COST/BENEFIT ANALYSIS OF INDEPENDENT SCHEDULING OF AIRCREW/AIRCRAFT: THE FIRST STEP TOWARDS AN INTERCHANGEABLE AIRCRAFT MANAGEMENT CONSTRUCT

GRADUATE RESEARCH PAPER

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Abstract

Air Mobility Command (AMC) has historical stationed the USAF fleet of C-17 aircraft to Air Force bases around the world. Associated C-17 flying squadrons are established at these bases to operate and execute assigned/tasked C-17 missions worldwide. Since each base is assigned specific aircraft (tails), their unit specific tasked missions originate and terminate at their base of assignment. This construct has led to numerous C-17 flights operated empty to pre/de-position aircraft for required cargo missions, potentially costing AMC/DoD millions of dollars in flight hour costs, reducing the operational life of the C-17 fleet, and creating an overall process inefficiency. This construct is contrary to the way that commercial and civilian cargo/passenger airlift operations are conducted. These companies/entities choose to leave the empty aircraft at the last offload location when mission capable, and commercially fly aircrew to/from the aircraft. This could potentially save aircraft wear/tear, and allow operations to be conducted at a significantly reduced rate. This research paper focused on conducting a cost benefit analysis of AMC's current operations of operating empty aircraft to/from their assigned base of record compared to the cost/efficiency savings of conducting C-17 operations in a manner comparable to commercial carriers. The research methodology included extensive analysis and filtering of all C-17 channel and contingency missions for fiscal years (FY) 2017-2018. The total cost of the 2-year flying data was then analyzed against an alternate construct of utilizing commercial carriers to the max extent possible. The presented cost comparison data is designed to offer AMC leadership with an alternate COA potentially identifying the logistical way-ahead and projected cost savings of operating under a centrally manned aircraft/aircrew construct.

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COST/BENEFIT ANALYSIS OF INDEPENDENT SCHEDULING OF AIRCREW/AIRCRAFT: THE FIRST STEP TOWARDS AN INTERCHANGEABLE AIRCRAFT MANAGEMENT CONSTRUCT

I. Introduction

18th Air Force (AF) maintains command and control (C2) over approximately 100 C-17 missions a day, including various types of operational support, exercise, and training missions. The current process segments the planning of these missions into subsets where they are then assigned to a squadron with an available aircraft and crew. In many instances the initial on-load and final cargo offload do not originate or terminate at the home base of the associated tasked squadron. Subsequently, the aircraft and crew are flying to or from these locations empty.

The purpose of this research is to explore potential aircrew operational cost savings associated with Air Mobility Command (AMC) adopting a C-17 central inter-changeable aircraft management system in comparison to the current base-allocated management system. Outside of the Department of Defense (DoD) this is the common practice. Commercial air and cargo carriers supporting passenger and cargo operations worldwide all use a centralized aircrew and aircraft management system. This research aims to focus on the potential benefits of the DoD adopting a similar construct to these proven commercial best practices.

A theory for the research project is informed by the Transactional Cost Economics (TCE) theory pioneered by Oliver Williamson. TCE is a theory of organizational efficiency investigating how a complex transaction should be structured and governed with the ultimate goal of minimizing waste. (Ketokivi 2017) It examines three dimensions including Frequency, Uncertainty, and Specificity to assist the organization in determining the most feasible least cost solution. The TCE model is then tested through a comparison of C-17 missions of aircrews flying empty pre-positioning/de-positioning mission legs, compared to commercially transporting these aircrew members to/from their assigned home base location to the on-load/offload sites. This cost-benefit analysis (CBA) provides conclusions regarding the amount of money it costs AMC annually to fly empty C-17s versus the amount of money it costs to airline the aircrew members to/from their assigned base installation while leaving the C-17 at its last offload location awaiting a further cargo/passenger tasking.

Background

Historically, the United States Air Force has allocated specific aircraft to individual wings and bases around the globe. Associated aircrew originate and terminate their temporary duty (TDY) at their assigned base, and tend to travel with an assigned airplane (tail) from that base. This specific type of aircraft management construct forces AMC to spend millions of dollars each year pre-positioning and de-positioning (prepo/depo) aircraft, for the sole purpose of returning a tail to its home base. Unfortunately, this current construct requires these aircraft to fly under-utilized with respect to cargo maximization making these missions expensive to the Department of Defense (DoD).

For example, a C-17 aircrew (aircrew #1) stationed at Joint Base Lewis-McChord, WA flying a C-17 aircraft assigned to that wing operates an active cargo leg from Ramstein AB, Germany to Dover AFB, DE. After their final offload at Dover AFB the aircraft will fly empty operated by the same aircrew (aircrew #1) back across the country to its home installation in Washington State. The very next day a second C-17 aircrew (aircrew #2) is alerted and tasked with flying an overseas mission that has no active cargo on its initial leg but performs its initial on-load at Dover AFB, DE. The aircraft is then operated back across the country 1 day after it left that very same location empty simply to complete its tasked de-positioning leg. The CBA utilized in this research aims to analyze the costs versus benefits of the aforementioned scenario having aircrew #1 fly home commercially from Dover AFB, DE upon completion of their final offload, leaving the C-17 at Dover awaiting its next active on-load mission leg. The next day aircrew #2 flies commercially from Washington State out to Dover AFB where they pick up that C-17 and operate it overseas in accordance with the specific mission details. The CBA will analyze the costs associated with hours of operation for the C-17 versus the costs of commercial travel for the aircrews.

In contrast to current DoD procedures, commercial cargo and passenger carriers maintain a central aircraft allocation system that enables them to interchange crews/planes as needed to maximize their routes and cost savings. This requires the commercial carriers to manage aircrew movements independently of the aircraft, often moving the individual aircrew members to and from the aircraft location at a significantly reduced price compared to flying an under-utilized aircraft. In this example, the aircrews fly commercially around the globe to pick-up aircraft waiting at on-load locations until there is an additional tasked mission. This is a common practice for all major air carriers to include FedEx, UPS, Atlas Air, and US passenger air carriers.

Problem Statement

Historically in AMC, the C-17 has not adopted an aircraft management approach independent of its' assigned base and aircrew comparable to commercial counterparts, which may be causing operational cost inefficiencies.

Research Question

This paper seeks to answer one primary question by addressing three investigative questions:

RESEARCH QUESTION: How could an inter-changeable aircraft management construct of the C-17 benefit Air Mobility Command in regards to aircrew management cost?

INVESTIGATIVE QUESTION 1: What is the total cost in FY17 and FY18 of C-17's pre-positioning/de-positioning empty or with opportune cargo?

INVESTIGATIVE QUESTION 2: What are the associated costs with deadheading aircrews to and from aircraft in FY17 and FY18 compared to the cost of pre-positioning / de-positioning the C-17?

INVESTIGATIVE QUESTION 3: To what extent does the current base management of the C-17 inventory compare to an inter-changeable fleet management approach and its effect on operational aircrew cost?

Assumptions

Several assumptions are necessary in order to quantify costs of C-17 missions:

Assumption # 1.

The C-17 contains an augmented crew totaling 5 crewmembers for tasked missions.

Assumption # 2.

Ramp space/ Maximum aircraft on ground (MOG) is not dependent on the C-17 departing on the scheduled date, as it may remain at its current en-route location for a few days awaiting the in-bound aircrew.

Assumption # 3.

The aircrew members will book their own airfare/travel arrangements in Defense Transportation System (DTS) or through their approved local travel office.

Assumption # 4.

C-17 aircraft will be flown as required to meet specified maintenance requirements.

Assumption # 5.

All commercial calculated travel prices are current as of February 2019. For all commercial travel prices used by the researcher in calculating airport/taxi costs see Appendix B for a detailed report and mission specifics.

Assumption # 6.

C-17 aircraft that are uniquely equipped/configured to support specific missions will need appropriate qualified crewmembers to operate them. Example: An airdrop mission requires an airdrop qualified crew and the aircraft configured for these specific airdrop missions.

Assumption # 7.

All specific C-17 mission information retrieved from the Global Decision Support System (GDSS) and AMC for FY17/FY18 is accurate.

Limitations

This research project is limited to unclassified information. Inaccuracies within open source documentation regarding the C-17 missions could lead to inaccuracies in the assumptions used to formulate the model. This research project is limited to locations that have available commercial travel in the vicinity. Time restrictions placed on the research project limited the sample size to FY17 and FY18.

Scope

This research solely focuses on C-17 missions that were pre-positioning or de-positioning in FY17 and FY18. To be included in the calculated data set, the pre-positioning legs had to originate from a C-17 crew base or the de-positioning legs had to terminate at a C-17 crew base. The cost of the airline tickets relative to the associated fiscal year of each specific C-17 mission were calculated based off of the applicable Government Services Administration (GSA) FY17/FY18 contract rates. If the necessary commercial airports were not included in the contract rates, the rates were estimated off of the current FY19 rates through Wingate Travel. Taxi rates were calculated based on 2019 shuttle service rates for services that transport 5 base personnel to common commercial airports. If there was not a commonly used shuttle service for that specific base, the researcher utilized taxifarefinder.com and calculated 2 taxis to accommodate all 5 crewmembers. A spreadsheet was created for each individual route leg displaying the associated shuttle service/taxi cost to/from the closest major commercial airport and the C-17 home base. This spreadsheet can be found as Appendix B.

II. Review of Literature Summary

There are numerous regulations, policies and procedures that govern current AMC aircraft tasking and allocation. To frame the research and create a foundation of knowledge on current operations, previous allocation attempts, etc. the following literature review will offer a general baseline of understanding.

Operational Factors Affecting Aircraft Utilization

A GAO report from 2005 discussed the inadequacies of the C-17 utilization rate and what factors may affect the aircraft capacity utilized. These factors are broken down into three categories; operational, environmental, and DOD policy, with subsets under each constraint. (GAO 2005) The first operational constraint identified in this GAO report was aircraft availability. User requirements and threat situations may not allow any flexibility in delivery times, locations or load configurations. The amount of aircraft that are dedicated to training missions, crew certifications, and undergoing maintenance also further reduces the ability of AMC to maximize the cargo utilization. Another operational factor affecting utilization is the aircraft characteristics. The size and shape of the aircraft cargo compartment along with the strength of the floors can impact the capacity and payload able to be transported. An aircraft's contours can limit the height of pallets and force them to hold less cargo than theoretically could be transported. A third operational constraint includes cargo characteristics and loading configurations. AMC attempts to match cargo dimensions with appropriate type aircraft, however that type may not be available. The aircraft may appear to be full of pallets but those pallets may not have met weight or volume limits. If you compare small dense cargo maximizing a weight requirement (ie: ammunition) with a large irregular shaped object (ie: helicopter), both could result in empty space in the cargo compartment. Additionally some cargo must be transported in containers with two or more pallets linked together, while transportation of hazardous goods may require transportation by itself. Another operational factor contributing to aircraft under-utilization is fuel considerations. Aircraft range and payloads are greatly affected by a mission's fuel requirements. Diplomatic clearances, weather, and availability of air refueling can all have operational impacts on what kind of payload that aircraft is permitted to carry. (GAO 2005)

The second main factor affecting the aircraft capacity utilized is environmental factors such as pressure, temperature, altitude, and weather. Summer and winter conditions can affect the payload of aircraft into and out of certain airports. (GAO 2005)

The final factor affecting utilized aircraft cargo capacity is DoD policy, specifically initiatives reducing customer wait time to fulfill AMC's primary objective of delivering the right items to the right place at the right time. The most efficient way to move cargo is not always the most appropriate for the specific mission requirements. The initiative to have pure pallets delivered to customers was also a way to expedite delivery but could result in lighter pallets and payloads. (GAO 2005)

The limiting factors discussed in this report still apply to the circumstances surrounding the C-17 missions that positioned or de-positioned in FY17 and FY18. There are going to be instances when an aircraft will need to fly empty to be able to meet mission requirements and such factors as the environment, operations, and policy will direct how many missions that will be. However, this research aims to offer AMC a possible course of action (COA) and way-ahead regarding aircraft utilization while still taking into account these limiting factors. This GAO report was first published 13 years ago and still has relevant insight into consideration factors for scheduling missions more efficiently.

Extending C-17 Fleet Life

Reducing the amount of potentially wasted flight hours of the C-17 by operating empty will increase the overall service life of the entire fleet. In 2016, Charles Eichner wrote his graduate research paper (GRP) directly addressing this issue by researching the ability to extend the C-17 fleet life through fleet management. His research accounted for actual airframe usage through equivalent flight hours (EFH) and mitigated exposure to highly corrosive environments by tracking the amount of time each aircraft was assigned to a severe corrosion location. He examined how many hours the C-17 had been historically overflown and what could be a plausible COA to diminish the accumulation of flight hour fatigue and corrosion to extend the overall C-17 service life. Eichner's research aimed at finding an alternative solution to extend the service life without reducing the annual usage rates. A likely option suggested dynamically changing aircraft basing assignments as aircraft rotated through depot level maintenance. He aimed to quantify the number of years an aircraft fleet could be extended by swapping aircraft basing assignments to mitigate airframe fatigue at higher usage bases. The research suggested that service life could be significantly affected for a fleet of aircraft by scheduling changes to aircraft and operating base assignments. In the case of the C-17, the total fleet service life may be extended to 2048. His research concluded by indicating possible advantages to a new paradigm for fleet basing decisions. Eichner concluded that fatigue and corrosion could be managed and service life extended for the C-17 by changing the current aircraft allocation construct. (Eichner 2016)

Even though Eichner's GRP focused on the savings as it relates to extending the C-17 fleet life, we can infer a potential savings on an annual basis by having a flexible scheduling option for the fleet.

Cost-Benefit Analysis (CBA)

The main analysis between the current and alternate aircraft/aircrew management systems was performed utilizing a cost benefit analysis. The concept of cost-benefit analysis dates back to 1848 from Jules Dupuit and is defined as a procedure for estimating all costs involved and possible profits to be derived from a business opportunity or proposal. (Economic Times 2019) The value of a cost–benefit analysis depends on the accuracy of the individual cost and benefit estimates. In order to reach a conclusion as to the desirability of a course of action, the costs and benefits must be expressed in terms of a common unit (Watkins 2014). For the purpose of this research, the common unit is dollars. The final goal of the researcher, upon completion of this research, is to offer AMC and Headquarters Air Force (HAF) leadership a detailed CBA showing the monetary value of the differing courses of action, and offering potential courses of action for the immediate time frame.

Mission Funding Categories

To do an accurate analysis of the C-17 missions and the costs associated with the different types of missions, it is essential to extensively research DoD published guidance on the different mission funding categories and understand funding sources and allocation to AMC. Use of air mobility aircraft is funded either through the Transportation Working Capital Fund (TWCF) or operations and maintenance (O&M) funds. O&M funding occurs out of the Service component budget with no charge levied directly against the user. Users of channel airlift missions use O&M funds to reimburse the TWCF based on weight/cube of cargo and per passenger from aerial port of embarkation (APOE) to aerial port of debarkation (APOD). On contingency missions, users reimburse the TWCF based on mission flying time, to include positioning and de-positioning when directly supporting an Operations Order (OPORD), disaster, or emergency**.** (JP 3-17 2013)

Current Air Mobility Command Process for Aircrew Scheduling

Having a centralized aircrew/aircraft management system run by AMC is contrary to their current guidance and procedures. It was essential for the researcher to internalize all of the published literature by AMC regarding their current process to identify potential areas for improvement and how the centralized system should be structured and operated. Currently, AMC's process for determining which tails and crews fly a certain mission begins as requirements filter down from United States Transportation Command (USTC). When validated requirements flow into the 618th AOC they are separated into 618 AOC (TACC)/XOG for channel cargo, 618 AOC (TACC)/XOO for SAAM cargo, or 618 AOC (TACC)/XOP for contingency and exercise cargo. XOG/XOO/XOP develops the route structures and schedules the missions. From there 618 AOC (TACC)/XOB allocates a Wing to support those missions. The allocation of aircrew and aircraft are prioritized according to the Chairman of the Joint Chiefs of Staff (CJCS) priority levels. (618AOCOI 13-1 2018) Another determination used to assign the tasking is the return of aircraft to home station to meet scheduled maintenance timelines. It is up to the aircraft assigned unit to input the aircraft required return date into GDSS. Maintenance plans and scheduling personnel coordinate with wing current operations personnel to ensure proper aircraft due home dates are entered correctly. (AMCI 11-208 2017) The missions also have to be tasked with an appropriately qualified aircrew (airdrop/airland), and an appropriately configured airplane depending on the mission. The other consideration that XOB schedules to is the COMAFFOR Allocation and Apportionment Process (CAAP). CAAP establishes the daily tasking levels for all wings on a monthly basis. (618AOCOI 13-1 2018)

XOB reviews aircraft and/or aircrew availability to support the mission tasking IAW CAAP. If there are no aircraft or aircrew available to satisfy the mission requirement, XOB has approximately 9 COA's to consider, including changing the tasking to another wing, delaying the mission timing, or changing the requirement to another aircraft type. Only after 6 COA's are considered does the OI propose to "task a crew from another unit to relocate to that base and originate the mission. This is not a common practice." (618AOCOI 13-1 2018) The aircraft returning to home base is what ultimately causes the mission to be "complete" in GDSS, and updates the CAAP capacity for that Wing. Finally, XOB considers the Mobility Air Forces Management instruction dictating that all C-17 missions are planned for maximum Allowable Cabin Load (ACL), unless otherwise indicated my mission need. (AMCI 11-208 2017) XOB plans as best as they can to meet this requirement but when they are restricted to planning aircrews with the correlated base tails it makes it hard to maximize efficiency. Current as of Feb 2019, the only way for XOB to maximize efficiency by linking routes that are not full would be through a manual process of comparing the requirements with the potentially scheduled missions. If the tasking levels become too heavy, the only way to delay or cancel a channel mission is through deliberate and detailed instruction with the XOG schedulers and the XOB and XOG leadership. (618AOCOI 13-1 2018)

Once missions are within 24 hours of the departure time of the first leg it is considered "in execution" and managed by 618 AOC (TACC)/XOC. They have three execution cells divided along functional areas of responsibility. One cell is responsible for Contingency, JA/ATT, Support, and Exercise mission operations. A second cell is responsible for global Channel, and Aeromedical Evacuation mission operations. The third cell is responsible for SAAM, and Operational Support Airlift mission operations. Each cell ensures global C2 of all respective mission types (AMCI 11-208 2017). Any changes that are made by execution to pre/de-position aircrew in support of mobility operations as Mission Essential Personnel (MEP) on a mobility aircraft would be approved through 618 AOC (TACC)/XOC. If they verify that there is no military or contract transportation available, they have to call the unit commander for approval to send the crewmembers via commercial transportation. (AMCI 11-208 2017)

East Coast Mission Link (ECML)

In 2009, AMC authorized Travis, Dover, and McChord AFB to participate in a 6-month aircraft efficiency trial known as the East Coast Mission Link (ECML). As stated in their initial narrative delivered to AMC, the goal of the ECML was “To optimize Mobility Air Force’s (MAF) scheduling processes through the de-coupling of aircrew and aircraft (tails) scheduling.” (Gilmore, 2009) The trial setup Dover AFB as the East Coast “Hub” and had 2 x C-17, and 1 x C-5 dedicated to Dover and the ECML assigned missions. For the next 6 months aircrew flew out commercially from Travis and McChord AFBs to Dover to operate TACC assigned missions. All mission essential equipment was prepositioned at Dover to include aircrew crew communication equipment, aircrew laser eye protection, deployment bags, weapons, etc. A goal of the ECML was to decrease the “waste” of flying empty aircraft across the county to begin missions from Dover, and to decrease the associated added weight of flying mission required items (secrets, A-bags, etc.) that could simply be prepositioned at a hub. The ECML was a 3-Phased operation beginning with a Concept of Operations, moving to mission execution with the 3 assigned aircraft, and then potentially moving forward to Phase 3 with a more robust aircraft footprint for a wider analysis of COA feasibility. Following the completion of Phase 2, AMC leadership was briefed on the results of the 3 aircraft 6-month trial. Overall the briefers believed that the ECML was a major success. In the short time allotted for the trial the ECML saved

AMC $20.4M by not operating empty aircraft, prepositioning mission essential aircrew items, and commercially transporting aircrews as required. The de-brief also highlighted the ease of aircrew flexibility by having an East Coast Hub. For example, when 1 aircrew member was unable to fly due to a sickness the ECML permitted another qualified member assigned to the Hub to flow to that aircrew and continue the mission. This is counter to the current AMC process of assigning specific aircrew to certain aircraft or having to remove the entire crew when 1 member is unable to fly. The out-brief highlighted this as a major positive impact to the supported COCOM as it gives the mission greater flexibility and less chance for delayed timing. There were numerous logistical and cultural challenges the ECML planners, maintenance personnel, and aircrews had to overcome/endure to include commercially shipping aircrew life support equipment, commercially transporting with their assigned weapons, and creating/sustaining a larger maintenance footprint at Dover during execution. Despite the results presented to AMC leadership in 2009 following Phase 2 of ECML, AMC chose to continue their operations as normal and not adopt the ECML construct by moving forward with Phase 3. (Gilmer, 2009)

III. Methodology

Research Methodology

AMC currently has limited information regarding a centralized Aircraft Management Construct. This research fills an inherent gap for AMC on the associated costs and benefits of utilizing such a model. To capture the data for this research a quantitative research method was selected in order to perform an associated cost-benefit analysis. Quantitative research is defined by Leedy and Ormrod (2016) as, “Research yielding information that is inherently numerical in nature.” Yet, the significance of the quantitative data depends on how the researcher extracts meaning from them. (Leedy and Ormrod 2016) AMC generously gave the researcher all of the FY17/FY18 GDSS mission data to utilize for analysis and research. To narrow down the thousands of lines of C-17 mission data to the specific missions related to this particular research topic an extensive GDSS mission filtering process was required. The specific details of this filtering process are outlined below under GDSS Data.

Transaction Cost Economics Theory

The researcher used the Transaction Cost Economics Theory for this research. TCE is a theory by Oliver Williamson that is a commonly identified theory in logistics and Supply Chain Management. It is a theory of organizational efficiency that compares the cost of exchanging resources in the environment to the cost of managing resources inside the organization. (Ketokivi 2017) TCE is a way to compare relevant alternatives and determine which solution is the most feasible, economical, and more efficient approach. Analyzing Frequency, Uncertainty, and Specificity are cornerstones of quantifying differences in transactions. (Williamson, 1985) The researcher applied this theory to the research problem by determining the common differences of transactions in the mission data and quantifying a relevant alternative cost.

Cost Benefit Analysis

The main methodology of this research was accomplished by constructing a cost benefit analysis. The researcher compared the cost of flying the C-17 for the relevant empty legs to/from home base, versus the alternative of transporting the aircrew to/from home base by utilizing commercial travel. The commercial travel cost included the airfare for that leg and the taxi/shuttle cost to and from the closest major commercial airports to the origin and destination bases. The cost of operating the C-17 was calculated based on the average flight time of the leg multiplied by the appropriate fiscal year variable cost per flying hour. This cost-benefit analysis provides conclusions regarding the amount of money it costs AMC annually to fly empty C-17s versus the amount of money it costs to airline the aircrew members to/from their assigned base installation while leaving the C-17 at its last offload location awaiting a further cargo/passenger tasking.

GDSS Data

Global Decision Support System (GDSS) is the primary command and control (C2) system for Air Mobility Command's (AMC) airlift missions. GDSS tracks C-17 missions, providing arrival and departure information, as well as their mission status. The mission types are coded in GDSS to provide visibility to the schedulers of individual mission movements. (JP 3-17, 2013) The researcher filtered the GDSS data from 2017 and 2018 to narrow down the missions that would be representative of the data that needed to be analyzed.

To begin data collection it was essential to initially filter the FY17/FY18 GDSS data by Aircraft Mission Design Series (MDS). C-17 aircraft missions were selected per the scope of this research project.

All missions entered into Mobility Air Force (MAF) C2 require differentiation for mission management. Each mission is assigned a unique mission number that is twelve characters in length. The first character position will have a "D" to indicate an ANG mission The third character position will indicate a "B,C,E,J,Q,R,U,W,Y,Z" if it is a channel mission. To further narrow down the missions, the second character of a channel mission indicates a "J" if the aircraft is positioning to its first on-load. The second character of a channel mission indicates a "V" if the aircraft is de-positioning from an offload to home station or another mission. An "M" in the third character position identifies a SAAM. A "G" in the third character position identifies a Joint Airborne/Air Transportability Training (JA/ATT) mission. An "X" in the third character indicates a CJCS approved exercise mission (AMC/A3CF 2017). The researcher filtered out the mission numbers that had a second character of "J" or "V," highlighting the C-17 missions that were positioning or de-positioning.

Table 1: MAF ENCODE/DECODE Table

Second Character		Third Character	
B	Channel Cargo	A	Not Assigned
J	Positioning to first onload	B	Distribution Channel, Atlantic Region
K	Channel PAX	C	Distribution Channel, Pacific Region
L	Aeromedical Evacuation (AE)	P	Not Assigned
Q	Channel Mixed (PAX and cargo)	E/Q	CPX Channel missions as assigned by AMC/A3Y
V	Depositioning from offload to new mission or home station	J/R/U W/Y/Z	Channel missions supporting Contingency Operations. Coordinate ID with 618 AOC/XOP

Joint Publication 3-17 describes the 8 different types of airlift missions that the C-17 supports. Aeromedical Evacuation (AE) missions support the movement of patients with qualified aeromedical crew members. Channel missions are regularly scheduled missions over fixed routes with known cargo/passenger capacities that are available to all customers. SAAMs are airlift missions that are bought by a user to satisfy their validated requirements. SAAMs support DoD users as well as other government agencies. Contingency missions operate in direct support of an operation order. Air Refueling (AR) missions provide in-flight refueling to users. Chairman of the Joint Chiefs of Staff (CJCS) exercise missions operate in support of a CJCS-directed exercise. Training missions are flown for crew currency and proficiency. JAATT missions are Joint Airborne/ Air Transportability Training. And last, Intra-theater common-user airlift missions are flown by theater airlift aircraft to support common-user theater movement requirements. (JP 3-17, 2013) GDSS breaks these missions down as AIREVAC, CHANNEL, CONTING, EXERCISE, GUARDLIFT, JAATT, SAAM, SUPPORT, and TRAINING. The problem statement seeks to identify operational cost inefficiencies from flying the C-17 empty. In order to filter out missions that may be considered an operational necessity, the researcher chose to keep only the missions that were categorized as Channel and Contingency.

GDSS has another mission column that differentiates who the Operating Component of that mission is, with choices of Guard, Reserve, and Regular. Since AMC controls the Regular (active duty) missions, only missions that applied to the Regular Operating Component were utilized.

The C-17 is operated out of 16 bases. The International Civil Aviation Organization (ICAO) designated codes are KSUU, KDOV, KTCM, KCHS, KWRI, PAED, PHIK, KJAN, KSWF, KMEM, KMRB, KCLT, KRIV, KFFO, KEDW, KLTS.

The C-17 is operated by Air Mobility Command from Travis AFB, California (KSUU); Dover AFB, Delaware (KDOV); Joint Base Lewis-McChord, Washington (KTCM); Joint Base

Charleston, South Carolina (KCHS); and Joint Base McGuire-Dix-Lakehurst, New Jersey (KWRI). Pacific Air Forces operates C-17s from Joint Base Elmendorf-Richardson, Alaska (PAED), and Joint Base Pearl Harbor-Hickam, Hawaii (PHIK). The Air National Guard operates C-17s from Jackson, Mississippi (KJAN); Stewart ANG Base, New York (KSWF); Memphis, Tennessee (KMEM); Martinsburg, West Virginia (KMRB); and Charlotte, North Carolina (KCLT). The Air Force Reserve Command operates C-17s at March Air Reserve Base, California (KRIV), and Wright Patterson AFB, Ohio (KFFO). Air Force Materiel Command has one C-17 on loan from Joint Base Charleston, South Carolina to conduct tests at Edwards AFB, California (KEDW). Air Education and Training Command performs C-17 aircrew training from Altus AFB, Oklahoma (KLTS). (www.amc.af.mil, 2018)

Table 2 contains a brief snapshot of the thousands of C-17 GDSS mission lines from FY17-18 the researcher had to filter for the specific data for this project. The filtering process and selection/consideration of each mission adds to the accuracy of the data collected. It is important to understand the magnitude of the data review and filtering process conducted in this research with the goal of eliminating potential bias in the data collection and final results. Every single C-17 mission for 2 years was analyzed and either determined to be included in the data set or discarded for unique mission specific requirements.

Table 2: Snapshot of FY17-18 GDSS C-17 Mission Data (Source: Author)

Mission ID	Mission Cl	Aircraft M	Tail Numb	Operating	Operating	Mission Pr	Departure	Departure	Departure	Actual Flyi	Passenger	Total Ston	Arrival ICA
PJZF102QI	CONTING	C017A	66157A	60AMW	REGULAR	1A3	KSUU	38.26333	NORTHCO	10.75			EGUN
AJZF113A\	CONTING	C017A	77180A	437AW	REGULAR	1B1	KCHS	32.89834	NORTHCO	0.6			KJAX
PJRA1134I	CONTING	C017A	10187A	62AW	REGULAR	1B1	KTCM	47.13833	NORTHCO	0.15			KGRF
PJRA1135I	CONTING	C017A	60001A	62AW	REGULAR	1B1	KTCM	47.13833	NORTHCO	0.183333			KGRF
PJRA1136I	CONTING	C017A	00184A	62AW	REGULAR	1B1	KTCM	47.13833	NORTHCO	0.2			KGRF
AJWA1145	CONTING	C017A	77186A	437AW	REGULAR	1B1	KCHS	32.89834	NORTHCO	0.833333			KLSF
AJWA1146	CONTING	C017A	00215A	437AW	REGULAR	1B1	KCHS	32.89834	NORTHCO	0.85			KLSF
PJWA1147	CONTING	C017A	66162A	60AMW	REGULAR	1B1	KSUU	38.26333	NORTHCO	4.2			KLSF
PJRA1140I	CONTING	C017A	33127A	62AW	REGULAR	1B1	KTCM	47.13833	NORTHCO	3.033333			KLAW

City Pair Program

The GSA City Pair Program dates back to 2001. It is a quid pro quo program that enacts contract fares for airline tickets on commercial carriers. The airlines contract reasonably cheap fares to the government in exchange for the government flying the majority of their flights on that airline, providing the airline with a steady income from traveling federal employees. Federal travelers must use the contract carrier unless an exception applies. The fares are locked in for the entire fiscal year to facilitate travel budgeting. It allows the flexibility of government employees to book one-way fares with no advance purchase, and have fully refundable tickets with no blackout dates. There are several fares detailed in the contract. The YCA fare is an unrestricted guaranteed coach class fare. The XCA fare is a lower cost, coach class capacity-controlled fare that is only restricted by the availability of seats. For the purpose of this GRP the researcher utilized the more expensive YCA fare to compare costs, as it is not known if the XCA fare would have been available upon the booking date. (https://www.gsa.gov/travel/plan-book/transportation-airfare-rates-pov-rates/city-pair-program-cpp, 2018)

Summary

The methodology stated above will help in the data analysis portion of this research. It focuses the analysis to help extract the meaningful information from the quantitative data.

IV. Analysis and Results

Chapter Overview

The first section in this chapter uses the literature review and transaction cost economic theory to outline the baseline format of this Graduate Research Paper. The literature mentioned above laid the groundwork for the researcher to draw out the current AMC aircraft/aircrew mission tasking process, funding sources, funding allocation, and general fleet management. Following the analyzation of all FY17/FY18 mission in GDSS the researcher was able to compare the associated costs of the current construct versus a centrally managed process. The selection of missions out of the thousands of total C-17 missions during FY17/FY18 was arduous. If there was a mission that seemed to necessitate a leg that required an empty pre-po/depo leg it was eliminated as part of the data set. The processes/results of the data analysis are listed below.

Application of Transaction Cost Economics Theory

This theory proposes that a decision involving organizational efficiency can be modeled using a cost/benefit analysis of the cost to utilize inner organizational means compared to outer organizational resources. The researcher analyzed the data by excluding mission legs that had uncertainty, including non-availability of capable commercial airline transportation or commercial travel within reasonable timelines. Further application of TCE theory was used by focusing on the frequency of how often the C-17's flew empty and the specificity of which legs were most commonly flown empty. (Ketokivi 2017)

Determining Applicable Missions

Once the filtered GDSS data showed only C-17 missions that were pre-positioning or de-positioning on Channel or Contingency flights, to or from a C-17 base, the researcher had to determine if there were any other missions that would not apply to the problem statement. 22 individual missions were removed from the data set because they were mission legs where the aircraft returned to the base of departure without landing at a different airfield. These missions were deleted from the final data set since it was not apparent what the specific mission purpose was that the aircrew were intending to fly. Additionally, the researcher deleted missions in FY17 and FY18 that were from Luis Muñoz Marín International Airport (TJSJ), José Aponte de la Torre Airport (TJRV), Rafael Hernández Airport (TJBQ) and Mercedita Airport (TJPS), which were all airports located in Puerto Rico. It is assumed that the influx of C-17s returning empty from Puerto Rico were in direct support of humanitarian relief missions following the destruction of Hurricane Maria. There were several other locations that were not easily serviceable by contract commercial carriers subsequently eliminating those locations from being included in the final data set as well. These missions included Wake Island (PWAK), Daegu (RKTN), Gander (CYQX), A.N.R. Robinson (TTCP), Guantanamo Bay (MUGM), Soto Cano (MHSC), Capitán FAP Renán Elías Olivera (SPSO), Goose Bay (CYYR), Amílcar Cabral (GVAC), Gangneung Airbase (RKNN), and Eareckson Air Station (PASY).

Data Analysis – Frequency

The GDSS filtering of all the C-17 missions for FY17/FY18 to display missions flown empty resulted in 2709 missions. The fiscal year breakdown consisted of 1754 missions in FY17 and 955 missions in FY18. Of those missions, they were further categorized into Channel and Contingency missions. The results of the mission analysis are provided below.

Tables 3 and 4 show the number of contingency missions in FY17 and FY18 that were flown empty to or from crew bases. The researcher compared that number to the total number of active duty C-17 contingency missions flown during that year to find a percentage of how many of the total contingency missions were therefore being flown empty to/from aircrew bases.

Table 3: FY17 Contingency Missions (Source: Author)

Empty Contingency	Total Contingency	% Empty
1,402 missions	12,807 missions	11 %

Table 4: FY18 Contingency Missions (Source: Author)

Empty Contingency	Total Contingency	% Empty
782 missions	9805 missions	8 %

Tables 5 and 6 show the number of channel missions in FY17 and FY18 that were flown empty to or from crew bases. The researcher compared that number to the total number of active duty C-17 channel missions flown during that year to find a percentage of how many of the total channel missions were therefore being flown empty to/from aircrew bases.

Table 5: FY17 Channel Missions (Source: Author)

Empty Channel	Total Channel	% Empty
352 missions	1354 missions	26 %

Table 6: FY18 Channel Missions (Source: Author)

Empty Channel	Total Channel	% Empty
173 missions	809 missions	21 %

In order to calculate the cost of the empty legs, the average flight time was taken for each leg then multiplied by the AMC C-17 variable cost per flying hour for that FY. This was labeled "Cost to operate C-17 empty per route." To get the FY total operating empty cost, each route was multiplied by the number of times a specific route was flown. The subsequent FY total is labeled "Total FY Cost to operate C-17 empty." The alternative cost for air lining the aircrew was taken by first determining if it was an inbound or outbound leg from the aircrew base. If it was a pre-positioning (outbound leg) the shuttle cost is from the aircrew base to the most appropriate commercial airport. Then the airline cost to the first on-load location commercial airport is multiplied by the 5 crewmembers and added to the initial shuttle cost. Finally the shuttle cost from the arrived commercial airport to the on-load location is added to the total. If it was a de-positioning leg the reverse calculations are accomplished to reach an air lining cost for that route. The total is labeled "Air lining Cost per Route." The FY total for air lining the aircrew is labeled "Total FY Cost to Airline Aircrew." To summarize the results, reference tables 8 and 9.

To quantify the total airframe hours flown empty for each fiscal year, the average flight time was calculated for each route flown empty. That average flight time was then multiplied by how many times the route was flown empty and subsequently added to all of the other empty route totals. The total airframe hours flown empty for each fiscal year in Table 7 is just the channel and contingency missions that operate to and from aircrew home bases. These empty airframe hours emphasize the unnecessary wear and tear that is accrued flying missions back to home bases.

Table 7: Airframe Hours Flying Empty (Source: Author)

FY 17	FY 18
6675 hours	4035 hours

Table 8: FY17 Cost Analysis (Source: Author)

Total FY Cost to operate C-17 empty	Total FY Cost to Airline Aircrew
$80 million	$4 million

Table 9: FY18 Cost Analysis (Source: Author)

Total FY Cost to operate C-17 empty	Total FY Cost to Airline Aircrew
$52 million	$2.3 million

Data Analysis - Specificity

In the course of data analysis there were certain routes that jumped out as being repeat offenders of flying empty in both directions. Some of the most common roundtrip empty routes were Dover AFB to Joint Base Lewis McChord, and Joint Base Lewis McChord back to Dover AFB; Joint Base McGuire-Dix-Lakehurst to Joint Base Lewis McChord, and Joint Base Lewis McChord back to Joint Base McGuire-Dix-Lakehurst; and finally Travis AFB to Joint Base Pearl Harbor-Hickam, and Joint Base Pearl Harbor-Hickam back to Travis AFB. These routes specifically accounted for approximately 300 of the flights that were flown empty, totaling 1600 airframe hours.

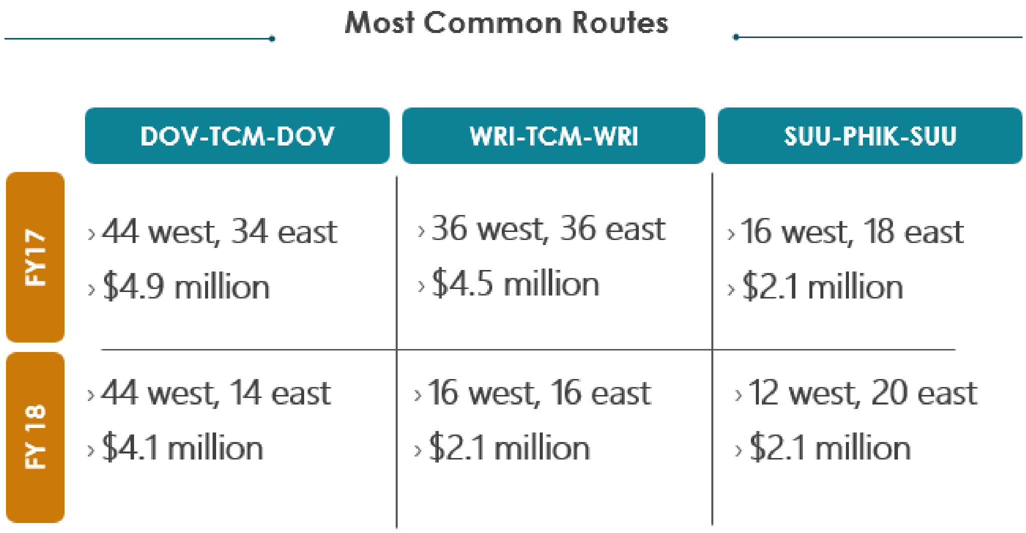

Figure 1: Common Routes Flown Empty (Source: Author)

There are many routes that were only flown empty once or twice over the year. It may be harder to justify re-coordinating the aircrew to fly commercially from locations that are slightly obscure or don't have a large airline equivalent to be able to fly commercially. Just by comparison, this route list shows the largest disparities between operating the C-17 for that route versus utilizing commercial travel. This chart is designed to give AMC mission planners and leadership specific routes to target as the most cost effective routes to use this alternate aircrew commercial travel option.

Table 10: Route Cost Comparison (Source: Author)

Route	Cost to Fly Leg Empty	Cost to use Commerical Travel	Total Cost Difference	# of Times Flown FY17-18
ETAR - KSUU	$ 152,221	$ 3,485	$ 148,736	9
ETAD - KSUU	$ 145,050	$ 3,985	$ 141,065	5
LERT - KTCM	$ 144,175	$ 6,705	$ 137,470	9
ETAD - KTCM	$ 134,706	$ 3,510	$ 131,196	6
ETAR - KTCM	$ 133,423	$ 3,010	$ 130,413	18
PHIK - RODN	$ 124,204	$ 6,835	$ 117,369	27
ETAD - KCHS	$ 119,565	$ 3,575	$ 115,990	12
LERT - KCHS	$ 109,298	$ 5,490	$ 103,808	20
PAED - KCHS	$ 84,102	$ 2,565	$ 81,537	16
KWRI - KTCM	$ 56,691	$ 1,875	$ 54,816	104
KDOV - KTCM	$ 57,049	$ 2,090	$ 54,959	136

V. Conclusions

Overarching Research Question and Summary of Research Conclusions

The purpose of this research effort was to attempt to quantify the cost of scheduling aircrew with base-assigned aircraft compared to an independent scheduling of aircrew to aircraft that are not necessarily assigned to their specific base. A goal of this research was to potentially offer a more effective, efficient, and cost reducing COA for AMC. Currently the C-17 has not adopted an aircraft management approach independent of its' assigned base and aircrew comparable to commercial counterparts. The researcher presented data from FY17-18 displaying how the current process has been causing significant cost inefficiencies to AMC.

Recommendations

A higher emphasis on the ability to airline crews instead of flying empty will cut down on the number of missions that will need to be flown. Additionally increased visibility of missions that are flying empty will enable the planners to notice missions that are close in timeframe that could be consolidated or eliminated. A simple fix as highlighting the pre-po/depo legs a different color in GDSS will emphasis these missions. The current AF construct requires tails to return home to their bases, therefore the tail go-home date in GDSS determined by the owning wing will presently still be used. But planners can have the option to have the tail out in the system being utilized by aircrew from various bases before it is required to be back at its home base for scheduled maintenance.

Takeaway: Focus on commercially air lining KTCM aircrew home as a priority. KDOV (36 parking spots) and KWRI (37 parking spots) can park a maximum of 73 C-17s so as MOG and specific mission requirements dictate the emphasis should be on sending these crews home commercially. This has the capability to save AMC $13.2M a year. KTCM averaged 1 roundtrip a week for 2 straight years flying empty to and from both KWRI and KDOV. If AMC can give guidance to commercially send these crews home to the max extent possible it can save millions of dollars, and potentially extend the service life of the C-17. Commercially transporting 2 aircrews per week from these 2 locations would potentially eliminate the entire number of empty flights for those city pairs.

Additionally, there were 44 flights between KDOV and KWRI flown empty during FY17 and 14 flights in FY18. This equated to $285,000 for the 25 minute flight. The researcher recommends utilizing freight, truck, and rail transport for these mission legs to the max extent possible further increasing the cost savings for AMC. For these legs, contract ground transportation could be utilized as required for the aircrews to be transported between the bases at a cost of $355 per leg, totaling $20,500 over the two years.

This new aircrew/aircraft centrally managed construct would require a major culture shift for AMC. The current way of managing aircraft and aircrew would have to be changed and with change there is usually resistance. However, with this research it has been presented how simply attempting to commercially transport aircrew to and from their home base installation as opposed to having them operate an empty C-17 can enable AMC to save millions of dollars that they could possibly use for additional flight training or required product acquisition.

Offering a COA designed to restructure the entire way AMC, 18 AF, and TACC task and allocate C-17 aircraft would also require reworking the current CAAP process. For example, in February of 2019 Joint Base Lewis-McChord averaged between 7-10 TACC tasked missions based on the current CAAP allocation process. This does not take into account any form of optimization or under/over-utilization of aircraft. The suggestions of the researcher focus solely on maximizing aircraft efficiency and not continuing to operate empty C-17s. It is inherent that each C-17 base would continue to participate at some level for all channel/contingency missions, the researcher simply suggests that each base would have differing numbers of aircrew and aircraft able to be tasked independently. This would allow aircrew members when possible/available to commercially fly to where the C-17 current resides to pick-up the aircraft and begin/continue the assigned mission from that enroute location. Under this adaptation of the current CAAP process each base would still get an assigned number of aircrews to have readily available, and often times they would utilize and fly their own bases' C-17 permitting the tasked mission originates with some cargo and doesn't operate empty. This would only require a minor change to the current CAAP process. For example, there would therefore be times that a Travis AFB aircrew flies commercially to Dover or McGuire AFBs to pick up an empty C-17 and operate that tail until it returns to its final tasked destination. At this point that Travis aircrew would then commercially fly back to Travis. The data supplied above would support the massive cost savings and wear/tear on the C-17s for this required change initiative. See Appendices C/D for the current 2019 CAAP data supplied by AMC/A3O for detailed CAAP tasking assignments by date/base. (AMC/A3O, 2019)

This change won't be made overnight, but if AMC can attempt to even commercially fly aircrew 1 out of every 4 flights this will save millions of dollars and have a massive impact on our already fiscally constrained Air Force. There are inherent difficulties (logistical, political, environmental, etc.) with changing current aircraft geographic allocations by base. It will be easy to continue on the path of least resistance, however, this research has presented evidence of a potential AMC cost savings of roughly 63 Million dollars/year by utilizing commercial travel to the max extent possible and creatively managing aircrew and aircraft de/pre-positioning. There will always be certain missions where the threat level, risk factors, security concerns, or unique mission details dictate a C-17 operates empty. However, if AMC can create guidance encouraging the usage of the new model presented in this research, C-17s will have longer service lives, and AMC will have millions of extra dollars to allocate as they see fit.

The effectiveness of commercially transporting aircrews versus having them operate empty C-17s has been proven in the past. The 2009 East Coast Mission Link (ECML) 6-month trial test staging 2 x C-17s (KTCM aircraft) / 1 x C-5s (Travis aircraft) at Dover designed to “de-couple” aircrew and aircraft scheduling produced a $20M cost savings for AMC. This 6-month trial further emphasizes the effectiveness of the researcher’s suggestions to “de-couple” the entire C-17 aircrew/aircraft fleet with the goal of optimization and cost effectiveness. Following the ECML trial, AMC chose to continue their current process for C-17 operations despite the proven cost savings. It will never be known how much money AMC could have potentially saved in the last 10 years since the ECML trial had they adopted the de-coupled process. (Gilmer, 2009)

Future Research Considerations

This research does not take into account the affect that air lining crews instead of operating the airplane would have on aircrew training requirements. Even though these missions are not coded as training missions there are still currency items that are accrued during these operational missions. There is a possibility that the home base would have an uptick of training sorties to account for these subsequently missing operational events.

Ideally, if aircraft tails are not required to make it back to their assigned home base they would fly routes solely on missions' requirements and could flex to other bases and airports around the system as needed for their maintenance requirements. These aircrew members would be able to fly the missions as dictated from the mission requirements, and may or may not fly that particular tail back to their home base. If the tails came back to base it would be due to maintenance requirements, not because a plane needed to return to home base to become "mission complete." Most cargo and passenger airlines have a construct where they pre-determine when planes need to make it back to a base for maintenance requirements, but in the meantime they deadhead crewmembers to the airplane location to keep the airplanes routes optimized. Atlas Air in particular uses a system called KRONOS that is an optimization forecasting software program. It enables pre-set data including when a plane is due for maintenance and where available aircrew are stationed. It calculates for the upcoming months what routes each tail should fly and what crews will operate which legs, in addition to what locations the aircrew will swap out to either fly a different tail home or deadhead home.

A future consideration would be to run tests of an optimization software program (like KRONOS) against previous years of data to determine how many empty legs would have been flown if that program was used. Then to test in conjunction with upcoming flying to determine how tails would be moved throughout the system. By comparing a KRONOS run schedule to a current AMC schedule it would highlight deficiencies in both programs and help narrow down if there could be baseline data updates into KRONOS to make it more realistic and fit the needs of AMC. An optimization program could potentially help AMC entirely overhaul their current operations by adopting a more modern process of routing planes and aircrew more efficiently.

Another future research recommendation would be a more thorough CBA on all of the C-17 missions as well as the entire AMC enterprise. The research presented in this CBA only examined C-17 flights pre-positioning or de-positioning from aircrew bases. However, there are flights throughout the year when C-17s fly empty legs around the world enroute to somewhere else to pick up the cargo. By extending the CBA out to all C-17 empty legs there may be a more noticeable example of the impact that changing the tail allocation structure would afford AMC. Also, since this CBA research was just comprised of C-17 aircraft and showed a cost differential of about $76 million for FY17 and $49 million for FY18, it would be interesting to acquire the cost differential of an analysis including AMC's other cargo aircraft. Since other cargo aircraft have the same requirement of returning tails to bases, it would be beneficial to analyze other aircraft such as the C-5 and C-130 and determine if it is just the C-17 that has a substantial amount of pre-po/depo legs or if it applies to the whole AMC enterprise.

The long term goal is not to airline crewmembers as abundantly as this CBA portrays. This schedule is purely looking at the current construct which does not seem to optimize routes, rather it focuses on getting planes back to their home bases. Pre-planning and optimization software would hopefully significantly decrease the amount of legs that would even require crews to airline. Additionally, the researcher calculated every leg as if the crewmembers would airline home, not taking into account that there may have been other aircraft (ie: KC-135, KC-10, C-5 that may have been flying those routes and had the opportunity to take those crewmembers on their planes as Mission Essential Personnel (MEP).

Appendix A

Military GDSS Airports and Equivalent Commercial Airports

GDSS	Commercial Airport	GDSS	Commercial Airport	GDSS	Commercial Airport	GDSS	Commercial Airport
AYPY	POM	KFOE	MCI	KMUO	BOI	KTUS	TUS
BIKF	REK	KFOK	JFK	KNBC	CHS	KVAD	VLD
EDDK	CGN	KFSD	FSD	KNBG	MSY	KVBG	SBA
EDDN	NUE	KFTK	SDF	KNEL	PHL	KVPS	VPS
EDDS	STR	KFWA	FWA	KNFW	DFW	KVQQ	JAX
EGPK	GLA	KGNF	GTR	KNGP	CRP	KWRB	ATL
EGUL	LON	KGPT	GPT	KNGU	ORF	KWRI	PHL
EGUN	LON	KGRB	SYR	KNHK	DCA	LEMO	SVQ
EGVA	LON	KGRF	SEA	KNIP	JAX	LERT	XRY
ENVA	TRD	KGRK	AUS	KNKT	ILM	LFOE	PAR
ETAD	FRA	KGTB	ART	KNKT	EWN	LHBP	BUD
ETAR	FRA	KHIF	SLC	KNKX	SAN	LICZ	CTA
GCLP	LPA	KHMN	ELP	KNQX	EYW	LPLA	TER
KADW	DCA	KHOP	BNA	KNTD	BUR	LTAG	ADA
KAEX	AEX	KHRT	VPS	KNTU	ORF	MGGT	GUA
KAGS	AGS	KHSA	GPT	KNUQ	SJC	MPTO	PTY
KAMA	AMA	KHST	MIA	KNUW	SEA	MSSS	SAL
KBAD	SHV	KHUA	HSV	KNYG	DCA	NSTU	PPG
KBAF	BOS	KIAB	ICT	KNZY	SAN	PAED	ANC
KBAK	IND	KIAG	BUF	KOFF	OMA	PAEI	FAI
KBGR	BGR	KIAH	IAH	KPAM	PTY	PANC	ANC
KBHM	BHM	KINS	LAS	KPDX	PDX	PGUA	GUM
KBIF	ELP	KIXD	MCI	KPOB	FAY	PHIK	HNL
KBIX	GPT	KJAX	JAX	KPSM	MHT	PHNG	HNL
KBKF	DEN	KLAW	LAW	KRIC	RIC	PHNL	HNL
KBLV	STL	KLFI	ORF	KRIV	ONT	PHTO	ITO
KBTV	BTV	KLNK	LNK	KROC	ROC	RJTA	TYO
KCAK	CAK	KLRF	LIT	KSAN	SAN	RJTY	TYO
KCEF	BOS	KLSF	CSG	KSDF	SDF	RKJK	SEL
KCHS	KCHS	KLSF	ATL	KSGF	SGF	RKSM	SEL
KCOF	MLB	KLSV	LAS	KSKA	GEG	RKSO	ICN
KCOF	MCO	KLTS	OKC	KSKF	SAT	RODN	OKA
KCOS	COS	KMCF	TPA	KSLN	MHK	RPLC	MNL
KCVG	CVG	KMDT	HAR	KSSC	CAE	SAEZ	EZE/BUE
KCVS	LBB	KMFE	MFE	KSUU	SMF	SBBR	BSB
KDLH	DLH	KMGE	ATL	KSVM	SVM	SBEG	MAO
KDMA	TUS	KMGM	MGM	KSVN	SAV	SEQM	UIO
KDOV	PHL	KMHK	MHK	KSWF	LGA	SKBO	BOG
KDYS	ABI	KMIB	MOT	KSYR	SYR	SKCG	CTG
KEGI	VPS	KMMT	CAE	KSZL	MCI	SPJC	LIM
KELP	ELP	KMRB	DCA	KTCM	SEA	TIST	STT
KEOD	BNA	KMSN	MSN	KTIK	KOKC	TISX	STX
KFFO	DAY	KMTH	EYW	KTOL	DTW	YBCS	CNS
KFHU	TUS	KMTN	BWI	KTUL	TUL	YSRI	SYD

Appendix B

Taxi and Shuttle Cost by Airfield

GDSS	Commercial Airport	Shuttle Service (Empty = Taxi Used)	Taxi cost (Dollars) x Number of Required Taxis
AYPY	POM		10 x 2
BIKF	REK		90 x 2
EDDK	CGN		10 x 2
EDDN	NUE		10 x 2
EDDS	STR		10 x 2
EGPK	GLA		10 x 2
EGUL	LON		300 x 2
EGUN	LON		300 x 2
EGVA	LON		225 x 2
ENVA	TRD		10 x 2
ETAD	FRA		300 x 2
ETAR	FRA	Alex Shuttle	100 total to ramstein
GCLP	LPA		10 x 2
KADW	DCA		55 x 2
KAEX	AEX		10 x 2
KAGS	AGS		10 x 2
KAMA	AMA		10 x 2
KBAD	SHV		40 x 2
KBAF	BOS		260 x 2
KBAK	IND		150 x 2
KBGR	BGR		10 x 2
KBHM	BHM		10 x 2
KBIF	KELP		12 x 2
KBIX	GPT		42 x 2
KBKF	DEN		40 x 2
KBLV	STL		100 x 2
KBTV	BTV		10 x 2
KCAK	CAK		10 x 2
KCEF	BOS		255 x 2
KCHS	KCHS		15 x 2
KCOF	MLB		40 x 2
KCOF	MCO		140 x 2
KCOS	KCOS		10 x 2
KCVG	CVG		10 x 2
KCVS	LBB		310 x 2
KDLH	DLH		10 x2
KDMA	TUS		35 x 2
KDOV	PHL	Andy's	80 per person
KDOV		George's Transpo	
KDOV Notes:		$325 to ACY, $495 to KNGU	
KDOV	DCA		300 x 2
KDYS	ABI		50 x 2
KEGI	VPS		10 x 2
KELP	ELP		10 x 2
KEOD	BNA		160 x 2

KFFO	KDAY		60 x 2
KFHU	TUS		195 x 2
KFOE	MCI		200 x 2
KFOK	JFK		195 x 2
KFSD	FSD		10 x 2
KFTK	SDF		100 x 2
KFWA	FWA		10 x 2
KGNF	GTR		265 x 2
KGPT	GPT		10 x 2
KGRB	SYR		200 x 2
KGRF	SEA	Kitsap Aeroporter	20 per person
KGRF Notes:		$14 cab from KGRF to JBLM	
KGRK	AUS		210 x 2
KGTB	ART		65 x 2
KHIF	SLC		90 x 2
KHMN	ELP		245 x 2
KHOP	BNA		200 x 2
KHRT	VPS		50 x 2
KHSA	GPT		75 x 2
KHST	MIA		90 x 2
KHUA	HSV		35 x 2
KIAB	ICT		50 x 2
KIAD			
KIAD Notes:		drive to dov $300 x 2	
KIAG	BUF		80 x 2
KIAH	IAH		10 x 2
KINS	LAS		125 x 2
KIXD	MCI		110 x 2
KJAX	JAX		10 x 2
KLAW	LAW		10 x 2
KLAW Notes:		OKC for SEA $200 x 2	
KLFI	ORF		50 x 2
KLNK	LNK		10 x 2
KLRF	LIT		60 x 2
KLSF	CSG		40 x 2
KLSF	ATL		260 x 2
KLSV	LAS		50 x 2
KLTS	OKC		310 x 2
KLTS Notes:		DOV, SUU LAW 135 x 2	
KMCF	TPA		40 x 2
KMDT	HAR		10 x 2
KMFE	MFE		10 x 2
KMGE	ATL		85 x 2
KMGM	MGM		10 x 2
KMHK	MHK		10 x 2
KMIB	MOT		45 x 2
KMMT	CAE		70 x 2

KMMT Notes:		drive to CHS 275 x 2	
KMRB	DCA		225 x 2
KMSN	MSN		10 x 2
KMTH	EYW		140 x 2
KMTN	BWI		60 x 2
KMUO	BOI		140 x 2
KNBC	CHS		200 x 2
KNBG	MSY		65 x 2
KNEL	PHL		
KNFW	DFW		90 x 2
KNGP	CRP		60 x 2
KNGU	ORF	James River	15 per person
KNHK	DCA		185 x 2
KNIP	JAX		75 x 2
KNKT	ILM		230 x 2
KNKT	EWN		45 x 2
KNKT Notes:		Car Rental 5.5 hours x 2 to KCHS, EWR For KWRI	
KNKX	SAN		40 x 2
KNQX	EYW		10 x 2
KNTD	BUR		150 x 2
KNTU	ORF		50 x 2
KNUQ	SJC		40 x 2
KNUQ Notes:		drive to KSUU 240 x 2	
KNUW	SEA		285 x 2
KNUW Notes:		drive to TCM 360 x 2	
KNYG	DCA		100 x 2
KNZY	SAN		30 x 2
KNZY Notes:		215 cab x 2 to kriv	
KOFF	OMA		45 x 2
KPAM	PTY		95 x 2
KPDX	PDX		
KPDX Notes:		drive to JBLM 360 x 2	
KPOB	FAY		40 x 2
KPSM	MHT		130 x 2
KRIC	RIC		10 x 2
KRIV	ONT		85 x 2
KROC	ROC		10 x 2
KSAN	SAN		10 x 2
KSDF	SDF		10 x 2
KSGF	SGF		10 x 2
KSKA	GEG		35 x 2
KSKF	SAT		45 x 2
KSLN	MHK		185 x 2
KSSC	CAE		105 x 2
KSSC Notes:		$240 cab to CHS x 2	
KSUU	SMF	Aloha Airporter	40 per person
KSUU Notes:		$50 per person SFO to PGUA, BGR, EWN,ETAR	

KSVM	SVM		10 x 2
KSVN	SAV		35 x 2
KSVN Notes:		Car rental 1.5 hours to KCHS or 270 cab x 2	
KSWF	LGA		200 x 2
KSWF Notes:		JFK to KCHS 250 x 2	
KSYR	SYR		10 x 2
KSZL	MCI		260 x 2
KTCM	SEA	Kitsap Aeroporter	20 per person
KTIK	KOKC		45 x 2
KTOL	DTW		150 x 2
KTUL	TUL		10 x 2
KTUS	TUS		10 x 2
KVAD	VLD		38 X 2
KVBG	SBA		170 x2
KVPS	VPS		10 x 2
KVQQ	JAX		88 x 2
KWRB	ATL		225 x 2
KWRI	PHL	Rapid Rover	37 per person to PHL
KWRI Notes:		$255 to EWR	
LEMO	SVQ		125 x 2
LERT	XRY		50 x 2
LFOE	PAR		205 x 2
LHBP	BUD		10 x 2
LICZ	CTA		30 x 2
LPLA	TER		10 x 2
LTAG	ADA		40 x 2
MGGT	GUA		10 x 2
MPTO	PTY		10 x 2
MSSS	SAL		90 x 2
NSTU	PPG		10 x 2
PAED	ANC		70 x 2
PAEI	FAI		100 x 2
PANC	ANC		10 x 2
PGUA	GUM		10 x 2
PHIK	HNL		10 x 2
PHNG	HNL		85 x 2
PHNL	HNL		10 x 2
PHTO	ITO		10 x 2
RJTA	TYO		100 x 2
RJTY	TYO		125 x 2
RKJK	SEL		345 x 2
RKSM	SEL		135 x 2
RKSO	ICN		165 x 2
RODN	OKA		85 x 2
RPLC	MNL		190 x 2
SAEZ	EZE/BUE		10 x 2
SBBR	BSB		10x 2

SBEG	MAO	10 x 2
SEQM	UIO	10 x 2
SKBO	BOG	10 x 2
SKCG	CTG	10 x 2
SPJC	LIM	10 x 2
TIST	STT	10 x 2
TISX	STX	10 x 2
YBCS	CNS	10 x2
YSRI	SYD	130 x 2

Appendix C

February 2019 C-17 CAAP Tasking

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C-17 Outlook
February Possessed Tail/AMR

			1-Feb-19	2-Feb-19	3-Feb-19	4-Feb-19	5-Feb-19	6-Feb-19	7-Feb-19	8-Feb-19	9-Feb-19	10-Feb-19	11-Feb-19	12-Feb-19	13-Feb-19	14-Feb-19	15-Feb-19	16-Feb-19	17-Feb-19	18-Feb-19	19-Feb-19	20-Feb-19	21-Feb-19	22-Feb-19	23-Feb-19	24-Feb-19	25-Feb-19	26-Feb-19	27-Feb-19	28-Feb-19
Charleston 437 AW	Possessed	C-17	32	31	31	31	31	31	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32
	AMR		4	5	5	5	5	5	4	4	5	6	7	7	7	7	6	5	5	6	6	6	6	6	5	6	5	5	5	5
McChord 62 AW	Possessed	C-17	32	32	32	32	32	32	32	33	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34
	AMR		5	6	6	7	7	7	7	6	5	6	7	7	7	7	6	5	6	6	6	6	6	6	5	5	5	5	5	5
McGuire 305th	Possessed	C-17	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
	AMR		2	1	1	2	2	2	2	2	1	1	2	2	2	2	2	1	1	1	1	1	1	2	1	1	2	2	2	2
Travis 60 AMW	Possessed	C-17	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
	AMR		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Dover 436 AW	Possessed	C-17	12	12	12	12	12	12	12	12	11	11	11	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
	AMR		1	2	2	2	2	2	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2

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Appendix D

Example of Individual Base-Specific Detailed C-17 Allocation Information

(McChord AFB February 2019)

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McChord C-17 February

62 AW

		1-Feb-19	2-Feb-19	3-Feb-19	4-Feb-19	5-Feb-19	6-Feb-19	7-Feb-19	8-Feb-19	9-Feb-19	10-Feb-19	11-Feb-19	12-Feb-19	13-Feb-19	14-Feb-19
Crews	Line Assigned Crews (AAMS)	60	60	60	60	60	60	60	60	60	60	60	60	60	60
Crews	Crews Committed to HHQ Tasking	21	21	21	22	20	22	22	22	22	22	20	20	20	22
Crews – CCDR	CCDR Allocation (Crews)	18	18	18	18	18	18	18	18	19	19	19	19	19	19
Crews – CCDR	Deployed	8	8	8	8	8	8	8	8	8	8	8	8	8	8
Crews – CCDR	Long Range Schedule (CCDR)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Crews – CCDR	TACC Mission (Manual Entry)	10	10	10	10	10	10	10	10	11	11	11	11	11	11
Crews – MAJCOM	OT&E Allocation (Crews)	42	42	42	42	42	42	42	42	41	41	41	41	41	41
Crews – MAJCOM	MAJCOM Crew Allocation	3	3	3	4	2	4	4	4	3	3	1	1	1	3
Crews – MAJCOM	MAJCOM Mission	3	3	3	4	2	4	4	4	3	3	1	1	1	3
Crews – MAJCOM	Untasked MAJCOM (Crews)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Crews – UNIT	UNIT Allocation (Crews)	39	39	39	38	40	38	38	38	38	38	40	40	40	38
Crews – UNIT	UNIT Admin Overhead: Crews	23	23	23	23	23	23	23	23	23	23	23	23	23	23
Crews – UNIT	Training Overhead: (Crews)	15	15	15	15	15	15	15	15	15	15	15	15	15	15
Crews – UNIT	UNIT Available	1	1	1	0	2	0	0	0	0	0	2	2	2	0
Tails	Total Possessed Tails (A4MM)	32	32	32	32	32	32	32	33	34	34	34	34	34	34
Tails	Aircraft Commit Rate	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%
Tails	Committed Tails = Possessed X Commit Rate	27	26	26	25	25	25	25	27	28	28	27	27	27	27
Tails – CCDR	CCDR Allocation (Tails)	13	13	13	13	13	13	13	13	13	13	13	13	13	13
Tails – CCDR	Deployed	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Tails – CCDR	Long Range Schedule (CCDR)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tails – CCDR	TACC Mission (Manual Entry)	9	9	9	9	9	9	9	9	9	9	9	9	9	9
Tails – MAJCOM	OT&E Allocation (Tails)	19	19	19	19	19	19	19	20	21	21	21	21	21	21
Tails – MAJCOM	MAJCOM Allocation (Tails)	9	8	8	7	7	7	7	9	10	10	9	9	9	9
Tails – MAJCOM	MAJCOM Missions	6	2	2	7	6	6	6	1	0	0	4	4	4	0
Tails – MAJCOM	Untasked MAJCOM	3	6	6	0	1	1	1	8	10	10	5	5	5	9
Tails – UNIT	UNIT Allocation (Tails)	10	11	11	12	12	12	12	11	11	11	12	12	12	12
Tails – UNIT	MX Allocation	5	6	6	7	7	7	7	6	6	6	7	7	7	7
Tails – UNIT	TNG Allocation	5	5	5	5	5	5	5	5	5	5	5	5	5	5
Tails – UNIT	UNIT Baseline Adjustment	0	0	0	0	0	0	0	0	0	0	0	0	0	0

		15-Feb-19	16-Feb-19	17-Feb-19	18-Feb-19	19-Feb-19	20-Feb-19	21-Feb-19	22-Feb-19	23-Feb-19	24-Feb-19	25-Feb-19	26-Feb-19	27-Feb-19	28-Feb-19
Crews	Line Assigned Crews (AAMS)	60	60	60	60	60	60	60	60	60	60	60	60	60	60
Crews	Crews Committed to HHQ Tasking	24	22	22	22	22	24	24	24	24	24	25	25	25	25
Crews – CCDR	CCDR Allocation (Crews)	19	19	19	19	19	15	15	15	15	15	15	15	15	15
Crews – CCDR	Deployed	8	8	8	8	8	8	8	8	8	8	8	8	8	8
Crews – CCDR	Long Range Schedule (CCDR)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Crews – CCDR	TACC Mission (Manual Entry)	11	11	11	11	11	7	7	7	7	7	7	7	7	7
Crews – MAJCOM	OT&E Allocation (Crews)	41	41	41	41	41	45	45	45	45	45	45	45	45	45
Crews – MAJCOM	MAJCOM Crew Allocation	5	3	3	3	3	9	9	9	9	9	10	10	10	10
Crews – MAJCOM	MAJCOM Mission	5	3	3	3	3	9	9	9	9	9	10	10	10	10
Crews – MAJCOM	Untasked MAJCOM (Crews)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Crews – UNIT	UNIT Allocation (Crews)	36	38	38	38	38	36	36	36	36	36	35	35	35	35
Crews – UNIT	UNIT Admin Overhead: Crews	23	23	23	23	23	23	23	23	23	23	23	23	23	23
Crews – UNIT	Training Overhead: (Crews)	15	15	15	15	15	15	15	15	15	15	15	15	15	15
Crews – UNIT	UNIT Available	-2	0	0	0	0	-2	-2	-2	-2	-2	-3	-3	-3	-3
Tails	Total Possessed Tails (A4MM)	34	34	34	34	34	34	34	34	34	34	34	34	34	34
Tails	Aircraft Commit Rate	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%
Tails	Committed Tails = Possessed X Commit Rate	28	28	28	28	28	28	28	28	28	28	28	28	28	28
Tails – CCDR	CCDR Allocation (Tails)	13	13	13	13	13	11	11	11	11	11	11	11	11	11
Tails – CCDR	Deployed	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Tails – CCDR	Long Range Schedule (CCDR)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tails – CCDR	TACC Mission (Manual Entry)	9	9	9	9	9	7	7	7	7	7	7	7	7	7
Tails – MAJCOM	OT&E Allocation (Tails)	21	21	21	21	21	23	23	23	23	23	23	23	23	23
Tails – MAJCOM	MAJCOM Allocation (Tails)	10	10	10	10	10	12	12	12	12	12	12	12	12	12
Tails – MAJCOM	MAJCOM Missions	1	0	0	0	4	4	5	6	6	6	2	2	6	6
Tails – MAJCOM	Untasked MAJCOM	9	10	10	10	6	8	7	6	6	6	10	10	6	6
Tails – UNIT	UNIT Allocation (Tails)	11	11	11	11	11	11	11	11	11	11	11	11	11	11
Tails – UNIT	MX Allocation	6	6	6	6	6	6	6	6	6	6	6	6	6	6
Tails – UNIT	TNG Allocation	5	5	5	5	5	5	5	5	5	5	5	5	5	5
Tails – UNIT	UNIT Baseline Adjustment	0	0	0	0	0	0	0	0	0	0	0	0	0	0

EAS: Six crews, Swapout 1 March

ODF: 26 January – 28 February

- Predictable Iron, 27 January - 4 February, 2/2
- BAC Spt, 4 - 8 February, 1/1
- Ops Trainer, 15 February, 1/2 (PC, 6-10 Feb)
- Ops Trainer, 21 February-3 March, 1/2 (PC, 14-20 Feb)
- BAC Spt, 25 February – 1 March, 1/1

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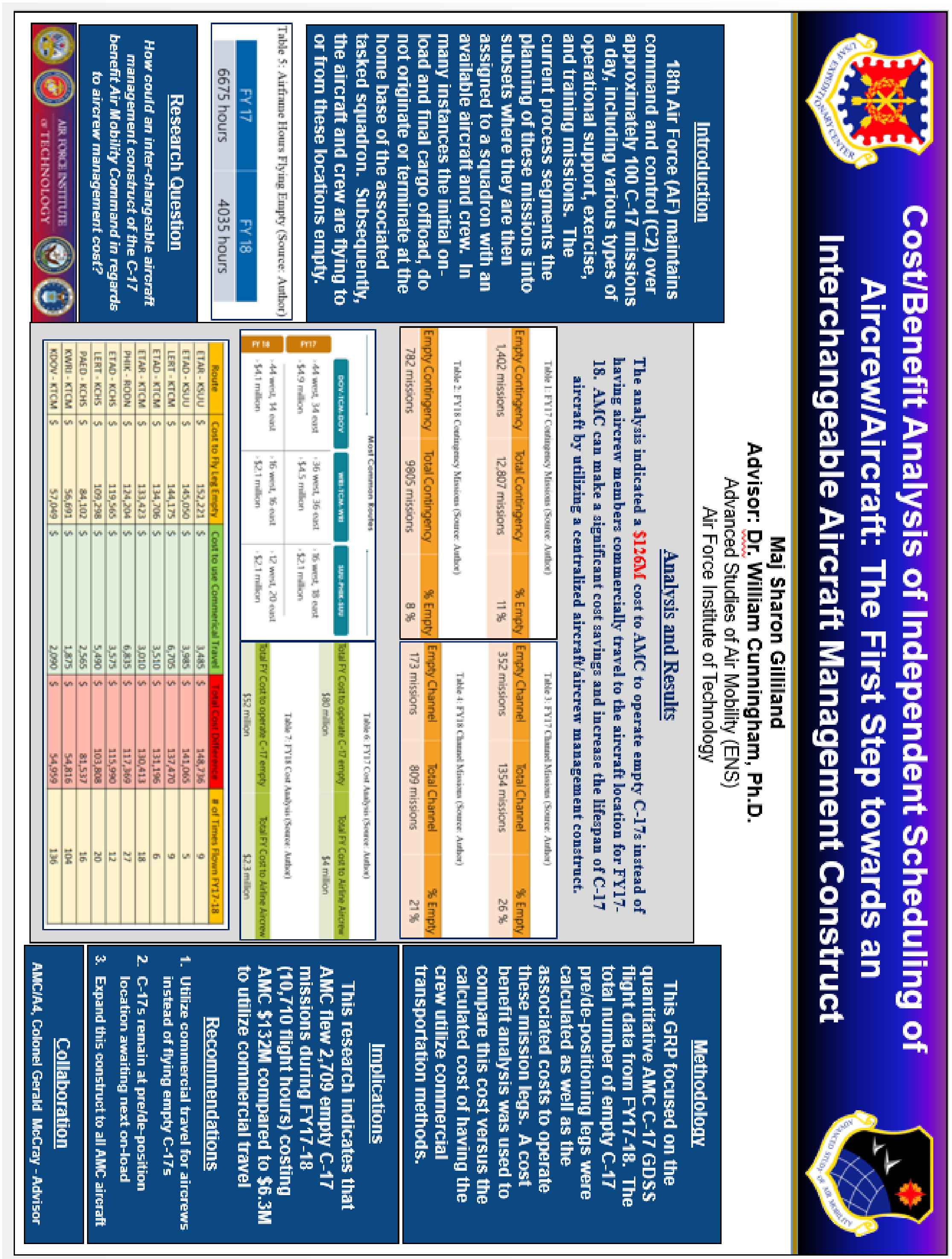
Appendix E

Quad-Chart



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14. ABSTRACT
Air Mobility Command (AMC) has historical stationed the USAF fleet of C-17 aircraft to Air Force bases around the world. Associated C-17 flying squadrons are established at these bases to operate and execute assigned/tasked C-17 missions worldwide. Since each base is assigned specific aircraft (tails), their unit specific tasked missions originate and terminate at their base of assignment. This construct has led to numerous C-17 flights operated empty to pre/de-position aircraft for required cargo missions, potentially costing AMC/DoD millions of dollars in flight hour costs, reducing the operational life of the C-17 fleet, and creating an overall process inefficiency. This construct is contrary to the way that commercial and civilian cargo/passenger airlift operations are conducted. These companies/entities choose to leave the empty aircraft at the last offload location when mission capable, and commercially fly aircrew to/from the aircraft. This could potentially save aircraft wear/tear, and allow operations to be conducted at a significantly reduced rate. This research paper focused on conducting a cost benefit analysis of AMC's current operations of operating empty aircraft to/from their assigned base of record compared to the cost/efficiency savings of conducting C-17 operations in a manner comparable to commercial carriers. The research methodology included extensive analysis and filtering of all C-17 channel and contingency missions for fiscal years (FY) 2017-2018. The total cost of the 2-year flying data was then analyzed against an alternate construct of utilizing commercial carriers to the max extent possible. The presented cost comparison data is designed to offer AMC leadership with an alternate COA potentially identifying the logistical way-ahead and projected cost savings of operating under a centrally manned aircraft/aircrew construct.

15. SUBJECT TERMS
Fleet Management, Aircrew Scheduling, AMC Cost Benefit Analysis

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