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RIGHT-SIZED OR DOWNSIZED: COMPARISON OF COSTS VERSUS CAPABILITY TO MAINTAIN INTRA-THEATER AIRLIFT

by

Jason S. Bertino, Major, USAFR

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Proposal Advisor: Dr. Paul Moscarelli

Project Advisor: Dr. Andrew Niesiobedzki

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Abstract

The US Air Force has revised how it operates and manages the force structure of intra-theater airlift due to reduced budgets in these fiscally constrained times. Developing a force structure of the Air Reserve Component (ARC) C-130H fleet that is cost-efficient while also preserving intra-theater airlift capabilities is a must as funds to operate shrink while demands for intra-theater airlift remain. The Air Force has determined that to efficiently meet airlift capabilities requirements a standard of eight total aircraft inventory (TAI) per ARC unit is the best force structure.

With consideration to the eight TAI force structure for ARC C-130H units, the goal of this research is to determine if this is in fact a cost-efficient method to assign aircraft and if this number of aircraft per unit will have any negative effect on airlift capability. This research analyzes some of the many cost and capabilities factors that should be considered when determining the ideal force structure for organizing the ARC's C-130H fleet.

An evaluation of cost and capabilities factors will identify if the Air Force's eight TAI force structure is cost-efficient or if alternate solutions should be explored. This research also seeks to uncover whether or not there are any limitations for the capabilities an eight TAI unit can provide or if the current set of required capabilities is better provided for by units with more aircraft.

INTRODUCTION

Overview & Nature of the Problem

As the Air Force faces greater budget pressures, identifying methods to realize cost efficiencies is at an all-time high. It is important for the Air Force to actively look for ways to minimize costs during these fiscally constrained times. Responding to these increasing budget pressures as a result of the 2011 Budget Control Act (BCA) and sequestration, the Air Force has pursued intra-theater airlift efficiencies in its recent President's Budget (PB) submissions.[1] While continually revising how to operate with a smaller budget, the Air Force has found it is necessary to effectively organize the C-130H fleet across the Air Reserve Component (ARC) to provide a cost-effective, yet mission capable option for intra-theater airlift. Establishing the correct number of aircraft at each ARC base will aid in the effort to eliminate excess aircraft and costs, and will also allow intra-theater airlift capabilities to be maintained.

The high operational demand for intra-theater airlift in multiple locations, supporting multiple operations has stretched the capabilities of the United State Air Force's tactical C-130 fleet. This is especially true for the ARC's legacy C-130H aircraft. The Air National Guard and the Air Force Reserve continually rotate units to deployed locations in the Middle East and elsewhere to provide airlift that is in high demand. Even though the demand for these capabilities is still present, increasing budget pressures to reduce costs have forced the Air Force to reconsider what the appropriate force structure for ARC C-130H aircraft should be. Determining how many C-130 aircraft the Air Force and the ARC specifically should operate is the first step to accurately identify what the force structure should look like. Eliminating excess aircraft and "right-sizing" units will allow the Air Force to realize the cost efficiencies it is hoping to gain. Balancing this with maintaining the ability to provide mission capability is

equally as important. Capabilities to include, for example, sending a four-ship deployment package to a Combatant Commander, having two aircraft available for in-garrison training, taking into account scheduled maintenance downtime and having a minimum of two aircraft available for surge capabilities are necessary considerations when determining the "right-size" of a unit.

Possessing too many C-130 aircraft, at too many locations, in units that were inefficiently sized to support national security requirements is a main reason the Air Force decided to reduce the C-130 force structure.[2] As the Air Force attempts to cut excess aircraft it has determined that in the FY15 PB the total number C-130 aircraft would be reduced from 358 to 328.[3] This total number would again be reduced in the FY16 PB to 300 aircraft.[4] The ARC C-130H units would also be standardized with eight total aircraft inventory (TAI) per base starting in the FY15 PB. Some perspectives, including that of the Air Force, presented in this research argue this number of aircraft will be the most efficient.[5] Other perspectives, to include those found in studies by the RAND Corporation and the Government Accountability Office (GAO) suggest that the recommended number of aircraft at ARC bases may just divert more requirements to the active duty as the need to reduce the overall fleet exists, without immediate operational requirements being reduced.[6] Although the Air Force presents a sound position for the intended reduction of excess aircraft aimed at attaining a more efficient overall fleet, the flaws of this position identified in studies published by the RAND Corporation, the GAO as well as others are important to consider. The problem is that despite perceived cost-savings, standardizing ARC C-130H units to eight TAI could potentially result in a loss of intra-theater airlift capability.

Purpose of the Study

The conclusion of the Air Force's research recommended that eight TAI at ARC C-130H units was the most efficient number to meet requirements. The decision to assign each ARC unit with eight aircraft, however, does not take into account the ability to surge should operations and requirements dictate.[7] It also does not consider whether ARC units on larger well-supported bases will be able to handle more aircraft and still realize acceptable cost-efficiencies compared to a smaller unit on a smaller, self-supported base. Because of this, a standard number may not fit all units.

Air Reserve Component C-130H units provide persistent mission capabilities to the Combatant Commander in the CENTCOM area of responsibility (AOR) as the United States continues its effort to fight terrorism. These units also must train regularly while in-garrison in order to be proficient to meet their wartime requirements. With ARC C-130H units' aircraft being reduced up to 33% it must be determined if these units can effectively train, maintain required mission capabilities and provide surge capabilities that utilize additional aircrews and aircraft for disaster response and potential further contingency requirements. This must be considered in addition to aircraft being unavailable to fill these roles due to maintenance and inspection cycles.

It is important to pursue this study because it will help make progress toward determining if a standardized number of aircraft at each ARC C-130H unit really is the solution that will be the most cost-effective. It will also help in determining if the projected number of aircraft, while potentially cost-effective now, will allow for intra-theater mission capability to be maintained in the future. A balance between cost and the ability to maintain mission capabilities is required to determine the optimal number of aircraft an ARC C-130H unit should be assigned. Therefore,

the purpose of this study is to determine if the decision to standardize ARC C-130H units at eight TAI will be cost effective while also allowing intra-theater airlift capability to be maintained.

Research Question

Throughout the ARC, C-130H units are feeling the struggle to maintain aircrew proficiency and provide required capabilities during what have become routine deployments with fewer assigned aircraft. Also, units with additional special missions such as aerial spray and airborne firefighting wonder how it will be possible to deploy, provide the required capabilities for their special mission, and have aircraft in scheduled maintenance. When this happens all at the same time, as frequently is the case, are there any aircraft left to allow aircrews to train in-garrison? Prior to FY16, ARC units were assigned up to twelve aircraft and are now reduced to eight. Units with eight aircraft can quickly be over-tasked in certain scenarios. With the Air Force's reduced budget, however, a cost-effective C-130H force structure is definitely needed. The Air Force has determined that eight aircraft assigned to each unit is the answer. Therefore, the research question is: Is the decision to standardize ARC C-130H units to eight TAI truly cost-effective while still being able to maintain required mission capability?

Research Methodology

Using the evaluation methodology, this research will attempt to resolve the differences in perspectives between those of the Air Force and agencies such as the RAND Corporation and the GAO. Criteria will be presented and utilized to evaluate the costs associated with an eight aircraft versus twelve aircraft unit and also for how effectively mission capability can be maintained with a standard of eight aircraft. A twelve aircraft unit will be used as a comparison since that is the maximum number of aircraft some ARC units owned prior to this reduction. This research will balance available data and current research on the basing of ARC C-130H

aircraft. To effectively evaluate the question it is important to use real data from Air Force financial and analysis sources. While the Air Force suggests their data supports a reduction in aircraft that will still provide required capabilities while saving costs and researchers from RAND and the GAO suggest there are flaws associated with this, the analysis of this data may in fact support a different possibility.

From the results of this evaluation a conclusion can be determined as to whether eight aircraft per base can effectively maintain mission capability to include additional surge and contingency requirements. It will also be determined if eight aircraft per base is truly the "right-size" in terms of cost-efficiency that the Air Force is hoping for. While this research is focused on the efficiencies of "right-sizing" ARC units, the results of any downsize in the reserve component may have significant implications to the active force as well. With a reduction in ARC aircraft, the active duty may have to accept more airlift requirements. Also, even though downsizing the number of C-130 aircraft and setting a standard of eight aircraft per ARC unit may gain potential cost-savings, it is important to consider if this will allow for intra-theater mission capability now as well as for tomorrow's war.

LITERATURE REVIEW

The topic of "legacy" C-130H aircraft has been heavily debated. This is particularly true for determining the force structure that works best in terms of cost and capabilities. The following literature review will provide perspective on how the Air Force determined that eight aircraft assigned to each ARC C-130H units is the appropriate number to provide cost-effectiveness without sacrificing mission capabilities. It will also provide perspective on how this number of aircraft may in fact reduce a unit's capabilities. Issues that may impact the cost-effectiveness of the Air Force's decision will also be discussed. The aspect that will not be

included in this study is the political aspect. While some testimony from congressional committee hearings will be used, political reasons for converting some ARC bases to new C-130H units or for not realigning and closing some bases will not be discussed.

When reorganizing the C-130 force structure with future wars in mind, past conclusions about force structure should not be overlooked. Just as lessons from previous wars should not be forgotten, lessons from previous force structure studies should at least be considered. The GAO published *Air Force Aircraft: Reorganizing Mobility Aircraft Units Could Reduce Costs* in 1998 with the focus of detailing proposed force structure changes for the C-130 and KC-135 aircraft. The GAO identified these force structure changes in an effort to reduce operating costs for airlift and refueling aircraft. For this research study, the intent of this document is to provide a historical look at how cost-effectiveness might be attained for the C-130 fleet by providing conflicting ideas to what is currently proposed today. As mentioned above, political agendas will be considered for this study.

The Air Force constantly has to react to changing budget situations as it strives to effectively manage the force with fewer resources. Government research organizations, such as the GAO, do their best to protect taxpayers' money by assessing government programs and determining how feasible it is to reduce program costs. The cost-effectiveness of reorganizing the airlift and refueling force into fewer, larger-sized units was assessed in this GAO study. [8]

At the time of this GAO report there were 22 National Guard C-130 units and nine Air Reserve units, all of which were spread throughout the United States.[9] Currently, there are 16 National Guard C-130H units and eight Reserve units which are still spread throughout the United States.[10] The GAO identified this very point in their report as one way the Air Force could reduce costs. Their analysis concluded "the Air Force could reduce costs and meet

peacetime and wartime commitments if it reorganized its C-130 and KC-135 aircraft into larger-sized squadrons and wings at fewer locations."[11] There are a number of benefits that come with this recommendation. Capabilities would still be maintained because the total number of aircraft is not reduced and also, the primary savings would come from eliminating overhead positions and potentially reducing entire bases. For example, taking two 8-aircraft units and converting them into one 16-aircraft unit would save $11 million annually in 1998.[11] This is a number that would be significantly higher in today's value. These are perhaps still the most relevant modes of savings that could be used today while still maintaining capabilities.

The Air Force published its *Report on C-130 Force Structure* in March 2015 which details its position on the C-130 Force structure. Intended for defense committees in congress, this report provides information specifically regarding the cost and the operations versus financial benefits of the Air Force's proposal to reduce the force structure in the ARC. It discusses how efficiencies can be gained by standardizing the size of ARC C-130H units and through reducing overhead by eliminating specific AFRC Airlift Wings. The C-130 force structure as laid out in this report summarizes the Air Force's response to increasing budget pressures.[12] For this study this document is crucial to understanding the position of the Air Force on why the decision to standardize ARC C-130H units was made.

This Air Force report discusses the recommended total number of C-130s in the Air Force and how efficiencies can be gained. In an effort to meet budget constraints, however, reducing the total number of C-130 aircraft is the primary tool the Air Force had at its disposal. As stated in this report, "savings are achieved by reducing the size of the C-130 fleet and, without Base Realignment and Closure (BRAC) authority to close stand-alone units, eliminating overhead by consolidating the remaining aircraft into more efficiently sized units."[13] With

congress denying the Air Force the authority to close smaller bases, a reduction of aircraft saves the most money. The planned reduction, though, is in line with the conclusions of the Mobility Capabilities Assessment (MCA) 2018. The MCA 2018 recommended C-130 force, active and ARC, is between 248 and 320 aircraft which is down from 358 established in the FY13 National Defense Authorization Act (NDAA).[14] While these numbers reflect the entire Air Force, not just the ARC as this study focuses on, it is important to note that this is a reduction of between 11% and 31% in aircraft compared to just three years ago.

A reduction in aircraft between 11% and 31% could be interpreted as a significant loss in intra-theater airlift capability, however the Air Force discusses in this March 2015 report that while this reduced number seems significant, the MCA 2018 states that "a fleet of more than 300 aircraft would only be necessary in a worst-case scenario requiring C-130s to simultaneously support current training, an operation to defeat aggression in one region, an operation to deny objectives in a second region, homeland defense, and Defense Support to Civil Authorities (DSCA)."[15] This amended force structure also standardizes the ARC C-130H units to eight TAI.[16] While today's requirements may not necessarily require all of the situations presented by the MCA 2018 to be covered simultaneously, future conflicts and potential situations should be considered when deciding if more than 300 aircraft really is excessive.

RAND Corporation's *Cost of Flying Units in Air Force Active and Reserve Components* discusses how the relative costs associated with operating and supporting Air Force units are important to consider when determining the appropriate mix of forces for various missions. It focuses on local costs of active and reserve wings to include base infrastructure support costs. While this document discusses more of a comparison between the active and reserve force and what is the right cost-effective mix between the active and reserve force, it is relevant to this

study because the force mix relates directly to the number of aircraft available to be assigned to the ARC. Also, due to budget-driven reductions the Air Force faces a reduction in its fleet size, however, no immediate reduction of operational demands exists.[17]

In order to determine whether the active or reserve component is more cost-effective, RAND identifies a comparison between these two components that relates to flying hours. Since the active and reserve forces are roughly comparable in terms of costs per flying hour, additional considerations are necessary to provide a more accurate cost analysis.[18] To clarify this, RAND concludes in its *Cost of Flying Units in Air Force Active and Reserve Components* report that to best meet strategic demands, ARC units are more capable at providing mission ready aircraft and aircrews at a lower cost per aircraft than active duty units are.[15] While this does not speak directly to the numbers of what the active duty to ARC mix might look like, the different scenarios RAND uses for analysis shift this mix in favor of one component or the other.

Since one possible capability requirement expected of ARC C-130H units is the ability to surge, it is important to consider if the ARC would be the most cost-effective force to receive the tasking to surge. RAND concludes that the ARC would normally be the most cost-effective component to provide surge capabilities, however the point is made that "for the purpose of meeting strategic surge demand, reserve component units provide [as stated above] mission-ready aircraft with competent aircrew and maintenance workforces at lower cost than active component units."[19] For this study, it will then be important to consider this conclusion and the need to include surge capabilities when determining if eight aircraft per ARC C-130H unit can in fact maintain required mission capabilities.

The GAO published the report titled, *Defense Transportation: Additional Information is Needed for DOD's Mobility Capabilities and Requirements Study 2016 to Fully Address All of*

its Study Objectives to provide an audit of what the Air Force included in its Mobility Capabilities and Requirements Study 2016 (MCRS-16). Issued in 2010, the MCRS-16 was intended to provide senior leaders a detailed understanding of the range of mobility capabilities that would be needed for possible future strategic environments as well as helping them make decisions on future mobility systems.[20] While the MCRS-16 is a classified document the unclassified executive summary is referenced by the GAO in this report. Along with providing information on how mobility capabilities as a whole support the National Military Strategy, the MCRS-16 specifically discusses intra-theater airlift to include the C-130 aircraft force structure and any shortfalls that may exist. The MCRS-16 was intended to address a number of issues concerning mobility capabilities, however the GAO determined three of the intended objectives were not fully or clearly addressed.[21] Of these, two relate specifically to intra-theater airlift C-130s which include the GAO determining that the MCRS-16 study did not clearly identify shortfalls and excesses in mobility systems assessments and also the study did not provide any risk assessments of mobility systems.[22] These two objectives were intended to be answered through an examination of the overall strategic and tactical airlift capacity.

For the first of these two objectives, Clearly Identify Shortfalls and Excesses in Mobility Systems Assessments, as it relates to C-130s specifically, it is unclear if a shortfall in capacity exists. The MCRS-16 report states, "there is sufficient aircraft" but also states that, "the crew structure cannot sustain steady-state operations in combination with a conflict."[23] Even if the total number of aircraft exceed what is required to meet National Military Strategy objectives, if there are not enough crewmembers then a shortfall exists. While the MCRS-16 does not identify an insufficient crew structure as a shortfall, the GAO does and therefore has determined there are possible gaps in the conclusions of the MCRS-16 report. The number of C-130 aircraft will be

referenced in the risk assessment objective following; however, the issue within this objective is that decision makers at the DOD and in Congress cannot make informed decisions concerning the C-130 force structure if the Air Force does not present clear and complete information on C-130 issues.[24]

The second objective, Provide Any Risk Assessments of Mobility Systems, again does not fully address the intentions of the MCRS-16 report. The GAO identified that no mobility risk assessments are discussed in this document and the intent of discussing risk assessments in the MCRS-16 was to identify risk associated with intra-theater airlift when the C-130 fleet is set at a particular size. As discussed by the GAO, the MCRS-16 states that a fleet of 401 C-130s exceeds demands, but does not describe the risk associated with this size force.[25] Of note, the DOD's 2005 Mobility Capabilities Study assessed the risk associated with an intra-theater force of 395 to 647 C-130s as moderate and this is important to consider when today's Air Force leadership is planning to set the C-130 fleet at 300 especially considering that the need for intra-theater airlift has only slightly declined from when the MCRS-16 was published in 2010.[26] If decision makers do not have the benefit of knowing the level of risk associated with setting a particular force structure for mobility aircraft, as identified was lacking in the MCRS-16, it is difficult to appropriately size the C-130 fleet to meet national strategy objectives.[27]

In an effort to discuss the issues surrounding the Air Force's aging fleet of C-130 aircraft, Timrek Heisler of Congressional Research Service published the document, *C-130 Hercules: Background, Sustainment, Modernization, Issues for Congress* in June 2014. As a nonpartisan organization, Congressional Research Service provides research and analysis intended for members of Congress that are authoritative and objective. The decisions Congress faces as they decide the future of what intra-theater airlift will consist of are continually impacted by budget

constraints. Several factors to include cost, desired capabilities and the most effective basing strategy are important considerations when defining the most effective and cost-efficient C-130 force structure. Along with these factors, it is important to understand that any change in force structure and basing requirements within the ARC will have an impact on the active force as well.[28]

In the context of current budget limitations, identifying opportunities to analyze the current C-130 force structure is required in order to maximize cost-efficiencies while also maintaining the right amount of intra-theater airlift to meet national security goals.[29] As was discussed in the Air Force's March 2015 *Report on C-130 Force Structure*, the MCA 2018 should be used as a guide to determine future intra-theater airlift requirements and as Mr. Heisler also points out, the MCA 2018 suggests there is currently a surplus of capability to meet intra-theater airlift requirements.[30] In terms of cost-efficiency and reducing the overall C-130 fleet to allow capabilities to match requirements, the Commander of Air Mobility Command (AMC), General Paul Selva, agrees with the MCA 2018 analysis. Gen Selva states, "My position is that the fleet is affordable. It's how we deploy the fleet and who operates it."[31] Identifying the total number of C-130 aircraft and what component of the Air Force operates them most efficiently is required to ensure overall affordability, but also it is the first step in determining what the correct force structure for the ARC should be. Gen Selva suggests that a reduction of approximately 40 aircraft down to about 300 total as well as moving some aircraft to the guard and reserve will achieve desired savings and also ensure required capabilities could still be met.[32] To effectively realize cost-efficiencies, the total number of aircraft retained must match current and future requirements and also it is essential to maintain the appropriate mix of aircraft between the active and ARC components.

EVALUATION CRITERIA

As the question of this study asks whether or not a standard of eight aircraft across all ARC C-130H units is cost-effective and also if this number of aircraft will allow required mission capabilities to be maintained it is important to consider both aspects for the development of evaluation criteria. Therefore, the criteria used within this study will be separated into two categories. The two categories will be: 1) Criteria for considering if the costs of eight aircraft versus twelve aircraft is more cost-effective, and 2) Criteria for determining if airlift capability can be maintained with eight aircraft.

The first category will consider the cost aspect of eight aircraft being assigned to each ARC C-130H unit. There are many ways to interpret the cost-efficiency of a certain number of aircraft per unit. For the scope of this study, however, cost-efficiency will be looked at with respect to eight aircraft per unit compared to twelve aircraft which was the maximum units were previously assigned prior to the standardization. Another factor that will be considered is the cost of infrastructure and support for a given base. This will likely vary between units on stand-alone bases and units on large well-supported bases. Criteria will be used that provides a common picture between ARC units to effectively discern whether or not the standard of eight TAI is cost-effective. Therefore, the criteria to evaluate whether the standard of eight TAI assigned to each ARC unit is cost effective are: the operations and maintenance (O&M) costs, infrastructure and support costs, personnel costs and the unit's average cost per aircraft.

The second category will consider the ability of required intra-theater airlift capabilities to be maintained with eight aircraft assigned to each ARC C-130H unit. For this study, required capabilities will refer to having required aircraft for deployment to a Combatant Commander's AOR, having enough aircraft available for in-garrison training, and having aircraft available to

provide surge capabilities. These capabilities are for all ARC units as well as having the ability to provide special mission capabilities for those ARC units that are assigned the modular airborne firefighting (MAFFS) mission and the modular aerial spray (MASS) mission. While these are considered surge capabilities for this study, they are unique missions that the five units assigned to them must perform in addition to the other capabilities. Also, when determining if a unit can provide required capabilities it is important to consider scheduled maintenance downtime. As actual deployment capabilities and numbers of aircraft could fall above the unclassified, non-FOUO level, theoretical, yet realistic criteria will be used. Therefore, the criteria to evaluate if an eight aircraft unit is able to maintain required capabilities will be the ability to provide for: deployment (four aircraft), in-garrison training (two aircraft), surge capabilities (two aircraft), scheduled maintenance downtime.

The deployment capability of four aircraft is based on typical requirements units must provide for the ongoing counter insurgency operations (COIN) and multi-theater non-governmental support operations. Two aircraft for in-garrison training is based on AMC published Air Force Instructions (AFI) that require a formation of two aircraft at a minimum to meet training and evaluation requirements.[33] Two aircraft will be used for surge capabilities due to potential additional domestic or contingency requirements as well as for MAFFS or MASS. For example, the four ARC units with the MAFFS mission are each required to provide two MAFFS equipped aircraft each fire season which also includes a 5.0 crew ratio (ten aircrews).[34] Normal, unexpected aircraft maintenance issues will be disregarded for this study, however scheduled maintenance downtime, such as programmed depot maintenance (PDM), is relevant for the criteria as these cycles can be predicted and will also prevent an aircraft from being available for an extended period of time.[35]

ANALYSIS

Cost Analysis

In an effort to evaluate whether or not the decision to standardize ARC C-130H units at eight TAI is cost effective it is important to use actual financial and cost data. Information from the Air Force Financial Management and Comptroller website will provide unclassified, open source data for use during this evaluation. Also, as part of this evaluation, more specific cost data will come from the Air Force Total Ownership Cost (AFTOC) program. The raw data, however, is for official use only (FOUO) so generalizations and approximations will be used to characterize any conclusions. From these sources the O&M costs, infrastructure and support costs, personnel costs and the unit's average cost per aircraft will be used for the data analysis. By using actual cost data as the method to evaluate this topic, the goal is to provide an unbiased answer as to whether the Air Force's decision regarding standardizing ARC units is cost-efficient or if, as the GAO suggests, larger and fewer units is more cost-efficient.

Currently there are 22 C-130H units in the ARC, of which, eight are Air Force Reserve and 16 Air National Guard (Figure 1). There is a varying spectrum for where these units are located and where they operate. Some units, such as the 302nd Airlift Wing (AW) at Peterson Air Force Base (AFB), CO, at one end of the spectrum, are tenant units on a large active duty base. The active duty host unit and the city airport pay for the majority of base infrastructure and airfield operations costs. Some units, such as the 94 AW at Dobbins Air Reserve Base (ARB), GA are on the opposite end of the spectrum. Units such as this are situated on stand-alone bases supporting the entire base infrastructure and the majority of airfield operations. Other units in the ARC fit between the ends of this spectrum. It is important to understand that while there are varying costs related to the operation of any given ARC unit, this study is concerned with the

variables that are common among all units - O&M costs, infrastructure and support costs, personnel costs and the unit's average cost per aircraft.

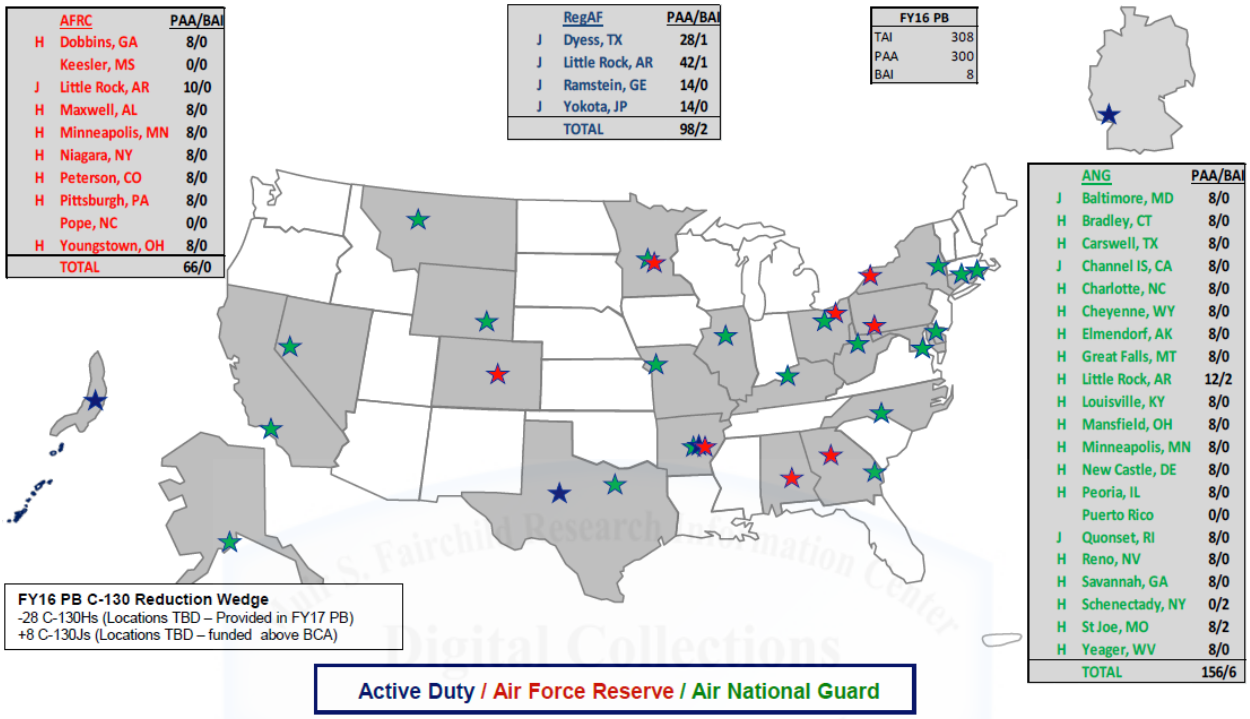

Figure 1. FY16 C-130 Force Structure (FY16 PB). Derived from "TFP-16 Adjustments," (presentation provided to 114th Congress of The United States). Extracted from the Air Force *Report on C-130 Force Structure*, March 2015.

"The FY16 PB C-130 force structure alignments reduce excess capacity and improve operations efficiency while preserving the Nation's contingency and domestic support response capability."[36] This is the position of the Air Force on why eight aircraft per unit is considered to be the desired standard and why this standard will be in-place starting in FY16. The AFTOC program provides cost information valuable to determining if the evaluation criteria for this study can successfully lead to an answer to the research question. In an effort to eliminate state Title 32 costs from this research, the AFTOC information will focus on AFRC data and it will be assumed for the purposes of this study that ANG data will be similar to that of AFRC.

Operations and Maintenance Costs

Operations and Maintenance funds are used to operate, sustain and maintain aircraft; including training, purchasing of critical supplies, equipment and fuel.[37] Using FY15 cost information, O&M costs can be compared between units with eight aircraft and units up to twelve aircraft. This cost comparison will help gauge potential efficiencies gained from assigning eight aircraft per unit.

For FY15, five AFRC C-130H units were assigned eight aircraft, one unit assigned nine, one unit assigned eleven and one unit assigned twelve aircraft. Operations and maintenance costs, however, were not linear with the number of aircraft assigned.[38] Three units with eight aircraft assigned, the 94 AW, the 934 AW and the 911 AW, had between 50% and 100% more operations costs when compared to the units with more aircraft.[39] The most probable reason for this was that these were the three AFRC C-130H units that were deployed during FY15 which would have resulted in higher O&M costs. As the AFTOC does not provide a breakdown to differentiate between deployed and in-garrison costs, this is an assumption. The other five units that did not deploy in FY15 had operating costs that were very similar to each other.[40] Except for taking into account deployments; the number of aircraft assigned to a unit does not have a significant impact on operations costs.

As can be expected for any unit that is deployed, maintenance costs, like operating costs, will be significantly more than while in-garrison. For the three units, the 94 AW, 934 AW and 911 AW, that were deployed during FY15, maintenance costs were between $1 million and $2 million higher than those units with eight aircraft assigned that did not deploy. However, the 302 AW with 12 aircraft assigned had the highest maintenance costs out of the eight ARC units in FY15.[41] While the overall maintenance cost number was highest for the 302 AW, when

comparing the total maintenance cost at each unit per aircraft owned, the 302 AW was still in line with those AFRC units that did not deploy. Due to the state of political flux the 440 AW at Pope Field has been in for at least the past year, its maintenance costs will be discounted for this comparison, as its cost numbers do not present an accurate picture. However, all units that did not deploy in FY2015 produced maintenance costs of about $200,000 less per aircraft compared to those that did deploy.[42] Presumably, if the three units that deployed in FY15 had not been, their maintenance costs would be in line with the rest of the AFRC units. As with operations, the number of aircraft assigned to a wing does not have a significant impact on overall maintenance costs.

Infrastructure and Support Costs

Infrastructure and support costs is a category that will vary by unit depending on how that unit is situated on a base. This is where the spectrum of whether a unit is located on a large well supported base or a smaller stand-alone base is important. Also, within this evaluation criterion, it is important to note the costs associated with converting previous non-C-130 ARC units to C-130 bases, instead of reallocating aircraft to already established units.

For this evaluation criterion, infrastructure and support will include *installation support* such as base operating support and real property maintenance and also *personnel support* such as medical support. Generally, all AFRC C-130H units are comparable with respect to support costs, specifically base operating and real property maintenance costs. The unit that recorded the highest FY15 support costs, however, was the 302 AW at Peterson AFB with about a 50% increase over the other units in this study.[43] While this seems high, especially since the 302 AW is supported by a full active duty base, it is not as significant with the fact that there are up to 50% more aircraft (FY15 numbers) at this unit than at the other ARC units. Also, there are

savings realized by locating an ARC C-130H unit on a large active duty base such as in this case. For example, medical support costs is one category the 302 AW spends up to 74% less than units on small self-supported bases due to the fact that the active duty provides the majority of medical operations and infrastructure on Peterson AFB.[44]

As previously mentioned, the costs involved with changing the mission of units to become C-130H units should be taken into account when determining the efficiencies that are potentially realized by assigning eight aircraft to many units versus assigning more aircraft to fewer units. This is one aspect where the Air National Guard presents specific information that the Air Force Reserve is not currently involved. This is not an inexpensive undertaking and the 120 AW at Great Falls, MT is a great example of how much it costs to construct a large amount of new infrastructure to meet intra-theater airlift aircraft requirements by converting a unit from F-15s to C-130Hs.

During FY14, the Air Force Financial Management and Comptroller reported that to convert the 120 AW to intra-theater airlift would cost about $22 million.[45] Although the infrastructure built, including hangars and air terminal facilities, was required to create a fully functioning C-130H base, it could have been more cost-efficient to place the C-130H aircraft, which were transferred from active duty, at already established ARC units. The Air Force's desire to make eight TAI units, effectively, created the unnecessary need to spend $22 million. It is assumed state politics were heavily involved in the decision to convert the 120 AW from F-15s to C-130Hs, however political decisions are outside the scope of this study.

Overall, the main factor impacting infrastructure and support costs is not the number of aircraft assigned to a unit, but its location. Cost-efficiencies are better realized when units are located at large active duty bases that allow the ARC unit to take advantage of provided support.

Fewer stand-alone ARC units with more than eight aircraft each would provide the same required capabilities while also providing a more cost-efficient solution. These results are more in-line with the GAO's 1998 report that discussed the potential cost savings of organizing more aircraft into fewer units and they are also contrary to the Air Force's current thinking, as laid out in their March 2015 *Report on C-130 Force Structure.*

Personnel Costs

Personnel costs are an area where any perceived cost-efficiencies of assigning eight aircraft to each unit can quickly disappear. The more units there are spread throughout the ARC, the more personnel there will be required to run them. Every category of personnel from leadership down to base support must be replicated for each individual unit. Also, like infrastructure and support costs, personnel costs will vary not just because of the number of aircraft a unit owns, but also from that unit's location. If a unit is located on a large active duty base the number of personnel required within the wing will be much less than for a unit on a small self-supported base. For example, ARC tenant units located on active duty bases do not have the need for as many full-time personnel positions or the requirement for large security forces squadrons as these are positions staffed by the active duty host unit.

From the example above it is clear there are many variables that determine the personnel assigned to a given unit and the costs associated with the overall personnel will vary by base. For FY15 personnel costs at the 934 AW were approximately $6 million less than the costs at the 302 AW.[46] Even though the 302 AW has 50% more aircraft than the 934 AW, its additional personnel costs are less than 50% more than for the 934 AW. This can be attributed to the 302nd having an increase mainly in aircrew and maintenance personnel due to the additional aircraft

whereas the 934th has more base support personnel than required for the 302nd because that unit must fully support a stand-alone air reserve station.[47]

As there are a number of variables that account for the difference in personnel costs by unit it is useful to focus on two of the categories of personnel that remain constant between each unit. Those two categories are aircrew and command and control. Across the ARC, FY15 costs for aircrew were very comparable between units with the only ones having slightly higher costs being the those with more than eight aircraft.[48] Using a 2.0 crew ratio (aircrew per aircraft) the main variable for aircrew costs is the total number of aircraft.[49] With this, the total aircrew costs should be relatively the same no matter how the C-130H force is structured as long as the total number of aircraft remain the same.

For example: if three units have 8 aircraft each with 16 aircrews (2.0 ratio) equaling 48 total aircrews and two other units have 12 aircraft each with 24 aircrews (2.0 ratio) equaling again 48 total aircrews the total cost in each scenario would be about the same. This same logic could be used for the Air Force's planned C-130H force structure of standardizing units with eight TAI. If eight AFRC units are going to each be assigned eight aircraft for a total of 128 aircrews, the same number of aircraft and aircrews could be retained if two units were assigned eight aircraft and four were assigned twelve aircraft. The savings could be significant, about $40 million annually; if an entire stand-alone ARC base was closed.[50]

Along with the costs of aircrews, the command and control costs are also constant in terms of every unit will have a command and control function. For most AFRC units this cost is about the same for FY15, however for the 302 AW its costs for command and control were approximately $30,000 less or about half that of the other units.[51] This assumingly can be

attributed to the fact that since it is a tenant unit on an active duty base, it does not need the full level of leadership throughout all the various squadrons within the wing.

Unlike aircrew costs, however, if the force structure of C-130H aircraft were similar to the second scenario above – two units assigned eight aircraft and four units assigned 12 aircraft – the costs of the command and control leadership functions would not necessarily transfer to another unit. Since each unit would only need one leadership function, i.e. the one already in place, if a unit were to close or at least be given a different mission, the savings of not having to fund a C-130H leadership function would be approximately $100,000 annually.[52] Even though many costs, such as aircrew costs, would be transferred to the gaining unit of the aircraft, cost-efficiencies could be increased by reducing the number of command and control leadership functions. Fewer ARC C-130H units each with more aircraft would provide a more cost-effective force structure while keeping the same total number of aircraft. This, again, provides a result that is more in-line to the GAO's conclusions than the current recommendations that are included in the Air Force's March 2015 force structure report.

Unit's Average Cost per Aircraft

As shown with the O&M costs, maintenance costs per aircraft at a given unit are relatively equal. Aircraft will need to be maintained and the costs per aircraft will be about the same if they are owned and maintained by a unit with eight aircraft or a unit with twelve aircraft. Cost-efficiency comparisons, however, can be looked at by determining approximately how much of a unit's overall costs are related to each aircraft. As the number of aircraft generally drives many factors within that unit, (i.e. the number of aircrews, the number of maintenance personnel and the required infrastructure) a unit's overall expenses can be broken down into an average cost per aircraft.

This breakdown can be useful when considering cost-efficiency, as this is a simplified way of looking at economies-of-scale. Although it is not necessarily realistic that adding additional aircraft to a particular unit will increase costs by a linear amount, it is useful to determine what the average cost per aircraft is to conclude if any cost-efficiencies could be gained by adding additional aircraft to particular units or if particular unit locations are more economical.

As the analysis above points out, there are many factors that determine what an individual unit's annual costs are. However, when comparing each unit's average cost per aircraft most units produce very similar results.[53] When comparing the number of aircraft owned to the unit's total costs, most units resulted in about $5 million per aircraft. The 440 AW at Pope Field is again an outlier because of its current political situation so its average cost per aircraft of about $3 million should be disregarded.[54] The 302 AW at Peterson AFB produced a result of about $4 million per aircraft which turns out to be the most cost-efficient.[55] Since this unit has up to 50% more aircraft than the other ARC units, some of which are located on stand-alone bases, it can be assumed part of the reason for the relatively inexpensive average cost per aircraft is a result of the 302 AW being located on a large active duty base.

As this analysis shows it is more cost-efficient to assign more aircraft to an ARC unit which is a tenant on an active duty base, reducing the total number of units and distributing the aircraft from those units to more cost-efficient units could save further costs. For example: If the 910 AW at Youngstown Air Force Reserve Station, a stand-alone base, were closed and its nine aircraft transferred to the 302 AW about $45 million per year could be saved from the base closing while only increasing the costs of the 302 AW by approximately $36 million per year.[56] While 17 aircraft at the 302 AW could be more than desired, the economies-of scale allow for

approximately $10 million to be saved by reducing the number of total ARC units and increasing the number of aircraft at the remaining units. Although the Air Force currently suggests that reducing the number of aircraft from their target of eight TAI "any smaller would adversely impact economies-of-scale and efficiencies,"[58] costs could more effectively be reduced if there were actually more aircraft at fewer units. Therefore, the standard of eight aircraft at the current number of ARC units is not the most cost-effective. Even though the Air Force discusses economies-of-scale in its March 2015 C-130 force structure report, a unit's average cost per aircraft again points to the ability to achieve greater cost-effectiveness by maintaining fewer ARC units with more aircraft.

Capabilities Analysis

As with the cost analysis, the criteria for evaluating the capabilities of standard eight TAI units will provide the focus for this section. The criteria for evaluating required capabilities will again be defined as the ability to provide aircraft for: deployment (four aircraft), in-garrison training (two aircraft), surge capabilities (two aircraft), and scheduled maintenance downtime.

There are many factors that can affect the number of aircraft a unit has available for particular missions, and these available aircraft are what will define the capabilities a particular unit can provide. The more aircraft a unit owns, the more opportunities there are to fill a required or even a requested mission tasking. A required tasking would fall under the categories of deployments or surge capabilities, such as for the MAFFS and MASS missions or additional contingency requirements, and a requested tasking could fall under in-garrison training such as providing airlift for a Joint Airborne/Air Transportability Training (JA/ATT) mission. These JA/ATT missions are typically scheduled in advance, but could be requested on an as needed basis and usually consist of personnel airdrops. If there are not any aircraft available, these

requested missions must be denied at the sacrifice of the training that would be accomplished. After taking into account required periodic aircraft maintenance, deployment and surge capability tasks must be filled at the expense of in-garrison training.

With respect to meeting capability requirements, the number of aircraft a unit has available is important. A unit must be able to deploy, provide surge capabilities as required, and train aircrews that remain at home station. This is all in addition to accounting for unavailable aircraft because they are involved in scheduled maintenance such as PDM or isochronal (ISO) maintenance inspections.

The ability to provide a four-ship package to a deployed location can be assumed to be a typical number of aircraft for a standard re-occurring deployment. While there is any number of possible variants to the standard number of required aircraft during a deployment, the typical deployment capability consists of four aircraft.

In determining a given unit's capability, the airframe capability, as calculated by the wing's maintenance group (MXG), is very important. The "airframe capability is used when determining the unit's capability to support the operational flying requirement for a specified month, quarter, or fiscal year."[58] It is important to note that when calculating the airframe capability, one of the most critical variables is the number of aircraft possessed. The number of aircraft a unit owns is key in determining everything up to the maximum sortie capability and the more aircraft a unit owns the more sorties it can fly.[59] The airframe capability computations are a compilation of factors that determine if a unit's available aircraft can support any type of requirement in peacetime and wartime.[60] While there are still other variables such as maintenance factors and attrition rates that go into calculating the maximum number of sorties that can be flown during a given period of time, the number of aircraft available is most

important.[61] Units with 12 aircraft, for example, will be able to provide more capabilities and fly more sorties than units with eight aircraft.

These airframe capability calculations also work to determine in-garrison training and surge capabilities while a four-ship package is deployed. If an eight aircraft unit has four aircraft deployed it will only have 50% of its original capability for sorties back home because there will only be 50% of the aircraft available for MXG to use in the airframe capability factors equations. A 12 aircraft unit, however, would only decrease to 66% if four of its aircraft were deployed leaving more aircraft available at home station to provide sortie capabilities. While these examples do not take into account the other various factors, such as maintenance factors, more capability per unit is available when that unit has more aircraft assigned to it.

Surge capabilities, like deployment capabilities, should be considered a priority over normal in-garrison training. Whether additional, follow-on aircraft are needed for a unit's deployment or if one of the five MAFFS/MASS units is activated, these surges will have a large impact on other unit capabilities. It is assumed surge capabilities will consist of two aircraft for this study. In today's continued fight within the COIN environment, it is realistic that at any time additional aircraft could be required to deploy. Fewer aircraft per unit could easily stretch that unit's capabilities if it is required to surge.

A complete compilation of a unit's capabilities, to include the ability to deploy a certain number of aircraft as well as how many follow-on aircraft it is required to have for surges is laid out in the unit's Designed Operational Capability (DOC) Statement.[62] This document indicates if a unit should be able to surge with a two-ship follow-on package or a four-ship follow-on package for wartime contingencies. Also, with MAFFS being a surge capability for the United States Forest Service as the civilian air tanker capability becomes over-tasked, two aircraft are

required to be available from each of the four MAFFS units for the whole fire season.[63] During fire season, the MAFFS mission can be considered a surge capability for the four MAFFS units as well. With the minimum of two additional aircraft required for surge capabilities, units with 12 aircraft will have a better opportunity to surge and still maintain their other requirements such as training or deploying. It is important to note, however, that General Mark Welsh, Chief of Staff of the Air Force, in his response to Representative Lamborn of Colorado during a House Armed Services Committee hearing, does not consider, for example, a reduction of the 302 AW from 12 to 8 aircraft a negative impact on the MAFFS mission.[64] While it is reassuring the Air Force has every intention of preserving the MAFFS mission, with only eight aircraft per unit, consideration for routine deployments will have to be given to those units performing this mission, as well as the MASS mission to ensure deployments do not overlap with seasons when those units are usually involved with those special missions.

The required maintenance downtime all aircraft periodically must complete, such as PDM and ISO, can be forecast and scheduled, however the overall capability of a unit is effectively reduced because it has fewer available aircraft during the downtime of aircraft. Units with aircraft unavailable because of these maintenance downtimes have a lower maximum sortie utilization rate due to a decrease in the airframe capability computations.[65]

For PDM for example, all C-130H aircraft must have this maintenance completed every 69 months.[66] If a unit is assigned aircraft that were built during the same year, such as the 302 AW has, then all aircraft will effectively be on the same interval to complete PDM. Although PDM schedules are essential to maintain the overall health of each aircraft, each unit and their major command should "ensure that sufficient aircraft are retained in order to accomplish their overall mission assignments while satisfying the planned PDM schedules."[67] This is an important

consideration in an effort to meet required capabilities, however with eight aircraft versus twelve aircraft, this task becomes harder to accomplish. For example, with an eight aircraft unit if four aircraft are deployed and one aircraft is continually rotating in and out of PDM until all unit aircraft are complete, there are only three remaining to provide in-garrison training or surge capabilities until the deployment is over and the PDM cycles are complete.

As units prepare for deployments or its aircrews that are not part of the deployment strive to remain current on flying events, in-garrison training is an important consideration. The number of aircraft a unit possesses quickly becomes a limiting factor on how many and what type of training events can be accomplished. For ARC C-130H aircrews, a minimum of two aircraft is required to complete all semi-annual training events.[68] Formations of at least two aircraft for training and evaluations are necessary to allow aircrew to maintain their proficiency and their qualification.[69] For example, if a unit with eight aircraft has four aircraft deployed, one in PDM, one in ISO and one on a JA/ATT mission, there is only one aircraft at home station to allow for in-garrison training. This becomes much more manageable if a unit has 12 aircraft as four more would potentially be available to allow for formation training to exist.

When considering the required capabilities of the ARC C-130H community as a whole, it should be noted that if one unit is over-tasked other units could be tasked to fill the capabilities gap. This is the potential solution for units with eight aircraft that could very quickly become over-tasked. While this solution does allow for required overall capabilities to be met, having only eight aircraft in a unit can have a negative impact on the training opportunities of its aircrew, thus posing a risk for its aircrew to not remain current and qualified to provide required capabilities. An eight aircraft unit cannot be expected to simultaneously provide aircraft for a

deployment, required surges, meet required maintenance cycles and have enough aircraft to effectively train aircrews.

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

Due to the current budget environment, the Air Force must determine the right size for ARC C-130H units that is cost-effective, but that will also maintain required intra-theater airlift capabilities. While the current goal of standardizing each ARC C-130H unit at eight TAI might be a lower cost per unit, it is not the most cost-effective model for the ARC overall. The large number of ARC units with a small number of aircraft is not as cost-effective as fewer units each with more aircraft. Even though eight aircraft per unit is not as cost-effective as 12 aircraft due to economies-of-scale, the number of aircraft per unit is not the only variable identified that could provide greater savings. The cost variables discussed within this study also suggest that locating ARC units on large active duty bases could provide even more cost-efficiencies than having units located on small stand-alone bases.

This conclusion is also in line with unit capabilities. Eight aircraft units are not as effective at providing intra-theater airlift capabilities. Deployments can consume half of an eight TAI unit's aircraft and additional requirements can quickly over-task the unit. Units with 12 TAI can better provide aircraft for required deployments and surges and also better facilitate training needs. The economies-of-scale offered by fewer, larger units allow intra-theater capabilities to be maintained while providing greater cost-efficiency.

Recommendations

Organizing the ARC into a cost-efficient force structure that is also capable of maintaining intra-theater airlift capabilities is important. Creating fewer, larger units can allow for greater cost-efficiencies and should be considered. The Air Force should further study the options for reducing the number of ARC C-130H units, especially in the ANG where there are twice the number of units as in AFRC, and increase the number of aircraft assigned to each. As the analysis in this study assumed the ANG costs and capabilities fell in line with AFRC units, further study should be accomplished to determine the feasibility of reducing the large number of ANG C-130H units and what impact this will have on the affected states.

While determining the optimal number of ARC C-130H units with a more cost-efficient number of aircraft is important, further study should be given to how feasible it is to locate more ARC units at large active duty bases as opposed to small stand-alone bases. With greater efficiency being achieved by having units located on active duty bases, eliminating stand-alone units can save even more costs. Through further study on this topic, if it is found that a reduction in the total number of ARC units is the most cost-efficient option, stand-alone units should be the first to be reduced.

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