6	4	126.0	95.3	Good
TR4090721658	700	6PH511W11197	KC010	REFUELING SORTIE	KNKX	KWRI	5.42	0	0	10	0	10	0	FA018D	6	4	100.0	67.7	Good
TR4090721802	100	6PH511W21197	KC010	REFUELING SORTIE	RODN	PWAK	6.17	3	0	3	0	0	0	FA018D	6	6	120.0	117.8	Good
TR4090721802	300	6PH511W21197	KC010	REFUELING SORTIE	PWAK	PHIK	4.67	0	0	3	0	3	0	FA018D	6	6	115.0	102.1	Good
TR4090721802	500	6PH511W21197	KC010	REFUELING SORTIE	PHIK	KSUU	5.05	9	0	9	0	9	0	FA018D	6	4	126.0	93.4	Good
TR4090721802	650	6PH511W21197	KC010		KSUU	KWRI	6.88	5	0	5	0	5	0						
TR4090721803	100	8PY144A12201	KC135	REFUELING SORTIE	KRDR	KPSM	6.95	0	0	0	0	0	0						No_AR_Data
TR4090721851	100	8PY144A22201	KC135	REFUELING SORTIE	KIAB	KBGR	6.42	0	0	0	0	0	0	F016C	6	6	243.0	97.1	Good
TR4090725019	100	ZJH758N11198	KC010		KSUU	KDMA	1.75	3	0	3	0	3	0						
TR4090725019	150	ZPH758N11199	KC010	REFUELING SORTIE	KDMA	KSUU	4.10	0	0	0	0	0	0	F022A	6	6	226.0	108.3	Good
TR4090725028	100	ZJH758N12198	KC010		KSUU	KSKA	3.25	3	0	3	0	3	0						
TR4090725028	250	ZPH758N12199	KC010		KSKA	PAED	1.55	0	0	0	0	0	0						
							14,428.86	5,617.00	1,068.39	6,476.00	1,348.31	5,615.00	1,069.47		5,215.00	4,526.00	151,074.50	89,785.30	

Excerpt of data for all positioning and de-positioning legs

All Non-Round Robin Positioning/De-positioning legs with no AR

1 Aug 2008 to 31 Jul 2009

	MISSION_ID	ACTYPE	DEP_ICAO	ARR_ICAO	FLYING HOURS	PAX ABOARD	STons ABOARD
1	8VH084E11113	KC135	CYQX	KGSB	3.42	0	0
2	8VH107Q21154	KC135	CYQX	KIAB	6.08	0	0
3	8VH005Q22282	KC135	CYQX	KMCF	4.47	0	0
4	8VH105Q13138	KC135	CYQX	KMCF	5.18	0	0
5	8VH105Q12135	KC135	CYQX	KRDR	4.82	0	0
6	8VH107Q11154	KC135	CYQX	KRDR	4.73	0	0
7	7VH005Q12282	KC135	CYQX	KSUX	4.55	0	0
8	1JH085E11188	KC135	CYQX	KWRB	4.33	0	0
9	8VH154E32220	KC135	CYYR	KMCF	4.47	0	0
10	8VH154E33218	KC135	CYYR	KMCF	4.60	10	0
11	6VH155E13272	KC010	CYYR	KWRI	3.08	0	0
12	7PH105Q22137	KC135	EGPK	EGUN	1.42	0	0
13	7PH105Q22137	KC135	EGPK	KPIT	7.67	0	0
14	8PH082E22008	KC135	EGUL	KRDR	9.35	0	0
15	1JH120E12186	KC135	EGUN	CYQX	5.35	0	0
16	1JH112E11078	KC135	EGUN	GCLP	4.37	0	0
17	1JH112E21078	KC135	EGUN	GCLP	4.70	0	0
18	8VH079E12072	KC135	EGUN	KBGR	6.88	0	0
19	8VH059Q22071	KC135	EGUN	KIAB	9.88	0	0
20	ZVH074Q11256	KC135	EGUN	KIAB	9.62	6	0
21	8JH082E12010	KC135	EGUN	KMCF	10.03	0	0
839	ZVH455W21062	KC010	VTBU	RJTY	6.15	0	0
840	ZVH512W11170	KC010	VTBU	RJTY	6.83	0	0
841	CVH439W21036	KC135	VTBU	RODN	5.23	0	0
842	ZJH455D11062	KC010	VTBU	RODN	5.08	0	0
843	ZVH409D11306	KC010	WSAP	PGUA	6.73	2	0
844	ZPY530A11272	KC010	WSAP	PGUA	6.88	0	0
845	ZVH435W11031	KC010	WSAP	RODN	4.67	0	0.1
846	ZVH525W11236	KC010	YBBN	KSUU	13.10	0	0
847	ZVH419D11311	KC010	YPDN	PHIK	10.75	0	0
848	ZVH419D21311	KC010	YPDN	PHIK	10.35	0	0
849	7VH479W11065	KC135	YPDN	PHIK	10.65	0	0
					Total Hours	**Total Pax**	**Total Cargo**
					5,209.20	**2819**	**508.15**
	Total Sorties					**Sorties w/ pax**	**Sorties w/>1 STON**
	849				**Median Flt Time**	**321**	**84**
	Sorties w/o cargo		**% of sorties w/o cargo**		**5.95**		**Sorties w/ any STON**
	765		**90%**				**114**
			# of "empty" Hrs flown		**% of Hrs flown with cargo**		
			4637.9		**11%**		

Excerpt of data for all OCONUS positioning and de-positioning legs thru KWRI

Non-AR OCONUS Legs To/From KWRI 1 Aug 2008 to 31 Jul 2009							
	MISSION_ID	ACTYPE	DEP_ICAO	ARR_ICAO	FLYING HOURS	PAX ABOARD	STons ABOARD
1	6VH155E13272	KC010	CYYR	KWRI	3.08	0	0
2	ZVH008Q11347	KC010	EGUN	KWRI	8.42	7	18.81
3	ZVH155E43275	KC010	EGUN	KWRI	7.82	11	7.98
4	ZVH106Q21147	KC010	EGUN	KWRI	7.63	6	0
5	6VH106Q31147	KC010	EGUN	KWRI	7.72	0	5.75
6	6VH157E21242	KC010	EGUN	KWRI	7.25	10	9.33
7	ZVH077E11045	KC010	EGUN	KWRI	7.35	3	1.66
8	6VH076Q11310	KC010	EGUN	KWRI	7.70	0	3
9	ZVH076Q21310	KC010	EGUN	KWRI	7.63	0	0
10	6VH049E11087	KC010	EGUN	KWRI	7.92	0	2.52
11	ZVH157E11236	KC010	EGUN	KWRI	7.20	7	6.53
12	ZVH157E21236	KC010	EGUN	KWRI	7.58	0	0
13	ZVH131E11242	KC010	EGUN	KWRI	7.17	11	0
14	6VH107Q14168	KC010	EGUN	KWRI	7.82	11	16.6
15	ZVH133D11264	KC010	ETAD	KWRI	8.37	0	0
16	ZVH017E21327	KC010	ETAR	KWRI	8.48	8	0
17	6JH155E13271	KC010	KWRI	CYYR	2.25	0	0
18	6JH154E11217	KC010	KWRI	EGUN	6.45	8	0
19	6JH154E21217	KC010	KWRI	EGUN	6.57	10	0
20	6JH154E31217	KC010	KWRI	EGUN	6.53	8	0
21	ZJH084E11098	KC010	KWRI	EGUN	6.58	2	0
22	6JH012E11032	KC010	KWRI	EGUN	6.38	8	2.2
23	7PH027E12300	KC135	KWRI	LEMO	6.90	0	0
24	7PH027E22300	KC135	KWRI	LEMO	7.00	0	0
25	8PY160E22262	KC135	KWRI	LEMO	7.17	0	0
26	6JH015E11324	KC010	KWRI	LEMO	7.25	0	0
27	6JH080E11097	KC010	KWRI	LEMO	6.55	0	0
28	ZJH063Q11096	KC010	KWRI	LEMO	6.97	0	0
29	ZJH063Q21096	KC010	KWRI	LEMO	6.93	0	0
30	ZJH133D11261	KC010	KWRI	LEMO	6.98	0	0
31	6JH015E12326	KC010	KWRI	LEMO	6.95	1	0
65	ZVH052E11042	KC010	LICZ	KWRI	9.95	1	0
66	6VH064Q11100	KC010	LICZ	KWRI	9.73	0	0
67	6VH064Q21100	KC010	LICZ	KWRI	10.13	0	0
68	ZPR135A11252	KC010	LICZ	KWRI	9.67	0	0
69	ZVH016E21311	KC010	LICZ	KWRI	10.85	1	0
70	8PR044A33014	KC135	LPLA	KWRI	6.93	0	0
71	6VH095E15147	KC010	LPLA	KWRI	5.62	0	0
72	6VH015E12328	KC010	LPLA	KWRI	5.27	0	0
73	ZPH514W21152	KC010	PAED	KWRI	6.52	3	0
74	ZVH713N11304	KC010	PAED	KWRI	6.53	1	0.17
75	6VH515W11193	KC010	PAED	KWRI	6.42	14	1.57
76	ZVH514W11153	KC010	PAEI	KWRI	6.17	9	0
77	6VH765N11204	KC010	PAEI	KWRI	6.65	3	0
78	ZPY530A11272	KC010	PHIK	KWRI	8.80	0	0
79	6VH471D21022	KC010	PHIK	KWRI	9.07	4	0
80	ZVH478W11086	KC010	PHIK	KWRI	9.17	13	0
81	ZVH536Q11253	KC010	PHIK	KWRI	8.97	13	0.18
82	6VH511W11176	KC010	PHIK	KWRI	8.95	12	0
83	6VH511W21174	KC010	PHIK	KWRI	8.63	0	0
84	ZVH519W21183	KC010	PHIK	KWRI	8.65	6	8.74
85	6VH519W11179	KC010	PHIK	KWRI	9.10	13	0
86	6VH519W21179	KC010	PHIK	KWRI	9.00	7	0
					Total Hours	Total Pax	Total Cargo
					669.32	318	85.04
	Total Sorties					Sorties w/ pax	Sorties w/>1 STON
	86				Median Flt Time	47	12
	Sorties w/o cargo	% of sorties w/o cargo			7.36		Sorties w/ any STON
	74	86%					14
			# of "empty" Hrs flown		% of Hrs flown with cargo		
			578.7		14%		

Appendix C: Air Force Form 3578 Tanker Activity Report

TANKER ACTIVITY REPORT									*Report Control Symbol* RCS:
Clearly print all entries. Read instructions carefully. Enter remarks when required.									
Z-DATE	MISSION #	MISSION SYM	TAIL NUMBER	DEP ICAO	Z-TIME	ARR ICAO	Z-TIME	DURATION	

USER CODES FOR SECTIONS I & II		AET - AIR EDUC TRAINING COMMAND
AMC - AIR MOBILITY COMMAND	CPF - USN CINCPACFLT	PAC - PACIFIC AIR COMMAND
ACC - AIR COMBAT COMMAND	CLF - USN CINCLANTFLT	MRF - MARINE RESERVE FORCES
AFE - AF EUROPE	CNE - USN CINCNAVEUR	SOC - SPECIAL OPS COMMAND
AFM - AF MATERIAL COMMAND	FMS - FOREIGN MILITARY SALES	MFL - MARINE FORCES ATLANTIC
AFT - AF OPERATIONAL TEST CENTER	FRG - FOREIGN GOVERNMENT	MFP - MARINE FORCES PACIFIC

SECTION I: AIR REFUELING SUPPORT

A/R USER EVENTS: A/R user events are separate from AF Form 781 (Airframe) sorties and will be charged to each user of tanker support. Use MSN Codes 1-5. Enter remarks when required for Mission Codes 1-3 and 6.

MISSION CODES FOR SECTION I

1 - Air refueling (A/R) support for JCS Directed Operations and Contingencies.
2 - JCS Operational Deployers, Coronets, FMS Case Suppor, Test OPS, Phoenix Boom, JCS/MAJCOM Exercises.
3 - NAF Exercises/ORI's, Intratheater Aircraft Movements, CCTS/RTU, Wing Exercises, and Evaluations.
4 - A/R for Continuation/Proficiency Receiver Training.
5 - Tanker Unit Requested Training Activity.
6 - Flying Hours Expended staging to/from direct support of Coronets, Business Effort, or A/R Dual Roles.

RCVR UNIT	USER CODE	MSN CODE	EVENTS	HOURS	RCVR TYPE	# OF RCVRS	FUEL OFF LOAD		REMARKS
							SCHED FUEL OFFLOAD	ACTUAL FUEL OFFLOAD	*(Coronet #, JA/ATT #, RTU, Business Effort, etc.)*

SECTION II: NON-AIR REFUELING SUPPORT *(AIRFRAME SORTIES)*

USER CODE	MSN CODE	MISSION DESCRIPTION	SORTIE	HOURS
	10	Exercise/Contingency TTF Re-/Deployment *(Remarks required)*		
	11	European TTF Re-/Deployment		
	12	Pacific Re-/Deployment		
	14	Crew Training		
	15	Staff/Senior Staff Training		
	16	Qualification and Upgrade Training *(CCTS)*		
	17	Programmed Depot Input/Return		
	19	Organic Airlift, Non-A/R Activity, etc. *(Airshow, CLT) (Remarks required)*		

SECTION III: AIRLIFT SUPPORT *(AIRFRAME SORTIES)*

USER CODE	MSN CODE	MISSION TYPE AND REMARKS *(Remarks are required for all of the following mission types)*	SORTIE	HOURS
AMC	31	Airlift Staging:		
AMC	32	Channel:		
AMC	33	JA/ATT: JA/ATT #		
AMC	34	SAAM: SAAM #		
AMC	35	Dual Role: *(Charge hours to the A/R block above)*		

FUEL CONSERVATION	PAX *(No.)*	PALLETS *(No.)*	CARGO *(Wt)*	TOTAL HOURS FROM SECTIONS I, II AND III

			REMARKS
	Ramp Fuel		
-	Shutdown		
+	Onload		
-	Off-load		
=	Total Fuel		
	Duration		
=	Lbs/Hour		

AIRCRAFT COMMANDER *(Print Name & Sign)*	REVIEWING OFFICIAL *(Print Name & Sign)*

AF IMT 3578, 19951101, V2 PRIOR EDITIONS ARE OBSOLETE.

Appendix D: Typical Flight Times for the KC-10

Average Historic Flight Times of the KC-10 (618 TACC Flight Time Calculator, 2009)

Departure Location	Arrival Location	Flight Time
KWRI	ETAR	7.2
KWRI	LEMO	6.7
KWRI	LICZ	8.2
KWRI	EGUN	6.1
ETAR	KWRI	8.2
ETAR	LEMO	1.9
ETAR	LICZ	1.6
ETAR	EGUN	1.1
LEMO	KWRI	7.8
LICZ	KWRI	9.7
EGUN	KWRI	7.4
LEMO	OTBH (Al Udeid, AB)	6.8

Appendix E: B-747 Channel Flights Transiting KWRI in 1st Qtr FY2010

Data obtained from USTRANSCOM Single Mobility System (SMS) on 22 Jan 2010 (https://sms.transcom.mil/)

Mission Number	ACMDS	DATE - TIME	STATUS	PREV ITIN for ARR / NEXT ITIN for DEP	Flt Time (Hours)	Mission Type	Cargo Load (STons)
BBB1DR30E296	B74740	23/OCT/2009 0825	DEP	ETAR KWRI	6.58	CHANNEL	38
BBB1DR30E316	B74740	12/NOV/2009 0720	DEP	ETAR KWRI	6.83	CHANNEL	57.8
BBB1DR30E330	B74740	26/NOV/2009 0500	DEP	ETAR KWRI	6.83	CHANNEL	53.8
BBB1DR40E296	B74740	24/OCT/2009 0355	ARR	KWRI ETAR	8.67	CHANNEL	35
BBB1DR40E316	B74740	13/NOV/2009 0220	ARR	KWRI ETAR	8.17	CHANNEL	38.3
BBB1DR40E330	B74740	27/NOV/2009 0110	ARR	KWRI ETAR	9.33	CHANNEL	46
BBB6DR30B292	B74710	19/OCT/2009 2120	DEP	ETAR EGUN KWRI	7.17	CHANNEL	51.8
BBB6DR40B293	B74710	20/OCT/2009 2052	ARR	KWRI ETAR EGUN	7.53	CHANNEL	22.1
BBB6XR30F297	B74710	24/OCT/2009 0520	DEP	ETAR	6.33	CHANNEL	42.1
BBBKDR30C342	B74710	08/DEC/2009 0905	DEP	ETAR KWRI	6.75	CHANNEL	56.4
BBBKDR30E274	B74710	01/OCT/2009 0035	DEP	ETAR KWRI	6.75	CHANNEL	39.5
BBBKDR30E281	B74710	08/OCT/2009 0035	DEP	ETAR KWRI	7.08	CHANNEL	57.7
BBBKDR30E337	B74710	03/DEC/2009 0035	DEP	EGUN ETAR KDOV	7.33	CHANNEL	39.7
BBBKDR30E344	B74710	10/DEC/2009 0035	DEP	EGUN ETAR KDOV	7.25	CHANNEL	39.5
BBBKDR30E351	B74710	17/DEC/2009 0035	DEP	EGUN ETAR KDOV	6.42	CHANNEL	45.3
BBBKDR40C342	B74710	09/DEC/2009 0521	ARR	KWRI ETAR	9.52	CHANNEL	54
BBBKDR40E274	B74710	01/OCT/2009 1917	ARR	KWRI ETAR	7.95	CHANNEL	33.2
BBBKDR40E281	B74710	08/OCT/2009 1925	ARR	KWRI ETAR	7.92	CHANNEL	44.3
BBBKXR30E309	B74710	05/NOV/2009 0935	DEP	ETAR	6.67	CHANNEL	58.1
BBR6DX60B323	B74710	19/NOV/2009 2222	ARR	KDOV EBLG LTAG ETAR HECA ETAR LPLA	6.4	CHANNEL	0
BBW1DY5BL282	B74720	09/OCT/2009 0755	DEP	ETAR OTBH ETAD OAIX	8.5	CHANNEL	47.9
BBW1DY5BL286	B74720	13/OCT/2009 0135	DEP	ETAR OTBH ETAR KWRI	7.08	CHANNEL	58.5
BBW1DY5BL328	B74720	24/NOV/2009 0455	DEP	ETAR OTBH ETAR KWRI	6.83	CHANNEL	45.7
BBW1DY5BL331	B74720	27/NOV/2009 0255	DEP	ETAR OTBH ETAR KWRI	6.83	CHANNEL	51.4
BBW1DY5BL356	B74720	22/DEC/2009 0455	DEP	ETAR OTBH ETAR KWRI	9.75	CHANNEL	44.6
BBW1DY5BL363	B74720	29/DEC/2009 0455	DEP	ETAR OTBH ETAR KWRI	7.12	CHANNEL	41.9
BBW1DY60C286	B74720	14/OCT/2009 1602	ARR	KWRI ETAR OTBH ETAR	7.62	CHANNEL	0
BBW1DY60C329	B74720	25/NOV/2009 2250	ARR	KWRI ETAR OTBH ETAR	9.17	CHANNEL	0
BBW1DY60C357	B74720	23/DEC/2009 1925	ARR	KWRI ETAR OTBH ETAR	6.67	CHANNEL	0
BBW1DY60C364	B74720	30/DEC/2009 1938	ARR	KWRI ETAR OTBH ETAR	8.3	CHANNEL	82.1
BBW1DY60F331	B74720	28/NOV/2009 1742	ARR	KWRI ETAR OTBH ETAR	8.65	CHANNEL	48.4
BBW1XG50B299	B74720	26/OCT/2009 1920	DEP	EDFH OKBK	5.65	CHANNEL	92.9
BBW1XG50G332	B74720	28/NOV/2009 0220	DEP	EDFH OKBK	10.27	CHANNEL	88
BBW6DG50A277	B74710	04/OCT/2009 0650	DEP	ETAR OKBK ETAR KDOV	8.5	CHANNEL	96.9
BBW6DG50A286	B74710	13/OCT/2009 0650	DEP	ETAR OKBK ETAR KDOV	8.83	CHANNEL	55.1
BBW6DG50D280	B74710	07/OCT/2009 0650	DEP	ETAR OKBK ETAR KDOV	8.58	CHANNEL	41.3
BBW6DG50D294	B74710	21/OCT/2009 0650	DEP	ETAR OKBK ETAR KDOV	7.35	CHANNEL	87.3
BBW6DG50D336	B74710	02/DEC/2009 0650	DEP	ETAR OKBK ETAR KDOV	6.83	CHANNEL	76
BBW6DG50E274	B74710	01/OCT/2009 0650	DEP	ETAR OKBK ETAR KDOV	6.75	CHANNEL	69.6
BBW6DG50E281	B74710	08/OCT/2009 0650	DEP	ETAR OKBK ETAR KDOV	8.17	CHANNEL	50.3
BBW6DG50L301	B74710	28/OCT/2009 1550	DEP	EBLG OKBK ETAR KDOV	8	CHANNEL	107.2
BBW6XG50C314	B74710	10/NOV/2009 1905	DEP	EBLG OKBK	6.92	CHANNEL	123.6
BBWKDG50D301	B74710	28/OCT/2009 0835	DEP	ETAR OKBK ETAR KDOV	28.97	CHANNEL	100.5
BBWKDG50D322	B74710	18/NOV/2009 0835	DEP	ETAR OKBK ETAR KDOV	8.83	CHANNEL	89.2
BBWKDG50D329	B74710	25/NOV/2009 0835	DEP	ETAR OKBK ETAR KDOV	9.75	CHANNEL	85.3
BBWKDG50D343	B74710	09/DEC/2009 0835	DEP	ETAR OKBK ETAR KDOV	8.22	CHANNEL	51.1
BBWTDG50A340	B74720	06/DEC/2009 0724	DEP	ETAR OKBK ETAR KDOV	6.93	CHANNEL	104.2
47 Total Msns				**Total Flt Time =**	**382.55**	**Total Cargo =**	2591.6
						Average Cargo=	**55.14**

Bibliography

1. Air Force Material Command (AFMC), KC-X Tanker Modernization Program Draft Request for Proposal (TMP-DRFP), Solicitation Offer and Reward Number: FA8625-10-R-6600, Aeronautical Systems Center, 24 Sept 2009

2. AMC Operations Summary, 8 Feb 2010, obtained from 618TACC/XONT via https://tacc.scott.af.mil/default.asp?action=FILEUPLOAD&component=OP_SUM_FILES on 8 Feb 2010.

3. Boeing. *"KC-7A7. United States Tanker"* Content taken from industry website. http://www.unitedstatestanker.com/ . December 9, 2009

4. Brigantic, R and Mahan, J. "Defense Transportation: Algorithms, Models, and Applications for the 21st Century." Elsevier, 2004.

5. Burns & McDonnell. Aircraft Characteristics 10th Edition, 2008

6. CRS Report for Congress. *"Air Force Air Refueling: The KC-X Aircraft Acquisition Program"* February 28, 2008

7. Dally, James R. Major, Coronet Shop Division Chief, 618 TACC, Scott AFB IL. Personal Correspondence. October 19, 2009

8. Department of the Air Force (DOAF). Air Force Instruction (AFI) 11-208 Air Mobility Command Instruction *Tanker/Airlift Operations*. Washington: HQ USAF, 1 June 2000.

9. DOAF. AFI 65-503, A15-1 SAAM, JCS, Exercise and Contingencies Rate Guidance. Washington: HQ USAF, obtained on 22 December 2009 from https://www.my.af.mil

10. DOAF, Air Mobility Command Aircrew/Aircraft Tasking System (AATA) CONOPS. HQ AMC Scott AFB, IL. 16 November 2005.

11. DOAF, Air Mobility Command Instruction (AMCI) 65-602, HQ AMC Scott AFB, IL. 23 December 2009

12. DOAF. Air Force Pamphlet (AFPAM) 10-1403 Air Mobility Planning Factors. Washington: HQ USAF, 18 December 2003

13. DOAF. AFI 11-221 Air Refueling Management (KC-10 and KC-135). Washington: HQ USAF, 1 November 1995

14. DOAF. KC-10A Fact Sheet, Air Mobility Command Public Affairs Office, September 2008

15. DOAF. KC-135 Fact Sheet, Air Mobility Command Public Affairs Office, September 2008

16. DOAF. TO 1C-10(K)A-1 Vol 1 Flight Manual. Washington: HQ USAF, 15 January 2008

17. DOAF. TO 1C-10(K)A-9 Cargo Loading Manual. Washington: HQ USAF, 1 August 2007

18. DOAF. TO 1C-135(K)(I)-1 Vol 1 Flight Manual. Washington: HQ USAF, 31 January 2008

19. DOAF. TO 1C-135 -9 Cargo Loading Manual. Washington: HQ USAF, 30 April 2008 DOAF, Air Mobility Command Instruction (AMCI) 10-202, Volume 6, Mission Reliability Reporting System. HQ AMC Scott AFB, IL. 13 August 2004

20. Department of Defense (DoD). "DoD Channel Tariffs: Passenger and Cargo Rates by Channel effective 01 Oct 2009 to 30 Sep 2010" Obtained from HQ AMC Financial Management & Comptroller on 22 December 2009 from https://www.my.af.mil AMC Financial Management and Comptroller: FMA: FMAT

21. DoD. "Charters – Special Assignment Airlift Missions (SAAM'S), Joint Chiefs of Staff Exercises (JCSE), and Contingencies for the Transportation Working Capital Fund (TWCF), and Non-TWCF Aircraft. EFFECTIVE: 01 Oct 09 through 30 Sep 10" Obtained from HQ AMC Financial Management & Comptroller on 22 December 2009 from https://www.my.af.mil AMC Financial Management and Comptroller: FMA: FMAT

22. DoD. Joint Doctrine for the Defense Transportation System, JP-4-01. Washington: GPO, 19 March 2003

23. General Accounting Office, GAO/T-NSIAD-00-98, "Visibility and Accountability of O&M Fund Movements". Washington, DC. 29 February, 2000

24. Northrop Grumman. *"KC-45 Tanker. Total Air Mobility"* Content taken from Industry website. http://www.northropgrumman.com/kc45/. 8 December, 2009

25. RAND Project Air Force. *"Analysis of Alternatives (AoA) for KC-135 Recapitalization (Executive Summary)."* RAND Corporation Publishing, 2006

26. Schwartz, Norton, General, Chief of Staff USAF, Airlift/Tanker Association 2009 Symposium Remarks, 31October, 2009

27. Walker, Steve, CONUS Outbound Operations Division (XOGB) Planner, 618 TACC, Scott AFB IL. Personal Correspondence. 9 February, 2010

28. 618 TACC Flight Time Calculators. Accessed via https://tacc.scott.af.mil/default.asp?action=dspFlyingTime . 22 December 2009

REPORT DOCUMENTATION PAGE	*Form Approved* *OMB No. 0704-0188*

1. REPORT DATE *(DD-MM-YYYY)*	**2. REPORT TYPE**	**3. DATES COVERED** *(From - To)*
18-0613-06-2010	Graduate Research Project	Jun 2009 – Jun 2010

4. TITLE AND SUBTITLE

CORONET VS.CARGO: A STUDY INTO INCREASING THE USAGE OF TANKER ASSETS FOR CARGO MOVEMENT ON CORONET POSITIONING AND DE-POSITIONING LEGS

5a. CONTRACT NUMBER

5b. GRANT NUMBER

5c. PROGRAM ELEMENT NUMBER

6. AUTHOR(S)

Major Timothy J. Stuart

5d. PROJECT NUMBER

5e. TASK NUMBER

5f. WORK UNIT NUMBER

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

Air Force Institute of Technology
Graduate School of Engineering
and Management (AFIT/ENS)
2950 P Street, Building 640
WPAFB OH 45433-7765

8. PERFORMING ORGANIZATION REPORT NUMBER
AFIT/IMO/ENS/10-13

9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES)
Dr James Moore
AFIT/ENS
2950 P Street, Bldg 640 Phone: DSN 785-3636 Ext 4528
WPAFB OH 45433-7765 e-mail: james.moore@afit.edu

10. SPONSOR/MONITOR'S ACRONYM(S)

11. SPONSOR/MONITOR'S REPORT NUMBER(S)

12. DISTRIBUTION / AVAILABILITY STATEMENT
Approved for public release, distribution unlimited

13. SUPPLEMENTARY NOTES

14. ABSTRACT
The Air Mobility Command (AMC) tanker force is heavily tasked moving fighter units on Coronets (missions to and from exercises, deployments and redeployments). Many of these missions have legs that are not utilized by the fighter units and that leave the tanker flying intratheater without off loading any fuel or carrying any cargo. In this age of decreased resources and increased workload, AMC needs to have a process in place that can take advantage of these unused legs to the maximum extent. By changing the way that Coronets are planned and by adding cargo hubs as stops in these "empty legs," AMC may be able to reduce the number of cargo aircraft required in the mobility system and reduce the number of underutilized flying hours on the tanker.

This research utilizes data from Tanker Activity Reports to validate the theory that AMC is not fully utilizing tankers to their maximum capabilities. After reviewing all of the data, processes and costs associated with operating various mission types, the research provides recommendations for adjusting the current scheduling process. This research shows a trend in the underutilization of the tanker's ability to carry cargo. This lost pool of resources will continue to grow as the KC-135 is phased out of service and the enhanced capabilities of the KC-X are brought online.

15. SUBJECT TERMS
Air Refueling and Airlift Scheduling

16. SECURITY CLASSIFICATION OF: Unclassified			**17. LIMITATION OF ABSTRACT**	**18. NUMBER OF PAGES**	**19a. NAME OF RESPONSIBLE PERSON** Dr. James T. Moore
a. REPORT U	**b. ABSTRACT** U	**c. THIS PAGE** U	UU	73	**19b. TELEPHONE NUMBER** *(include area code)* (937) 255-3636 Ext 4528

Standard Form 298 (Rev. 8-98)
Prescribed by ANSI Std. Z39.18