
# KC-46A ENTERPRISE FLEET MANAGEMENT

GRADUATE RESEARCH PROJECT

Timothy R. Guy, Major, USAF

AFIT-ENS-MS-16-J-023

**DEPARTMENT OF THE AIR FORCE**
**AIR UNIVERSITY**

***AIR FORCE INSTITUTE OF TECHNOLOGY***

**Wright-Patterson Air Force Base, Ohio**

AFIT-ENS-MS-16-J-023

# KC-46A ENTERPRISE FLEET MANAGEMENT

GRADUATE RESEARCH PROJECT

Presented to the Faculty

Department of Operational Sciences

Graduate School of Engineering and Management

Air Force Institute of Technology

Air University

Air Education and Training Command

In Partial Fulfillment of the Requirements for the

Degree of Master of Science in Logistics

Timothy R. Guy, BBA, MBA

Major, USAF

June 2016

AFIT-ENS-MS-16-J-023

# KC-46A ENTERPRISE FLEET MANAGEMENT

Timothy R. Guy, BBA, MBA

Major, USAF

Committee Membership:

Joseph R. Huscroft, Lt Col, USAF
Research Advisor

AFIT-ENS-MS-16-J-023


## Abstract

The goal of this research is to explore potential efficiencies and cost savings implementing fleet maintenance centers and mission generation bases for the KC-46A enterprise. AMC/A4 is proposing a KC-46A enterprise-level management strategy focusing on maintenance and sustainment. This management strategy leverages new ideas and commercial fleet management concepts with the intent of maximizing efficiencies and aircraft availability while reducing potential redundancies and excess in infrastructure, maintenance personnel and operations and sustainment costs (HQ/AMC, 2013). The KC-46 fleet would have primary fleet maintenance centers with other bases serving primarily as mission generation bases. It is assumed that implementing this type of strategy will create efficiencies and cost savings for the program.

*To my beautiful wife and two wonderful daughters*
*Your love and support made this possible*

**Acknowledgments**

I would like to express my sincere appreciation to my faculty advisor, Dr. Joseph Huscroft. Your support to the development of this Graduate Research Paper has been outstanding.

I would also like to thank my sponsor, Col Walter (Ike) Isenhour, Deputy Director of Logistics HQ AMC/DA4 for the guidance and direction on this topic.

Furthermore I would like to thank MSgt Noah Shedd, KC-46A Weapon System Manager, HQ AMC/A4QT, for providing me with a tremendous amount of information on the KC-46A.

Finally I would like to thank the maintenance professionals across the MAF that took the time out of their busy schedules to complete three rounds of surveys to make this research possible.

Timothy R. Guy

## Table of Contents

## List of Figures

Page

KC-46A ENTERPRISE FLEET MANAGEMENT

# I. Introduction

## Background

The previous AMC Commander (Gen Selva) tasked AMC/A5Q to take a holistic view at establishing a grey tail fleet management strategy using the KC-46A as the pilot program. AMC/A5Q developed a KC-46 Maintenance and Sustainment White Paper that proposes the Air Force adopt a new enterprise management strategy utilizing commercial fleet management concepts as the backbone for the new Air Force strategy. The White Paper was briefed at the 2013 Acquisition Sustainment Review and AMC/A4 took the lead in developing further logistical analysis of the White Paper. "The intent is to maximize efficiencies and aircraft availability while reducing potential redundancies and excess in infrastructure, maintenance personnel and operations and sustainment costs" (HQ/AMC/A4, 2014). This management strategy leverages new ideas and commercial fleet management concepts with the intent of maximizing efficiencies and aircraft availability while reducing potential redundancies and excess in infrastructure, maintenance personnel and operations and sustainment costs. The KC-46 fleet would have primary fleet maintenance centers or centralized repair facilities with other bases serving primarily as mission generation/regeneration centers. The primary fleet maintenance center would serve to consolidate major maintenance functions, wheel and tire functions, engine changes, and others. Due to current and projected fiscal constraints the Air Force needs to leverage commercial-like fleet management concepts. "This and

other considerations drive the need to pursue a sustainment approach for the KC-46A which maximizes internal efficiencies while also leveraging commercial best practices and reducing sustainment costs where practical. The elimination of potential redundancies and overhead in areas such as maintenance capacity, infrastructure and personnel should contribute to overall monetary savings" (HQ/AMC, 2013). This research paper looks to provide additional information to AMC/A4 while they continue to conduct their analysis.

**Currently Proposed KC-46 Support and Sustainment Strategy**

The currently proposed support and sustainment strategy for the KC-46A is much like the support and sustainment strategies for the rest of the Air Force aircraft. "The current planned long-term support concept is organic two-level maintenance consisting of organization level (O-level) and depot level (D-level) using G081/MAF Log Command and Control (C2) as the system of record for all maintenance data and Integrated Logistics Support – Supply/Standard Base Supply System (ILS-S/SBSS) as the system of record for all supply data" (HQ/AMC, 2013). Within the two level maintenance construct, repairs will be conducted on-equipment (O-level) if possible or removed and sent to a depot or regional facility (D-level) for repairs if not possible. "The Air Force will maintain the KC-46A with organic O-level and D-level maintenance under an FAA-aligned Maintenance Management Plan" (HQ/AMC, 2013).

**Research Problem Statement**

Based on current and projected fiscal constraints the USAF and more specifically AMC, needs to analyze the best way to establish the maintenance construct for the KC-

46A that maximizes efficiencies and aircraft availability while reducing redundancies in personnel, infrastructure, and operations and sustainment costs.

## Research Objectives/Questions

***Objective:***

The objective of this research is to gain a consensus from maintenance experts on the most effective maintenance construct for the KC-46A while minimizing infrastructure, maintenance personnel and sustainment costs while still meeting the KC-46A mission. The goal is to determine if AMC/A4 should look at utilizing mission generation bases and fleet maintenance centers for the KC-46A by identifying efficiencies, cost savings and roadblocks of consolidation efforts.

***Questions:***

- Should AMC/A4 utilize mission generation bases and fleet maintenance centers for KC-46A maintenance?
    - Are there efficiencies that could be realized utilizing mission generation bases and fleet maintenance centers?
    - If consolidation should occur, what current maintenance functions should be consolidated?
    - Can the overall infrastructure be reduced?
    - Are there any personnel cost savings? Will the cost savings be realized or transferred?
    - What are some potential roadblocks to consolidation?

## Research Focus

This research focused on the KC-46A program and the potential to stand up fleet maintenance centers and mission generation bases. The research did not focus on specific bases or locations for the establishment of these constructs. It also did not cover other AMC aircraft.

## Methodology

This research utilized a three round Delphi study to collect and analyze the expert opinions of Maintenance Officers assigned to AMC, mostly at the squadron, group and wing levels. The first round of the survey consisted of open-ended questions to gather expert opinions on utilizing fleet maintenance centers and mission generation bases for the KC-46A. The researched utilized the panels input to develop the second round of questions. The second round of questions asked the experts to evaluate a number of options derived from the first round answers using a Likert Scale. They were also asked to rank order some of the suggestions from the first round. The final round consisted of similar questions as the second but also presented the panel with the cumulative results of round two. This round allowed the respondents to change or modify their answers based on the overall group responses if applicable.

## Assumptions/Limitations

### *Assumptions:*

This paper includes a number of assumptions regarding the maintenance construct for the KC-46A. First, utilizing fleet maintenance centers and mission generation bases for KC-46A maintenance is a step to implementing an enterprise fleet management

strategy. Second, the maintenance requirements for the KC-46A will be similar to the KC-135 under the two-level maintenance concept. Third, the KC-135 and KC-46A programs are similar for maintenance operations. Fourth, any additional maintenance requirements for the KC-46A will be offset by a different maintenance function. Fifth, the Air Force would be able to divest itself of any excess infrastructure realized by centralizing any KC-46A maintenance functions. Finally, any legal issues will be able to be overcome to implement fleet maintenance centers and mission generation bases if required.

***Limitations:***

One of the major limitations for this research is; maintenance data for the KC-46A does not currently exist. The program is in its infancy and the projected maintenance intervals and the overall maintenance requirements are not defined. The researcher and respondents relied on knowledge from other platforms to inform their opinions of potential KC-46A maintenance requirements. The KC-46A is a Boeing 767 variant however the Air Force has different maintenance requirement than the commercial industry and the KC-46A contains parts unique to the Air Force requirement.

Another limitation is the limited response from conducting an online survey. The researched utilized a panel size large enough to be statistically significant, however the responses of the panel members were not guaranteed. The panel also did not have to complete the entire survey once they started it which could change how significant some answers were compare to others.

## Implications

This research provides Senior Leadership with some recommendations for consolidation as well as potential roadblocks to consolidation for the KC-46A maintenance enterprise. It has the potential to impact the entire KC-46A program and how it's managed as well as impact the maintenance construct for other airframes. It should also provide Senior Leadership a view of how the field feels about consolidating maintenance activities for major weapon systems.

# II. Literature Review

## Chapter Overview

There are a number of reports, studies and articles written on maintenance operations for the commercial airline industry and a handful of reports written on Air Force maintenance operations. This chapter analyzes the reports, studies and articles as they relate to both the Air Force and the commercial airline industry providing a background for maintenance operations. This chapter introduces the Delphi Methodology and Likert Scale as tools for utilizing a panel of experts for research purposes. Due to the limited amount of KC-46A maintenance data available, the researcher relied on the Delphi method and Likert Scale to gain new insights into the research question.

## RAND Studies

The proposed KC-46A aircraft future enterprise-level management strategy focuses on maintenance and sustainment. This management strategy leverages new ideas and commercial fleet management concepts with the intent of maximizing efficiencies and aircraft availability while reducing potential redundancies and excess in infrastructure, maintenance personnel and operations and sustainment costs (HQ/AMC, 2013). The KC-46 fleet would have primary fleet maintenance centers or centralized repair facilities (CRF) with other bases serving primarily as mission generation/regeneration centers. The primary fleet maintenance center would serve to consolidate major maintenance functions, wheel and tire functions, engine changes, and others. It is assumed that moving to a fleet management strategy creates efficiencies and

cost savings for the program. This maintenance consolidation is a departure from the current maintenance strategy where every base has a full maintenance group to support the repair of the aircraft. Maintenance processes will be changed from the local level to the centralized repair facilities with the hope of generating efficiencies in the maintenance enterprise and saving on personnel and infrastructure costs.

Numerous reports have been developed dealing with the consolidation of maintenance functions for a number of different Air Force aircraft. The RAND Corporation, through Project Air Force, has produced reports in 2009 dealing with consolidation of the F-16 and KC-135 maintenance enterprise and in 2011 dealing with the consolidation of C-130 maintenance functions. In one of the RAND studies the authors claim:

> "Our major overarching conclusion is that consolidated wing-level scheduled inspections and component back-shop maintenance capabilities would be more effective and efficient than the current system, in which every wing has significant maintenance capabilities to accomplish these activities. Consolidation yields efficiencies because it requires fewer people. It is more effective because consolidation can speed the flow of aircraft through inspections, which means fewer aircraft are tied up in maintenance processes at any given time and, thus, more aircraft are available to the operational community." (Tripp et al., 2010).

The authors recommend a consolidated approach to inspections and back-shop maintenance activities. Through consolidation the Air Force can take advantage of the efficiencies and effectiveness that comes with consolidation. According to Van Roo et al. (2011), "The Air Force can maintain its C-130 fleet using significantly fewer resources or can increase operational unit maintenance capabilities at a cost comparable to that of the current system by reallocating maintenance resources from unit back shops to a centralized network", furthermore, "In addition to providing enhanced maintenance

capabilities, by implementing the CRF concept, the Air Force would realize gains in operational effectiveness of the C-130 fleet" (Van Roo, et al., 2011). McGarvey et al, also discuss the efficiencies and effectiveness of the F-16 fleet and KC-135 fleet:

> "For both the F-16 and the KC-135, our analyses suggest that the potential exists for improvements in operational effectiveness and/or system efficiency, whether the CRF network supports the TF or only the AD and AFRC forces. If the CRF network supports only the AD/ AFRC forces, the associated reduction in backshop manpower is large enough to create a split-operations capability at AD and AFRC squadrons without increasing the baseline total maintenance manpower; resources would not be freed to also generate a split-operations capability at ANG squadrons. While the potential savings associated with the increased-efficiency alternative would be larger for the TF network, there is still an economic case for repair network centralization for an AD/AFRC CRF network." (McGarvey, et al., 2009).

These RAND studies recommend consolidating the maintenance enterprise, specifically the back shops and inspection functions to take advantage of the efficiencies and effectiveness of consolidation. All of these studies utilize actual air force maintenance data from past years and the Logistics Composite Model (LCOM) for each aircraft. The LCOM model takes a number of inputs, runs a Monte Carlo simulation and provides a number of outcomes based on the parameters loaded in the LCOM model. RAND's recommendation for consolidation applies to everything from single seat fighters to tactical airlift aircraft and air refueling aircraft. There is no reason to believe that it will not hold true to the latest air refueling aircraft as well.

RAND completed another study in 2008, sponsored by Deputy Chief of Staff for Installations and Logistics with the premise "that well-designed CONUS CIRF [centralized intermediate repair facilities] networks could provide maintenance support more efficiently and effectively than can the traditionally used procedures, which generally rely on decentralized, or local, maintenance facilities" (McGarvey et al., 2008).

The authors examined a number of failed aircraft components and tried to determine if it was more efficient to repair these components at a centralized location or continue to repair them at the local installation. They looked at aircraft engines, EW pods, targeting pods and F-15 avionics LRUs. Through their analysis the authors came to a number of conclusions. First, "CONUS CIRF is a cost-effective maintenance strategy." (McGarvey et al., 2008). They discovered that the centralized repair facilities outperformed decentralized repair facilities in both weapon system availability and cost. They also found that the increased transportation costs are offset by the potential manpower savings gained through centralization. Additionally, the authors found that larger bases are good candidates for CIRF locations because of the number of assets located there and reduction of transportation costs for these assets. Once again, RAND recommends a centralized management strategy because of the cost savings and efficiencies gained by centralization over a distributed maintenance strategy.

**Airline Industry**

While RAND has developed a number of reports dealing with the centralization of different maintenance functions, the Air Force can also look to industry to analyze emerging trends in maintenance concepts and practices. The airline industry has recently experienced a number of mergers and consolidations because of increased maintenance costs and skyrocketing fuel prices. The industry is continuously looking for ways to reduce its non-fuel costs like maintenance and personnel costs. One of the major ways the airline industry is reducing its maintenance costs is through centralization and outsourcing. "Prior to 2012, some 30% of all North American airline heavy maintenance

and modification hours were generated internally…for 2013-14, ATS predicts this will drop to 22%" (Seidenman and Spanovich, 2013).

In the airline industry, much of the backend maintenance is performed by maintenance, repair and overhaul (MRO) networks. MRO networks can either be contracted out to a third party or maintained under a parent airline or parent company. These networks provide airlines a number of repair options including airframe, engine and component services. Some MRO providers will also perform line maintenance and modifications as well. "The airframe MRO market-including heavy checks, line maintenance and modifications will be worth about $17.5 billion in 2014. This includes $9.1 billion for narrowbody aircraft and $8.4 billion for the widebody fleet (Baldwin, 2013). The MRO network is expected to continue to grow to $90 billion by 2024 at a rate of 3.8% per year (Kelly, 2015). This network provides direct savings to the airlines through consolidation and efficiencies driven by economies of scale. Most of the MROs work on aircraft from many of the different major carriers which allows them to focus on a particular type or style of airframe and pass this expertise and cost savings back to the carriers. "The airline industry has seen its unit costs for maintenance, repair and overhaul services decline by 19% in the last four years even as the MRO industry exhibits healthy growth rates, particularly in outsourcing" (Mecham, 2006). MROs are also able to lower costs by using data to identify trends and recommend major overhauls to components instead of waiting until failure and having to replace the components. One example a MRO identified was the integrated drive generator which costs $500,000 to replace. The MRO was able to recommend removal and overhaul before the part failed saving the airlines the replacement cost (Baldwin, 2013). MROs are also able to keep costs down by

paying employees less and utilizing places with lower pay scales than the US. "Mechanics at maintenance contractors tend to be non-union and earn less than airline mechanics. Airlines are outsourcing work to firms in the USA as well as Mexico, Central America, Africa, Asia and other locations with lower pay scales than the USA" (Adams, 2007).

Outsourcing and centralizing maintenance functions can represent a major cost savings for airlines. From 2001 – 2005, Delta Airlines lost $8.5 billion. As a way to stem some of those losses Delta outsourced scheduled maintenance on 344 jetliners and cut 2,000 maintenance jobs to try and save $240 million over five years (Adams, 2005). Delta identified maintenance as a major cost to the company and looked at ways to minimize those costs. Many of the other major airlines had already used outsourcing as a way to reduce maintenance costs across their enterprise. "United, for example, closed two major maintenance centers as part of its bankruptcy restructuring, contracted out the work and furloughed mechanics. More than half of its maintenance spending now goes to private contractors, up from 21% in 1990" (Adams, 2005). "When an airline must cut quickly, "maintenance pops right up," says Steve Casley of consulting firm Back Aviation Solutions. He said it's the third-biggest cost after labor and fuel" (Adams, 2005). Delta identified maintenance outsourcing/consolidation as a major cost saving area. As Steve Casley pointed out for airlines, maintenance is typically the third biggest cost they incur. Finding a way to drive this cost down is critical to the airlines to allow them to continue to operate. All of the major US air carriers' contract out a portion of their maintenance activities. By 2011, "American, Continental, Delta and United airlines, and US Airways combined to spend 40.8% of their maintenance dollars with outside

providers. American held firm at 24.4%. At the other end of the spectrum? US Airways, at 57.8%" (Broderick, 2013).

Foreign carriers utilize consolidation and outsourcing as well. Cathay Pacific Airlines, Hong Kong's largest airline, contracts out almost all of its maintenance efforts. "Cathay Pacific outsources all of its maintenance, with the exception of line maintenance outside Hong Kong" (Schofield, 2012). The reason for this is to keep operational costs low and focus on core competencies of operating the airline. Some of the major advantages and disadvantages of outsourcing almost all of the maintenance activities include:

> "The advantages are that it's quite a flexible arrangement, in a very volatile business. It's not a fixed cost within the airline. Another major benefit is that the [providers] like Haeco are experts in MRO. They are specialized, so they optimize turnaround time, quality and cost. A disadvantage is that the airline needs to be able to work effectively with another company or companies. Working across a company boundary takes effort, and we work hard at partnering well with Haeco. You need to have sufficient oversight and involvement. So you need to work at [the relationship]; it doesn't come for free." (Schofield, 2012).

Cathay's outsourcing arrangement with Haeco provides them with a robust maintenance network with a lower cost than they can accomplish in house.

The proposed KC-46A fleet management strategy leverages new ideas and management concepts from the commercial aviation world. This proposed strategy could fundamentally change the way the Air Force maintains and sustains its future aircraft fleet. Many of these changes are required to reduce redundancies in the current maintenance environment and reduce costs in response to the current fiscal environment. RAND, through numerous studies, recommends the Air Force consolidate major maintenance functions, wheel and tire functions, and engine changes. Their analysis used

actual maintenance data and simulation models to recommend the consolidation of these functions and realize the potential for manpower and facility savings. Using the commercial aviation industry as a comparison also makes a strong case for consolidation. Since the 1990s, many commercial aviation companies have stopped performing many maintenance functions in-house and have sent most of that work to MROs. These MROs generate efficiencies and cost savings for the airlines through better facility and personnel utilization as well as providing detailed trend analysis. The Air Force can leverage both the RAND studies and the commercial aviation industry to implement the KC-46A fleet maintenance centers and mission generation bases.

**Delphi Method**

When making decisions, senior leaders need to be armed with the best information available to make the most informed decision. Senior leaders can use quantitative or qualitative data to better inform their decisions. Quantitative data, or data that can be measured, is usually preferred since the measurements can be duplicated and analysis is usually easier to perform. Qualitative data, or more descriptive data, is harder to measure and analyze. One of the ways to capture qualitative or mixed (qualitative and quantitative) data is utilizing the Delphi Method. The Delphi method is a research method developed by RAND in the 1950s to assist with policy making, organizational decision making and to inform organizational practices (Brady, 2015).

The Delphi method utilizes structured anonymous communication between subject matter experts on a particular topic. The goal of the Delphi method is to reach a consensus in the areas of policy, practice or organizational decision making. Delphi

studies typically have three rounds of questionnaires that typically begins with open ended questions, a second round where participants can provide feedback on based on the round one responses and a final questionnaire developed from the previous two rounds to develop a final consensus (Brady, 2015). The data collected from the Delphi method can be analyzed and used to make better informed decisions.

## The Likert Scale

In order to correctly interpret data from a Delphi study the researcher needs a way to quantify responses to survey questions. The Likert Scale provides researchers a tool to quantify response results for more in-depth analysis. The Likert Scale was developed in 1932 by Rensis Likert as an effort to quantify attitudinal research (Edmondson, 2004). Respondents are presented with a number of questions and a scale to rate their level of agreement with the questions. The scale can range from three to 21 different choices depending on the survey. Typically researchers use a five point scale. The Likert scale assigns values from one to five on the scale with one being on the negative end and five being on the positive (Edmondson, 2004). Researchers can then use this data to conduct statistical analysis to interpret the results of the survey.

## Chapter Summary

This chapter provided information on maintenance consolidation as it applies to the airline industry and the Air Force. It also covered the Delphi Method as an instrument of research and the Likert Scale for interpreting survey results. This information provides a foundation for the methodology used in Chapter 3 and research analysis conducted in Chapter 4.

# III. Methodology

## Chapter Overview

The KC-46A is still in development and the maintenance schedule intervals are still being established. Since current maintenance data does not exist, using the LCOM model and projected maintenance intervals to run simulations to predict required maintenance manning levels for different candidate locations at is not feasible at this time. Because limited maintenance data exists, the researcher relied on a panel of experts and the Delphi Method to establish a consensus of maintenance experts on the best maintenance construct for the KC-46A enterprise. The maintenance exerts chosen were seasoned maintenance officers in the Mobility Air Force. They were asked to provide their opinion on questions in three different rounds of the survey. The questions in each round built off the previous rounds answers. The surveys were created using the SurveyMonkey website and accessed via a web browser on the respondents end. The results were analyzed and the findings are presented in Chapter 4.

## Delphi Method

The researcher utilized the Delphi Method to conduct the survey and conducted three rounds of questioning. Round one consisted of asking the panel open ended questions about how they felt about establishing mission generation bases and fleet maintenance centers for the KC-46A enterprise. They were also asked questions on consolidating maintenance activities overall as well as advantages/disadvantages and roadblocks to consolidation. In round two the panel was asked to rank questions based on their responses to the round one questionnaire from strongly agree to strongly disagree

(1 to 5 scale). They were also asked to rank order responses for two questions. In round three the panel was presented with the average panel and demographic scores from round two and asked to once aging chose their level of agreement with questions based on round two results.

**Round One Questionnaire**

The questions for round one were based on the AMC KC-46A Enterprise Fleet Management whitepaper as well as the researcher's experience in maintenance. The panel was asked for their feelings on establishing mission generation bases and fleet maintenance centers for the KC-46A enterprise. They were asked to provide a little demographic information and then presented with eight questions regarding the establishment of these constructs as well as questions regarding overall maintenance consolidation. The questionnaire was sent to about 60 potential panel members. The entire round one questionnaire is in Appendix A. Round One Questionnaire.

***Round One Survey Questions***

- How do you feel about standing up fleet maintenance facilities and mission generation bases for the KC- 46A maintenance construct?
- How do you feel about consolidating maintenance activities for the KC-46A to save on facility and manpower costs and reduce redundancy?
- If consolidation of maintenance functions would occur, what activities do you feel we should consolidate?
- What do you feel are some roadblocks to consolidation?

- Do you have experience with centralized repair facilities?

- What are some disadvantages of centralized repair facilities?

- What are some advantages of centralized repair facilities?

- Do you think centralized repair facilities create effectiveness and efficiency for the maintenance enterprise? Please cite specific reasons for your opinion

The panel was given two weeks to respond to the questionnaire and 33 of the 60 potential panel members responded. The panel provided a number of opinions that were analyzed and used to develop the questions for round two.

**Round Two Questionnaire**

The questions for round two were developed using panel responses from the questions in round one. The responses were analyzed for key themes in each response and these themes were used to develop the questions for round two. The SurveyMonkey text analysis tool was utilized to assist with identifying key themes and ideas and provided a starting point for generating questions for round two.

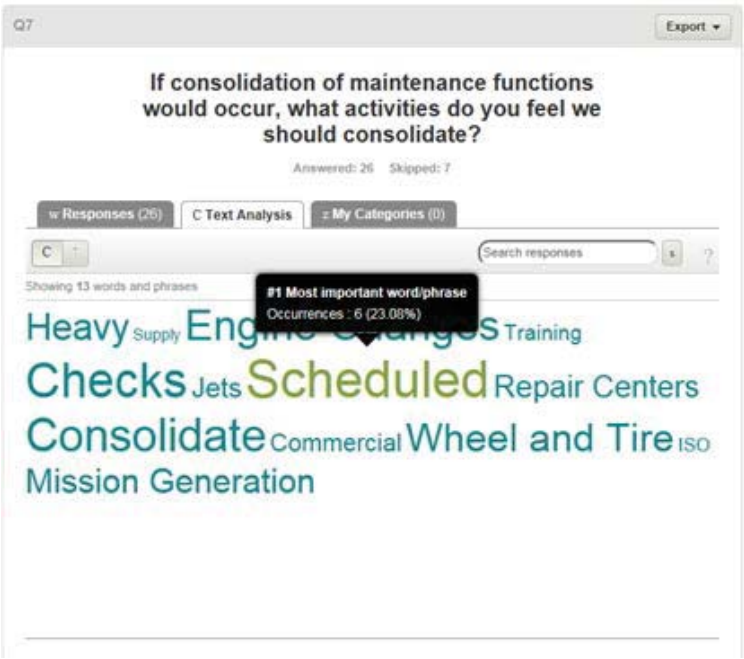



**Figure 1. SurveyMonkey Text Analysis**

The panel was asked to use a Likert Scale ratings providing their level of agreement from strongly agree to strongly disagree for seven questions and was also asked to rank order their responses for two additional questions. The survey was sent to the same 60 panel members, but only those that participated in round one were asked to continue in round two. The entire round two questionnaire is in Appendix B. Round Two Questionnaire.

***Round Two Survey Questions***

- Please rate how much you agree with standing up the following maintenance constructs for the KC-46A.
    - Fleet Maintenance Center
    - Mission Generation Bases
- Please rate the following statements regarding consolidating maintenance activities.

    - Consolidating maintenance activities for the KC-46A will drive substantial facility savings
    - Consolidating maintenance activities for the KC-46A will drive substantial manpower savings
    - Consolidating maintenance activities for the KC-46A will substantially reduce redundancy
- Please rate how much you agree with consolidating the following maintenance functions.
- Please rank order each of the 15 maintenance functions based on how you feel their consolidation will help the KC-46A maintenance enterprise. (1 being help the most and 15 being help the least)
- Please rate how much you agree the following are roadblocks to consolidation
- Please rank the 12 roadblocks from 1 most inhibiting to 12 least inhibiting
- Please rate your level of agreement with the following DISADVANTAGES of centralized repair facilities
- Please rate your level of agreement with the following ADVANTAGES of a centralized repair facility
- Please rate your level of agreement for the following.
    - Centralized Repair facilities create effectiveness for the maintenance enterprise
    - Centralized repair facilities create efficiency for the maintenance enterprise

The panel was given a two week timeline to complete round two of the survey and 21 of the 33 panel members that completed round one completed round two in that time. The panel's responses from round two were used to develop questions for round three.

**Round Three Questionnaire**

The questions for round three were developed using analysis of the responses to the questions from round two. The Likert Scale responses were analyzed for the entire

panel population and a number of different subgroups based on rank, major weapon system and level of current assignment. The mean scores were presented back to the panel and they were asked their level of agreement on questions derived from the round two questions.

| | Panel Mean | | Squadron | Group | Wing, HQ, School | O-4 | O-5 | O-6 | Tankers | Airlift |
|---|---|---|---|---|---|---|---|---|---|---|
| Please rate how much you agree with consolidating the following maintenance functions. | | | | | | | | | | |
| ISO/HSC | 4.11 | | 4.83 | 3.22 | 5.00 | 4.83 | 4.30 | 2.00 | 3.83 | 4.23 |
| A-Checks | 3.32 | | 4.17 | 3.22 | 2.25 | 3.83 | 3.40 | 2.00 | 3.83 | 3.08 |
| B-Checks | 3.47 | | 4.17 | 3.56 | 2.25 | 3.83 | 3.40 | 3.00 | 3.83 | 3.31 |
| C-Checks | 4.00 | | 3.83 | 3.78 | 4.75 | 4.00 | 4.10 | 3.67 | 3.33 | 4.31 |
| Wash | 3.05 | | 4.00 | 2.44 | 3.00 | 2.83 | 3.70 | 1.33 | 3.67 | 2.77 |
| Composites/Paint | 3.94 | | 4.33 | 3.38 | 4.50 | 4.20 | 4.30 | 2.33 | 3.17 | 4.33 |
| Wheel and Tire | 3.32 | | 3.67 | 2.89 | 3.75 | 3.67 | 3.40 | 2.33 | 3.50 | 3.23 |
| Sheet Metal | 1.89 | | 2.00 | 1.78 | 2.00 | 1.83 | 2.10 | 1.33 | 2.00 | 1.85 |
| Fuel Cell | 2.58 | | 3.00 | 2.44 | 2.25 | 2.83 | 2.80 | 1.33 | 3.00 | 2.38 |
| Age | 1.74 | | 2.17 | 1.44 | 1.75 | 1.83 | 1.80 | 1.33 | 2.33 | 1.46 |
| E/E | 1.89 | | 2.00 | 2.00 | 1.50 | 1.83 | 1.78 | 2.33 | 1.83 | 1.92 |
| TCTO | 3.33 | | 4.00 | 3.00 | 3.25 | 4.20 | 3.30 | 2.00 | 3.20 | 3.38 |
| Hydraulics | 2.58 | | 3.00 | 2.44 | 2.25 | 2.67 | 2.60 | 2.33 | 2.00 | 2.85 |
| Avionics | 2.21 | | 1.83 | 2.67 | 1.75 | 1.50 | 2.60 | 2.33 | 1.50 | 2.54 |
| All scheduled maintenance that will require more that 48 hrs to complete | 3.26 | | 3.33 | 3.00 | 3.75 | 2.67 | 4.00 | 2.00 | 2.67 | 3.54 |

**Figure 2. Questionnaire Two Mean Scores**

The panel was asked once again to use the Likert Scale to provide their level of agreement with five final questions. If they did not agree with the recommendation of the panel to that point they were asked to provide input as to why they disagreed. The survey was sent to the same 60 panel members, but only those that participated in round one and two were asked to continue in round three. The entire round three questionnaire is in Appendix C. Round Three Questionnaire.

***Round Three Survey Questions***

- Please rate how much you agree with the following:
    - AMC should implement Fleet Maintenance Centers for the KC-46A
    - AMC should implement Mission Generation Bases for the KC-46A
- Please rate how much you agree with the following, If AMC were to consolidate maintenance activities they should consolidate:
    - ISO/HSC

    - C-Checks
    - Composite/Paint
- Please rate your level of agreement with the following, The largest barrier to maintenance consolidation is:
    - Congress
    - States Interests
    - Air National Guard
- Please rate your level of agreement with the following: "Prioritization conflicts are the greatest DISADVANTAGE of consolidating maintenance activities."
- Please rate your level of agreement with the following, "The largest ADVANTAGE of consolidating maintenance functions is taking advantage of economies of scale."

The panel was given a two week timeline to complete round two of the survey and 20 of the 21 panel members that completed round one and two completed round three in that time. The panel's responses from all three rounds were used to conduct the final analysis and provide recommendations.

**Summary**

This chapter provided the research method used for this study as well as an in-depth analysis of how each round of the survey was created. Panel members were selected based on their expertise. They were asked a number of open ended questions regarding fleet maintenance centers, mission generation bases and maintenance consolidation in round one. These questions were used to develop the questions in round two where the panel members were asked to utilize the Likert Scale to rank their level of agreement with the questions. These responses became the basis for round three where the panel members were asked their level of agreement on final questions.

# IV. Analysis and Results

## Chapter Overview

This chapter covers the analysis used to conduct this research. It covers Likert Analysis as well as analysis of each of the three survey rounds. A number of statistical tools are used to analyze the panel results and the results are shown using the mean, standard deviation, median and mode.

## Likert Analysis

There are numerous debates about the best way to analyze Likert data. Some researchers argue that because Likert data is ordinal, categorized in ordered groups, the best way to analyze the data is using median and mode. The best way to describe the data is by using ranges and percentages (Edmondson, 2004). Their argument is that "It is impossible to state that the difference between strongly agree and agree is the same as the difference between agree and undecided" (Edmondson 2004). Others claim that Likert data is interval, or continuous and evenly spaced, where using the mean and standard deviation is more appropriate. Data presented in this section is displayed using the mean and standard deviation as well as the median and mode.

## Round One

Round one of the survey began with four demographic questions and eight open ended questions. The questions related to standing up fleet maintenance centers and mission generation bases as well as general questions on maintenance consolidation. The goal was to identify the feeling of the field relating to maintenance consolidation and

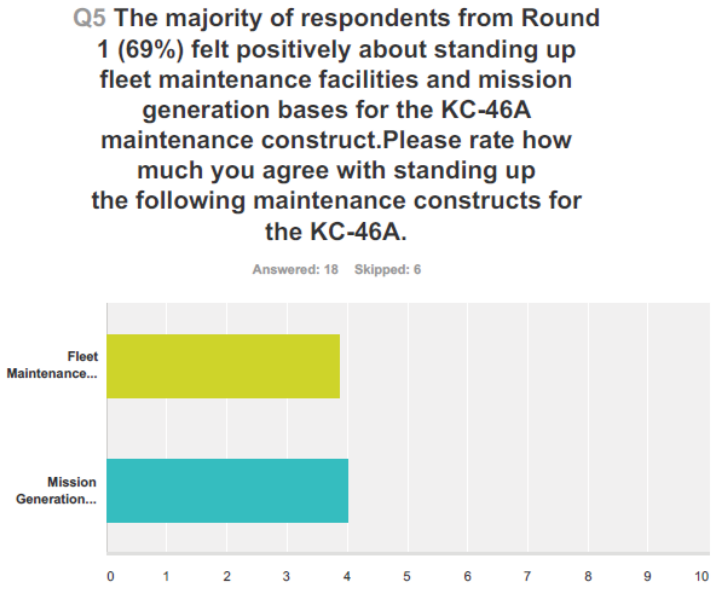
capture reoccurring themes that could be used to generate questions for round two of the survey. Thirty-Three Active Duty respondents completed the survey. The responses were all text based so the researcher read each response pulling out the common themes and overall feelings from each question.

Overall the majority of the respondents (69%) felt positively about standing up fleet maintenance facilities and mission generation bases for the KC-46A enterprise. A majority (59%) also felt that consolidating maintenance activities for the KC-46A would save on facility and manpower costs while reducing redundancy. The main argument against consolidation was respondents felt that maintenance consolidation would not save on manpower costs as the manpower would be transferred elsewhere. They also felt that the Air Force would not realize infrastructure savings without authorization to conduct another round of Base Realignment and Closure (BRAC). The respondents also provided a number of potential areas for consolidation, roadblocks to consolidation and advantages and disadvantages to consolidation. The responses to the round one questionnaire were used to create the questions presented back to the panel in round two.

**Round Two**

Round two of the survey began with three demographic questions; seven questions where the panel was asked to rank their level of agreement and two where the panel was asked to rank order a number of options. The questions were derived from the answers from round one of the survey and the overall goal was to gather panel agreement with the questions presented.

Question five asked the panel to rank their level of agreement on how much they agree with standing up fleet maintenance facilities and mission generation constructs for the KC-46A.




| | Strongly Disagree | Disagree | Neutral | Agree | Strongly Agree | Total | Weighted Average |
|---|---|---|---|---|---|---|---|
| Fleet Maintenance Centers | 5.56% 1 | 5.56% 1 | 11.11% 2 | 50.00% 9 | 27.78% 5 | 18 | 3.89 |
| Mission Generation Bases | 5.56% 1 | 5.56% 1 | 11.11% 2 | 38.89% 7 | 38.89% 7 | 18 | 4.00 |

**Figure 3. Round 2 Q5**

As you can see from Figure 3, the majority of the panel (77.78%) either agrees or strongly agrees with standing up fleet maintenance centers and mission generation bases. The median, or number where 50% of the results fall above and 50% of the results fall below, was four for establishing fleet maintenance centers and mission generation bases. The mode, or most common result, is four for establishing fleet maintenance centers and mission generation bases as well. The mean, or average, for establishing fleet maintenance centers is 3.89 with a standard deviation of 1.08 and the mean for

establishing mission generation bases is 4.0 with a standard deviation of 1.14. Figure 4 shows how the panel responded to establishing these maintenance constructs.

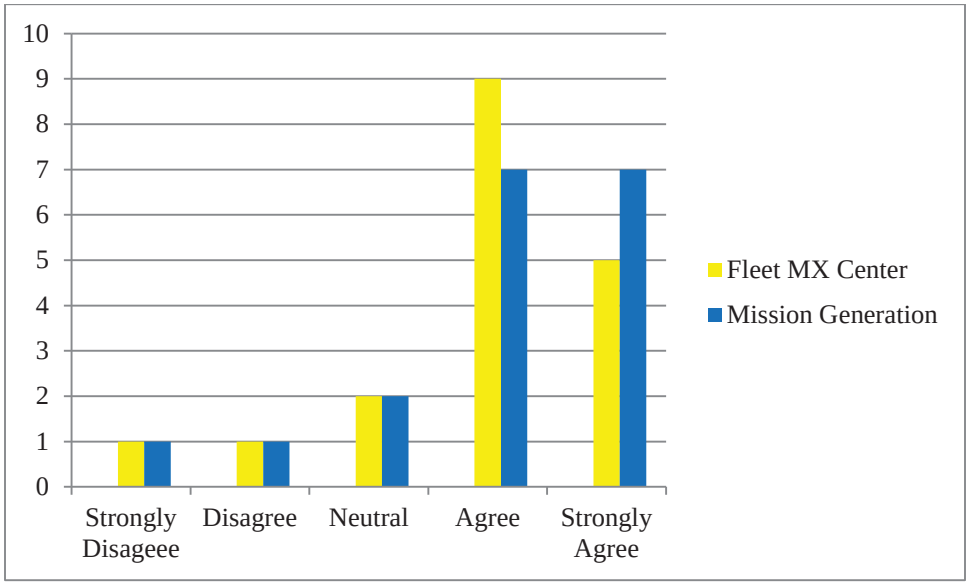
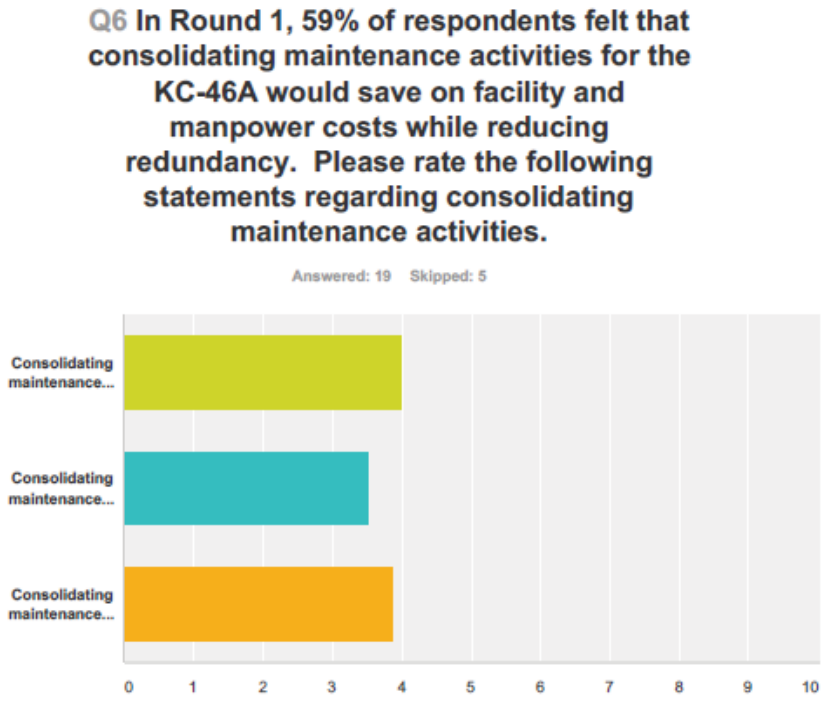



**Figure 4. Round 2 Q5 Bar Chart**

Question six asked the panel their level of agreement on consolidation of maintenance activities providing cost savings and reducing redundancy in the maintenance enterprise. Figure 5 shows that 73.69% of the panel agree or strongly agree that consolidating maintenance activities for the KC-46A will drive substantial facility savings. It also shows that 78.95% agree or strongly agree that consolidation will substantially reduce redundancy, while 52.63% agree or strongly agree that consolidation will drive substantial manpower savings. The mean for facility savings is 4.0 with a standard deviation of 1.15. For manpower savings the mean is 3.53 with a standard deviation of 1.12 and for reducing redundancy the mean is 3.89 with a standard deviation of 1.15. Overall the panel feels that consolidating maintenance activities for the KC-46A

is more likely to drive facility savings and reduce redundancy than to provide manpower savings.




| | Strongly Disagree | Disagree | Neutral | Agree | Strongly Agree | Total | Weighted Average |
|---|---|---|---|---|---|---|---|
| Consolidating maintenance activities for the KC-46A will drive substantial facility savings | 5.26% 1 | 5.26% 1 | 15.79% 3 | 31.58% 6 | 42.11% 8 | 19 | 4.00 |
| Consolidating maintenance activities for the KC-46A will drive substantial manpower savings | 5.26% 1 | 10.53% 2 | 31.58% 6 | 31.58% 6 | 21.05% 4 | 19 | 3.53 |
| Consolidating maintenance activities for the KC-46A will substantially reduce redundancy | 5.26% 1 | 10.53% 2 | 5.26% 1 | 47.37% 9 | 31.58% 6 | 19 | 3.89 |

**Figure 5. Round 2 Q6**

Questions seven asked the panel to rate their level of agreement with consolidating specific maintenance activities. Question eight asked the panel to rank order the activities where they felt consolidating would benefit the maintenance enterprise the most. For question eight the panel was asked to rank the items 1-15 with

one being the most helpful and fifteen being the least helpful. Figure 6 shows the panel mean, standard deviation, median and mode for each of the specific maintenance activities.

| | Panel Mean | SD | Median | Mode |
|---|---|---|---|---|
| Please rate how much you agree with consolidating the following maintenance functions. | | | | |
| ISO/HSC | 4.11 | 1.370107 | 5 | 5 |
| A-Checks | 3.32 | 1.565341 | 4 | 5 |
| B-Checks | 3.47 | 1.576509 | 4 | 5 |
| C-Checks | 4.00 | 1.452966 | 5 | 5 |
| Wash | 3.05 | 1.580214 | 3 | 1 |
| Composites/Paint | 3.94 | 1.392088 | 4.5 | 5 |
| Wheel and Tire | 3.32 | 1.565341 | 4 | 4 |
| Sheet Metal | 1.89 | 1.04853 | 2 | 1 |
| Fuel Cell | 2.58 | 1.426565 | 2 | 2 |
| Age | 1.74 | 0.933459 | 1 | 1 |
| E/E | 1.89 | 1.07861 | 2 | 1 |
| TCTO | 3.33 | 1.414214 | 3 | 3 |
| Hydraulics | 2.58 | 1.387075 | 2 | 2 |
| Avionics | 2.21 | 1.474937 | 2 | 1 |
| All scheduled maintenance that will require more that 48 hrs to complete | 3.26 | 1.521772 | 4 | 4 |
| | Panel Mean | SD | Median | Mode |
| Please rank order each of the 15 maintenance functions based on how you feel their consolidation will help the KC-46A maintenance enterprise | | | | |
| ISO/HSC | 4.06 | 4.880601 | 2 | 1 |
| A-Checks | 6.94 | 5.754509 | 4 | 3 |
| B-Checks | 5.67 | 4.537426 | 3.5 | 2 |
| C-Checks | 4.61 | 3.987316 | 4 | 1 |
| Wash | 7.33 | 3.985267 | 6 | 6 |
| Composites/Paint | 6.61 | 3.238353 | 6.5 | 3 |
| Wheel and Tire | 8.06 | 3.455128 | 8.5 | 9 |
| Sheet Metal | 10.78 | 2.533437 | 11 | 11 |
| Fuel Cell | 9.72 | 2.718251 | 9.5 | 9 |
| Age | 10.06 | 3.505831 | 10.5 | 11 |
| E/E | 10.44 | 3.091206 | 11.5 | 13 |
| TCTO | 7.61 | 2.659918 | 8 | 8 |
| Hydraulics | 11.00 | 3.06786 | 11.5 | 13 |
| Avionics | 10.94 | 3.857342 | 12 | 15 |
| All scheduled maintenance that will require more that 48 hrs to complete | 6.17 | 3.884358 | 5 | 5 |

**Figure 6. Round 2 Q7-8**

Question nine asked the panel their level of agreement on roadblocks to consolidation identified in round one. Question 10 asked the panel to rank order the roadblocks 1-12 with one being the most inhibiting and 10 being the least inhibiting. Figure 7 shows the panel mean, standard deviation, median and mode for each of the roadblocks.

| | Panel Mean | SD | Median | Mode |
|---|---|---|---|---|
| Please rate how much you agree the following are roadblocks to consolidation. | | | | |
| Congress | 4.26 | 0.933459 | 5 | 5 |
| State Interests | 4.42 | 0.768533 | 5 | 5 |
| Air National Guard | 4.16 | 0.898342 | 4 | 5 |
| Air Force Reserve | 3.42 | 1.017393 | 3 | 3 |
| Mission Priority | 2.68 | 1.056863 | 3 | 3 |
| Communication | 2.84 | 1.213954 | 3 | 4 |
| Leadership | 3.68 | 0.945905 | 4 | 4 |
| Organizational Resistance | 4.00 | 1.247219 | 4 | 5 |
| Priority Management | 2.84 | 1.258887 | 3 | 3 |
| Lack of Manning | 2.79 | 1.397575 | 3 | 2 |
| Lack of Funding | 2.89 | 1.286457 | 3 | 2 |
| Training | 2.17 | 1.043185 | 2 | 1 |
| | Panel Mean | SD | Median | Mode |
| Please rank the 12 roadblocks from 1 most inhibiting to 12 least inhibiting. | | | | |
| Congress | 2.68 | 3.000975 | 1 | 1 |
| State Interests | 2.68 | 2.604539 | 2 | 2 |
| Air National Guard | 4.58 | 2.93098 | 3 | 3 |
| Air Force Reserve | 5.95 | 2.504966 | 5 | 4 |
| Mission Priority | 6.79 | 2.65788 | 7 | 8 |
| Communication | 6.84 | 2.692854 | 7 | 6 |
| Leadership | 6.06 | 1.954549 | 6 | 7 |
| Organizational Resistance | 6.11 | 2.826115 | 6 | 10 |
| Priority Management | 7.67 | 2.543735 | 8 | 9 |
| Lack of Manning | 9.28 | 2.696524 | 10 | 12 |
| Lack of Funding | 8.83 | 2.749331 | 10 | 11 |
| Training | 10.06 | 2.919956 | 11 | 12 |

**Figure 7. Round 2 Q9-10**

Questions 11 and 12 ask the panel to rate their level of agreement with advantages and disadvantages of consolidation identified in round one. Figure 8 shows the panel mean, standard deviation, median and mode for each of the advantages and disadvantages.

| | Panel Mean | SD | Median | Mode |
|---|---|---|---|---|
| Please rate your level of agreement with the following DISADVANTAGES of centralized repair facilities. | | | | |
| Aircraft availability during wartime and natural disasters | 2.53 | 1.428613 | 2 | 1 |
| Prioritization conflicts | 3.47 | 0.964274 | 4 | 4 |
| Increased shipping costs | 3.32 | 1.335525 | 3 | 2 |
| Increased time for repairs | 3.21 | 1.357242 | 3 | 4 |
| Complicated organizational structure | 2.16 | 0.95819 | 2 | 3 |
| Reduced enterprise manning | 2.32 | 0.945905 | 2 | 2 |
| Lack of funding | 2.53 | 1.218762 | 3 | 3 |
| Logistics Challenges | 3.37 | 1.06513 | 4 | 4 |
| Loss of expertise | 3.26 | 1.446916 | 3 | 5 |
| | Panel Mean | SD | Median | Mode |
| Please rate your level of agreement with the following ADVANTAGES of a centralized repair facility | | | | |
| Efficient | 3.95 | 0.779864 | 4 | 4 |
| Reduces enterprise costs | 3.63 | 1.211543 | 4 | 4 |
| Create expertise | 3.16 | 0.95819 | 3 | 3 |
| Take advantage of economies of Scale | 4.05 | 0.524265 | 4 | 4 |
| Reduced infrastructure | 3.84 | 1.118688 | 4 | 4 |
| Repair process improvements | 3.63 | 1.011628 | 4 | 4 |
| Reduced enterprise manning | 2.95 | 1.129094 | 3 | 3 |
| Simplified Supply Chain | 3.11 | 1.04853 | 3 | 4 |

**Figure 8. Round 2 Q11-12**

Questions 13 asked the panel to rate their level of agreement with centralized repair facilities creating effectiveness and efficiency for the maintenance enterprise. Figure 9 shows the panel mean, standard deviation, median and mode for each of the advantages and disadvantages.

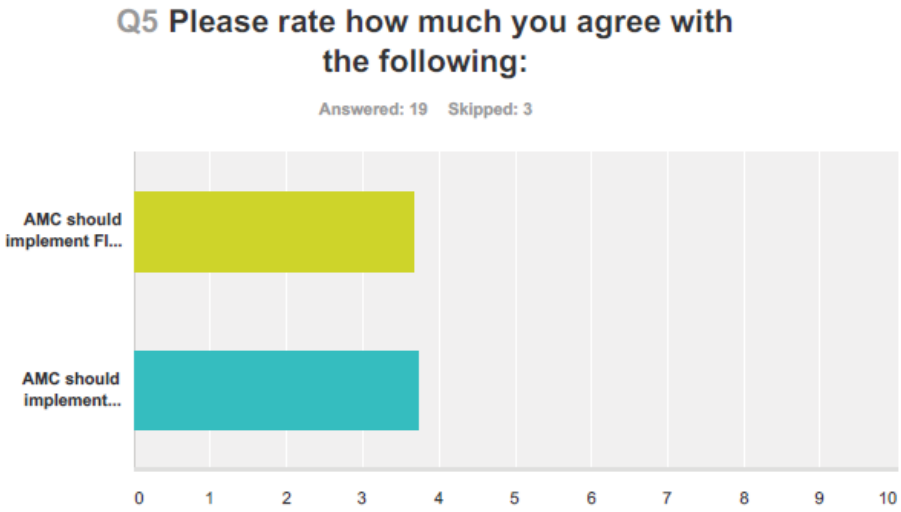
| | Panel Mean | SD | Median | Mode |
|---|---|---|---|---|
| Please rate your level of agreement for the following. | | | | |
| Centralized repair facilities create effectiveness for the maintenance enterprise | 3.68 | 1.06 | 4.00 | 4.00 |
| Centralized repair facilities create efficiency for the maintenance enterprise | 4.37 | 0.68 | 4.00 | 5.00 |

**Figure 9. Round 2 Q13**

## Round Three

Round three of the survey began with three demographic questions and five questions where the respondents were asked to rank their level of agreement with questions derived from the answers in round two. The panel was presented with a heat chart showing their answers from round two that showed the panel mean and specific demographic means. They were then asked a similar question to the one presented in round two.

Question five asked the panel to rank their level of agreement with AMC standing up fleet maintenance centers and mission generation bases for the KC-46A. Figure 10 shows the question responses.




| | Strongly Disagree | Disagree | Neutral | Agree | Strongly Agree | Total | Weighted Average |
|---|---|---|---|---|---|---|---|
| AMC should implement Fleet Maintenance Centers for the KC-46A | 5.26%<br>1 | 15.79%<br>3 | 10.53%<br>2 | 42.11%<br>8 | 26.32%<br>5 | 19 | 3.68 |
| AMC should implement Mission Generation Bases for the KC-46A | 5.26%<br>1 | 10.53%<br>2 | 10.53%<br>2 | 52.63%<br>10 | 21.05%<br>4 | 19 | 3.74 |

**Figure 10. Round 3 Q5**

As Figure 10 shows, the overall number of respondents that agree or strongly agree with AMC implementing fleet maintenance centers and mission generation bases has gone down. After round 3, 68.43% (-9.43%) of respondents responded as agree with standing up fleet maintenance center and 73.68% (-4.1%) agree with standing up mission generation bases. The mean for establishing fleet maintenance centers is 3.68 with a standard deviation of 1.20 and the mean for establishing mission generation bases is 3.74 with a standard deviation of 1.10. Figure 11 shows the new responses.

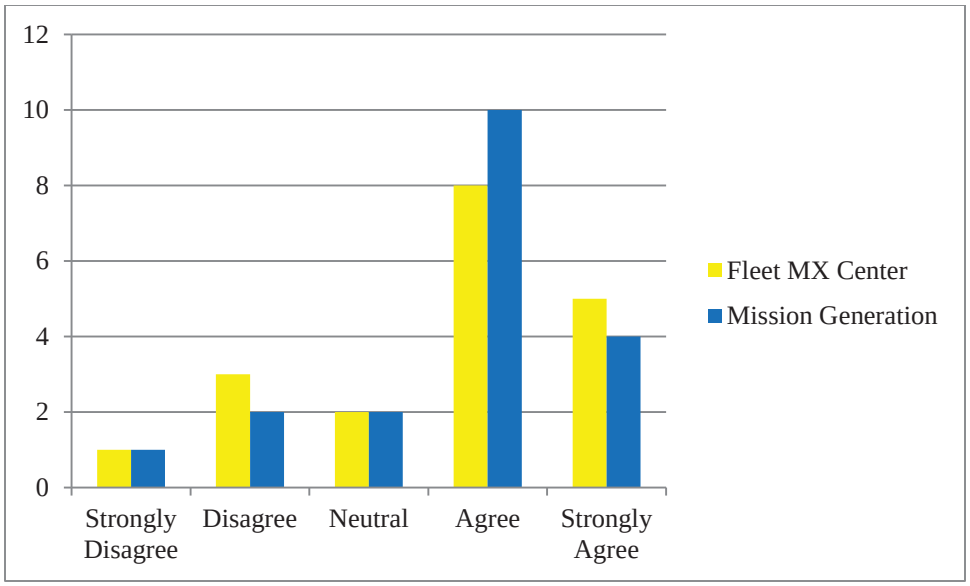



**Figure 11. Round 3 Q5 Bar Chart**

The respondents were asked if they did not agree with the panel rankings to identify why they disagreed. Six respondents provided an explanation as to why they disagree with the panel recommendation. Some of the respondents feel that consolidation will hurt readiness where others are concerned with the overall cost of transportation of parts and the aircraft to consolidated locations. Other respondents feel that it will hurt readiness and that maintenance skills will atrophy.

Question six showed the panel the top three maintenance areas recommended for consolidation based on the round two results and asked the panel to rate their level of agreement with consolidating these functions. Figure 12 shows the panel mean, standard deviation, median and mode for each of the areas recommended for consolidation.

| Please rate how much you agree with the following, If AMC were to consolidate maintenance activities they should co: | | | | |
|---|---|---|---|---|
| | Mean | SD | Median | Mode |
| ISO/HSC | 3.9473684 | 1.3933845 | 5 | 5 |
| C-Checks | 4.1578947 | 0.9581903 | 4 | 5 |
| Composite/Paint | 4.1578947 | 1.0678721 | 4 | 5 |

**Figure 12. Round 3 Q6**

Question seven showed the panel the top three roadblocks to consolidation identified in round two and asked them to rate their level of agreement with the roadblocks identified. Figure 13 shows the panel mean, standard deviation, median and mode for each of the identified roadblocks.

| Please rate your level of agreement with the following, The largest barrier to maintenance consolidation is: | | | | |
|---|---|---|---|---|
| | Mean | SD | Median | Mode |
| Congress | 4.3157895 | 0.8852264 | 5 | 5 |
| States Interests | 4.1052632 | 1.1002392 | 4 | 5 |
| Air National Guard | 3.8947368 | 1.1496249 | 4 | 5 |

**Figure 13. Round 3 Q7**

Question eight asked the panel to rank their level of agreement with "the biggest disadvantage of consolidation is prioritization conflicts." Overall 52.64% of the panel agree or strongly agree with prioritization conflicts being the biggest disadvantage. The mean is 3.32 and standard deviation is 1.06. The panel members that disagree with the panel rankings identified some additional disadvantages such as aircraft availability, possession of aircraft and maintenance skills atrophy.

Question nine asked the panel to rank their level of agreement with "the greatest advantage of maintenance consolidation is economies of scale." Eighty-nine percent of

the panel agreed the greatest advantage of maintenance consolidation is economies of scale. The panel mean is 4.16 with a standard deviation of 0.77.

**Questions Answered**

- Should AMC/A4 utilize mission generation bases and fleet maintenance centers for KC-46A maintenance?
    - Based on the panel recommendations from round two and round three, AMC/A4 should utilize mission generation bases and fleet maintenance centers for KC-46A maintenance. The majority of the panel either agrees or strongly agrees with employing these concepts.
- Are there efficiencies that could be realized utilizing mission generation bases and fleet maintenance centers?
    - Overall the panel feels that centralizing maintenance functions for the KC-46A can provide efficiencies and reduce redundancy in the maintenance enterprise.
- If consolidation should occur, what current maintenance functions should be consolidated?
    - The panel recommends consolidating ISO/HSC, C-Checks and Composite/Paint for the KC-46A enterprise.
- Can the overall infrastructure be reduced?
    - The panel feels the overall infrastructure can be reduced by implementing fleet maintenance centers and mission generation bases.

- Are there any personnel cost savings? Will the cost savings be realized or transferred?
    - The panel agrees consolidating maintenance functions can lead to personnel savings however there are concerns that the savings would not be realized and the manpower would just be transferred elsewhere.
- What are some potential roadblocks to consolidation?
    - The panel identifies Congress, states interests and the Air National Guard as potential roadblocks to consolidation.

**Summary**

This chapter covered typical analysis for Likert type responses and reviewed the statistical analysis from all three rounds of questionnaires. The Delphi method was used to capture panel opinions to open ended questions in round one, quantify levels of agreement to questions in round two and ultimately sought to reach a consensus in round three. The panel's level of agreement was represented by the panel mean, standard deviation, median, mode and percentages. Finally this chapter answered the research questions to help meet the research objective.

# V. Conclusions and Recommendations

## Chapter Overview

This chapter discusses the research conducted for this study. It also covers the significance of the research and end with some recommendations for additional research.

## Summary of Research

The goal of this research is to gain a consensus from maintenance experts on the most effective maintenance construct for the KC-46A while minimizing infrastructure, maintenance personnel and sustainment costs while still meeting the KC-46A mission. The objective is to help identify efficiencies and cost savings of utilizing centralized repair facilities for major maintenance functions as well as identify any roadblocks for consolidation efforts and determine if AMC/A4 should look at utilizing mission generation bases and fleet maintenance centers for the KC-46A.

A panel of 20 maintenance experts was asked, through the Delphi method, to answer a number of open ended questions regarding consolidation of maintenance activities. The answers were used to develop a second round of questions where the panel was asked to rank their level of agreement with the questions. Finally, a third round of questions was generated to see if the panel concurred with the recommendations.

Overall, the panel recommends standing up fleet maintenance centers and mission generation bases for the KC-46A maintenance construct. They feel that establishing this maintenance construct will drive substantial facility cost saving and may drive some manpower savings as well. The panel believes that consolidating maintenance activities

for the KC-46A will also reduce redundancy. The panel identified HSC/ISO, C-Checks and Composite/Paint as areas for potential consolidation. They also identified Congress, states interests and the Air National Guard as the top three roadblocks to consolidation.

**Significance of Research**

This research provides Senior Leadership with some recommendations for consolidation as well as potential roadblocks to consolidation for the KC-46A maintenance enterprise. The panel of maintenance experts identified potential areas for consolidation as well as some areas of concern with regards to consolidation. The panel also identified possible areas for cost savings from maintenance consolidation. Senior Leadership can use these recommendations to help shape the future of the KC-46A program. At a minimum, this research provides Senior Leadership with insight on how the field views standing up fleet maintenance centers and mission generation bases for the KC-46A enterprise.

**Recommendations for Future Research**

This research only covered fleet maintenance centers and mission generation bases for the KC-46A enterprise. Due to limited maintenance data and unknown maintenance intervals on the KC-46A, the researcher used the Delphi method to gather expert opinions on the establishment of these maintenance activities. As the program matures and more data becomes available, a more thorough quantitative analysis can be performed.

The first recommendation for future research is to utilize an updated LCOM model and projected maintenance data to determine the number of personnel required at

each fleet maintenance center and mission generation base. This will allow the researcher to determine the potential cost savings of implementing this maintenance structure.

Another recommendation is for researchers to determine the best way to implement fleet maintenance centers and mission generation bases. This research explored if the maintenance construct should be implemented but did not address how it should be implemented. Without a solid plan in place, implementing a new maintenance structure will probably not be successful.

The final recommendation for future research is to decide if this research can be expanded to other platforms. This research only looked at the KC-46A enterprise; however similar concepts may be able to be applied to other aircraft in the Air Force inventory.

**Summary**

This chapter covered a summary of the research conducted for the study including the goals and methodology used. It summarized the results of the study and highlighted the significance of the findings. Finally it provided recommendations for future research that enhances the results found in this research.

## Appendix A: Round One Questionnaire

KC-46A Enterprise Fleet Management

### Introduction

**You are receiving this questionnaire as an experienced Maintenance Officer in the Mobility Air Forces (MAF). By responding, you have the unique opportunity to influence and shape maintenance activities in the MAF. The purpose of this research is to explore potential efficiencies and cost savings of a fleet management strategy over the current distributed management strategy for the KC-46A enterprise.**

**BACKGROUND: Due to current and projected fiscal realities, the Air Force needs to identify new ways to save money while retaining effectiveness. One potential way to do this is adopt a management strategy that leverages new ideas and commercial fleet management concepts with the intent of maximizing efficiencies and aircraft availability while reducing potential redundancies and excess in infrastructure, maintenance personnel and operations and sustainment costs. Under this new strategy, the KC-46 fleet would have primary fleet maintenance center(s) with other bases serving primarily as mission generation/regeneration centers. The primary fleet maintenance center would serve to consolidate major mx functions such as A-checks, wheel and tire functions, engine changes, and others. While the mission generation/regeneration centers would be primarily responsible for launching and recovering aircraft.**

**Please note the following:**

**BENEFITS and RISKS: There are no personal benefits or risks for participating in this study. Your participation in completing this questionnaire should take less than 20 minutes per round.**

**CONFIDENTIALITY: All survey responses are confidential. Your identity will not be associated with any responses you give in the final research report. No individual data will be reported; only data in aggregate will be made public. I understand that the names and associated data I collect must be protected at all times, only be known to the researcher, and managed according to the Air Force Institute of Technology (AFIT) interview protocol. At the conclusion of the study, all data will be turned over to the advisor and all other copies will be destroyed.**

**PARTICIPATION: Your participation in this study is completely voluntary. You have the right to decline to answer any question, to refuse to participate or to withdraw at any time. Your decision of whether or not to participate will not result in any penalty or loss of benefits to which you are otherwise entitled. Completion of the questionnaire implies your consent to participate.**

**INSTRUCTIONS:**

**Please complete this survey by 18 December 2015.**

**This survey is an instrument of a Delphi study. The surveys are designed to focus on problems, opportunities and solutions. Each survey round is developed based on the group results of the previous questionnaire. The process continues until sufficient data has been collected to answer the primary research question.**

**This survey is expected to take 3 rounds with the panel. Again, the questionnaire is non-attributional, so please elaborate fully on your answers. Subsequent rounds will be announced as needed and all research will conclude by March 2016.**

**Round 1 requests a small amount of demographic information, and consists of two primary and six secondary research questions which will shape the questions on subsequent rounds.**

**CONTACT: If you have questions about this survey please contact Maj Timothy R. Guy by email at timothy.guy.1@us.af.mil**

**KC-46A Enterprise Fleet Management**

## Demographics

1. Grade/Rank

- ◯ O-1/2d Lt
- ◯ O-2/1st Lt
- ◯ O-3/Capt
- ◯ O-4/Maj
- ◯ O-5/Lt Col
- ◯ O-6/Col
- ◯ O-7/Brig Gen

2. Which MWS(s) is associated with your current unit, or your last operational unit?

3. Which service component are you a member of?

- ◯ AD
- ◯ AFRC
- ◯ ANG

4. Current duty position level

- ◯ Flight
- ◯ Squadron
- ◯ Group
- ◯ Wing
- ◯ HQ
- ◯ Other (please specify)

## Questions

5. How do you feel about standing up fleet maintenance facilities and mission generation bases for the KC-46A maintenance construct?

6. How do you feel about consolidating maintenance activities for the KC-46A to save on facility and manpower costs and reduce redundancy?

7. If consolidation of maintenance functions would occur, what activities do you feel we should consolidate?

8. What do you feel are some roadblocks to consolidation?

9. Do you have experience with centralized repair facilities?

10. What are some disadvantages of centralized repair facilities?

11. What are some advantages of centralized repair facilities?

12. Do you think centralized repair facilities create effectiveness and efficiency for the maintenance enterprise? Please cite specific reasons for your opinion.

13. Other comments?

## Appendix B: Round Two Questionnaire

### KC-46A Enterprise Fleet Management Round Two

Introduction

**You are receiving this questionnaire as an experienced Maintenance Officer or Operator in the Mobility Air Forces (MAF) that has completed Round 1 of this Dephi Study. Only Round 1 participants should continue with this questionnaire.**

**Round 2 questions are based on the collective responses from Round 1. Many of the questions will ask you to quantitatively rate the most popular survey responses from the previous round.**

**Please note the following (same as Round 1):**

**PURPOSE: The purpose of this research is to explore potential efficiencies and cost savings of a fleet management strategy over the current distributed management strategy for the KC-46A enterprise. The specific purpose of this Delphi Study is to gain perspective from experts in the MAF community in regards to the best maintenance construct to support the KC-46 in light of current and future budget constraints.**

**BENEFITS and RISKS: There are no personal benefits or risks for participating in this study. Your participation in completing this questionnaire should take less than 20 minutes per round.**

**CONFIDENTIALITY: All survey responses are confidential. Your identity will not be associated with any responses you give in the final research report. No individual data will be reported; only data in aggregate will be made public. I understand that the names and associated data I collect must be protected at all times, only be known to the researcher, and managed according to the Air Force Institute of Technology (AFIT) interview protocol. At the conclusion of the study, all data will be turned over to the advisor and all other copies will be destroyed.**

**PARTICIPATION: Your participation in this study is completely voluntary. You have the right to decline to answer any question, to refuse to participate or to withdraw at any time. Your decision of whether or not to participate will not result in any penalty or loss of benefits to which you are otherwise entitled. Completion of the questionnaire implies your consent to participate.**

**INSTRUCTIONS:**

**Please complete this survey by 20 January 2016.**

**CONTACT: If you have questions about this survey please contact Maj Timothy R. Guy by email at timothy.guy.1@us.af.mil**

## KC-46A Enterprise Fleet Management Round Two

### Demographics

1. Did you participate in Round 1 of this survey?

- ◯ Yes
- ◯ No

2. What is your grade/rank?

- ◯ O-3/Capt
- ◯ O-4/Maj
- ◯ O-5/Lt Col
- ◯ O-6/Col

3. Which MWS(s) is associated with your current unit, or your last operational unit?

4. Current duty position level?

- ◯ Flight
- ◯ Squadron
- ◯ Group
- ◯ Wing
- ◯ HQ
- ◯ Other (please specify)

## KC-46A Enterprise Fleet Management Round Two

### Questions

5. The majority of respondents from Round 1 (69%) felt positively about standing up fleet maintenance facilities and mission generation bases for the KC-46A maintenance construct.

Please rate how much you agree with standing up the following maintenance constructs for the KC-46A.

| | Strongly Disagree | Disagree | Neutral | Agree | Strongly Agree |
|---|---|---|---|---|---|
| Fleet Maintenance Centers | ○ | ○ | ○ | ○ | ○ |
| Mission Generation Bases | ○ | ○ | ○ | ○ | ○ |

Additional Comments (if desired)

6. In Round 1, 59% of respondents felt that consolidating maintenance activities for the KC-46A would save on facility and manpower costs while reducing redundancy.

Please rate the following statements regarding consolidating maintenance activities.

| | Strongly Disagree | Disagree | Neutral | Agree | Strongly Agree |
|---|---|---|---|---|---|
| Consolidating maintenance activities for the KC-46A will drive substantial facility savings | ○ | ○ | ○ | ○ | ○ |
| Consolidating maintenance activities for the KC-46A will drive substantial manpower savings | ○ | ○ | ○ | ○ | ○ |
| Consolidating maintenance activities for the KC-46A will substantially reduce redundancy | ○ | ○ | ○ | ○ | ○ |

Additional Comments (if desired)

7. In Round 1 I asked, "If consolidation of maintenance functions would occur, what activities do you feel we should consolidate?"

Please rate how much you agree with consolidating the following maintenance functions.

| | Strongly Disagree | Disagree | Neutral | Agree | Strongly Agree |
|---|---|---|---|---|---|
| ISO/HSC | ○ | ○ | ○ | ○ | ○ |
| A-Checks | ○ | ○ | ○ | ○ | ○ |
| B-Checks | ○ | ○ | ○ | ○ | ○ |
| C-Checks | ○ | ○ | ○ | ○ | ○ |
| Wash | ○ | ○ | ○ | ○ | ○ |
| Composites/Paint | ○ | ○ | ○ | ○ | ○ |
| Wheel and Tire | ○ | ○ | ○ | ○ | ○ |
| Sheet Metal | ○ | ○ | ○ | ○ | ○ |
| Fuel Cell | ○ | ○ | ○ | ○ | ○ |
| Age | ○ | ○ | ○ | ○ | ○ |
| E/E | ○ | ○ | ○ | ○ | ○ |
| TCTO | ○ | ○ | ○ | ○ | ○ |
| Hydraulics | ○ | ○ | ○ | ○ | ○ |
| Avionics | ○ | ○ | ○ | ○ | ○ |
| All scheduled maintenance that will require more that 48 hrs to complete | ○ | ○ | ○ | ○ | ○ |

Additional Comments (if desired)

8. Please rank order each of the 15 maintenance functions based on how you feel their consolidation will help the KC-46A maintenance enterprise. (1 being help the most and 15 being help the least)

- ISO/HSC
- A-Check
- B-Check
- C-Check
- Wash
- Composite/Paint
- Wheel and tire
- Sheet Metal
- Fuel Cell
- AGE
- E/E
- TCTO
- Hydraulics
- Avionics
- All scheduled maintenance that will require more than 48 hrs to complete

9. Please rate how much you agree the following are roadblocks to consolidation.

| | Strongly Disagree | Disagree | Neutral | Agree | Strongly Agree |
|---|---|---|---|---|---|
| Congress | ○ | ○ | ○ | ○ | ○ |
| State Interests | ○ | ○ | ○ | ○ | ○ |
| Air National Guard | ○ | ○ | ○ | ○ | ○ |
| Air Force Reserve | ○ | ○ | ○ | ○ | ○ |
| Mission Priority | ○ | ○ | ○ | ○ | ○ |
| Communication | ○ | ○ | ○ | ○ | ○ |
| Leadership | ○ | ○ | ○ | ○ | ○ |
| Organizational Resistance | ○ | ○ | ○ | ○ | ○ |
| Priority Management | ○ | ○ | ○ | ○ | ○ |
| Lack of Manning | ○ | ○ | ○ | ○ | ○ |
| Lack of Funding | ○ | ○ | ○ | ○ | ○ |
| Training | ○ | ○ | ○ | ○ | |

○ Additional Comments (if desired)

10. Please rank the 12 roadblocks from 1 most inhibiting to 12 least inhibiting.

- Congress
- States Interests
- Air National Guard
- Air Force Reserve
- Mission Priority
- Communication
- Leadership
- Organizational Resistance
- Priority Management
- Lack of Manning
- Lack of Funding
- Training

11. Please rate your level of agreement with the following DISADVANTAGES of centralized repair facilities.

| | Strongly Disagree | Disagree | Neutral | Agree | Strongly Agree |
|---|---|---|---|---|---|
| Aircraft availability during wartime and natural disasters | ○ | ○ | ○ | ○ | ○ |
| Prioritization conflicts | ○ | ○ | ○ | ○ | ○ |
| Increased shipping costs | ○ | ○ | ○ | ○ | ○ |
| Increased time for repairs | ○ | ○ | ○ | ○ | ○ |
| Complicated organizational structure | ○ | ○ | ○ | ○ | ○ |
| Reduced enterprise manning | ○ | ○ | ○ | ○ | ○ |
| Lack of funding | ○ | ○ | ○ | ○ | ○ |
| Logistics Challenges | ○ | ○ | ○ | ○ | ○ |
| Loss of expertise | ○ | ○ | ○ | ○ | ○ |

Additional Comments (if desired)

12. Please rate your level of agreement with the following ADVANTAGES of a centralized repair facility

| | Strongly Disagree | Disagree | Neutral | Agree | Strongly Agree |
|---|---|---|---|---|---|
| Efficient | ○ | ○ | ○ | ○ | ○ |
| Reduces enterprise costs | ○ | ○ | ○ | ○ | ○ |
| Create expertise | ○ | ○ | ○ | ○ | ○ |
| Take advantage of economies of Scale | ○ | ○ | ○ | ○ | ○ |
| Reduced infrastructure | ○ | ○ | ○ | ○ | ○ |
| Repair process improvements | ○ | ○ | ○ | ○ | ○ |
| Reduced enterprise manning | ○ | ○ | ○ | ○ | ○ |
| Simplified Supply Chain | ○ | ○ | ○ | ○ | |

○ Additional Comments (if desired)

13. In Round 1, 66% of respondents said they thought centralized repair facilities create effectiveness and efficiency for the maintenance enterprise.

Please rate your level of agreement for the following.

| | Strongly Disagree | Disagree | Neutral | Agree | Strongly Agree |
|---|---|---|---|---|---|
| Centralized repair facilities create effectiveness for the maintenance enterprise | ○ | ○ | ○ | ○ | ○ |
| Centralized repair facilities create efficiency for the maintenance enterprise | ○ | ○ | ○ | ○ | ○ |

Additional Comments (if desired)

## Appendix C: Round Three Questionnaire

### KC-46A Enterprise Fleet Management Round Three

Introduction

**You are receiving this questionnaire as an experienced Maintenance Officer or Operator in the Mobility Air Forces (MAF) that has completed Round 2 of this Dephi Study. Only Round 2 participants should continue with this questionnaire**

**THIS IS THE FINAL ROUND AND I THANK YOU VERY MUCH FOR YOUR TIME AND INPUT**

**Round 3 questions will be asking for your level of concurrence on final paper recommendations based on quantitative scores from the panel in Round 2.**

**Please note the following (same as Rounds 1 & 2):**

**PURPOSE: The purpose of this research is to explore potential efficiencies and cost savings of a fleet management strategy over the current distributed management strategy for the KC-46A enterprise. The specific purpose of this Delphi Study is to gain perspective from experts in the MAF community in regards to the best maintenance construct to support the KC-46 in light of current and future budget constraints.**

**BENEFITS and RISKS: There are no personal benefits or risks for participating in this study. Your participation in completing this questionnaire should take less than 20 minutes per round.**

**CONFIDENTIALITY: All survey responses are confidential. Your identity will not be associated with any responses you give in the final research report. No individual data will be reported; only data in aggregate will be made public. I understand that the names and associated data I collect must be protected at all times, only be known to the researcher, and managed according to the Air Force Institute of Technology (AFIT) interview protocol. At the conclusion of the study, all data will be turned over to the advisor and all other copies will be destroyed.**

**PARTICIPATION: Your participation in this study is completely voluntary. You have the right to decline to answer any question, to refuse to participate or to withdraw at any time. Your decision of whether or not to participate will not result in any penalty or loss of benefits to which you are otherwise entitled. Completion of the questionnaire implies your consent to participate.**

**INSTRUCTIONS:**

**Please complete this survey by 11 February 2016.**
**CONTACT: If you have questions about this survey please contact Maj Timothy R. Guy by email at timothy.guy.1@us.af.mil**

## KC-46A Enterprise Fleet Management Round Three

### Participation

1. Did you participate in Round 2 of this survey?

- ◯ Yes
- ◯ No

## KC-46A Enterprise Fleet Management Round Three

### Demographics

2. What is your grade/rank?

- ◯ O-3/Capt
- ◯ O-4/Maj
- ◯ O-5/Lt Col
- ◯ O-6/Col

3. Which MWS(s) is associated with your current unit, or your last operational unit?

4. Current duty position level?

- ◯ Flight
- ◯ Squadron
- ◯ Group
- ◯ Wing
- ◯ HQ
- ◯ Other

## KC-46A Enterprise Fleet Management Round Three

Explanation Page

**The next few pages will ask you to rate your level of agreement for final paper recommendations based on scores from Round 2. Scores will be displayed to aid in your decision for each recommendation.**

**Please note:**

**1) The original question from Round 2 is placed directly above the numerical values for your reference.**

**2) The average panel mean of all 22 participants will be shown on the far left and composite averages for several demographic categories are shown to the right of the Panel Mean.**

**3) Scores are conditionally formatted in Excel for you to visually identify the highest (darkest green) and lowest scores (darkest red) for each question. For ranking question the lowest scores (darkest green) and highest scores (darkest red) will be displayed for each question.**

## KC-46A Enterprise Fleet Management Round Three

### Questions

**In Round 1 the majority of respondents from Round 1 (69%) felt positively about standing up fleet maintenance facilities and mission generation bases for the KC-46A maintenance construct.**

**In Round 2 the majority of respondents felt favorably about standing up fleet maintenance facilities and mission generation bases primarily due to facility cost savings.**

| | Panel Mean | | Squadron | Group | Wing, HQ, School | O-4 | O-5 | O-6 | Tankers | Airlift |
|---|---|---|---|---|---|---|---|---|---|---|
| 5. Please rate how much you agree with standing up the following maintenance constructs for the KC-46A. | | | | | | | | | | |
| Fleet Maintenance Centers | 3.89 | | 3.80 | 3.67 | 4.50 | 4.00 | 4.22 | 2.67 | 3.33 | 4.17 |
| Mission Generation Bases | 4.00 | | 4.20 | 3.89 | 4.00 | 4.50 | 3.89 | 3.33 | 3.67 | 4.17 |
| | Panel Mean | | Squadron | Group | Wing, HQ, School | O-4 | O-5 | O-6 | Tankers | Airlift |
| 6. Please rate the following statements regarding consolidating maintenance activities. | | | | | | | | | | |
| Consolidating maintenance activities for the KC-46A will drive substantial facility savings | 4.00 | | 3.83 | 4.00 | 4.25 | 4.33 | 3.90 | 3.67 | 3.33 | 4.31 |
| Consolidating maintenance activities for the KC-46A will drive substantial manpower savings | 3.53 | | 3.67 | 3.33 | 3.75 | 4.17 | 3.40 | 2.67 | 2.33 | 4.08 |
| Consolidating maintenance activities for the KC-46A will substantially reduce redundancy | 3.89 | | 4.00 | 3.89 | 3.75 | 4.50 | 3.80 | 3.00 | 3.33 | 4.15 |

5. Please rate how much you agree with the following:

| | Strongly Disagree | Disagree | Neutral | Agree | Strongly Agree |
|---|---|---|---|---|---|
| AMC should implement Fleet Maintenance Centers for the KC-46A | ◯ | ◯ | ◯ | ◯ | ◯ |
| AMC should implement Mission Generation Bases for the KC-46A | ◯ | ◯ | ◯ | ◯ | ◯ |

Please explain if you disagree with the panel recommendation.

## KC-46A Enterprise Fleet Management Round Three

### Questions

**In Round 2 respondents recommended consolidating a number of maintenance activities**

| | Panel Mean | | Squadron | Group | Wing, HQ, School | O-4 | O-5 | O-6 | Tankers | Airlift |
|---|---|---|---|---|---|---|---|---|---|---|
| Please rate how much you agree with consolidating the following maintenance functions. | | | | | | | | | | |
| ISO/HSC | 4.11 | | 4.83 | 3.22 | 5.00 | 4.83 | 4.30 | 2.00 | 3.83 | 4.23 |
| A-Checks | 3.32 | | 4.17 | 3.22 | 2.25 | 3.83 | 3.40 | 2.00 | 3.83 | 3.08 |
| B-Checks | 3.47 | | 4.17 | 3.56 | 2.25 | 3.83 | 3.40 | 3.00 | 3.83 | 3.31 |
| C-Checks | 4.00 | | 3.83 | 3.78 | 4.75 | 4.00 | 4.10 | 3.67 | 3.33 | 4.31 |
| Wash | 3.05 | | 4.00 | 2.44 | 3.00 | 2.83 | 3.70 | 1.33 | 3.67 | 2.77 |
| Composites/Paint | 3.94 | | 4.33 | 3.38 | 4.50 | 4.20 | 4.30 | 2.33 | 3.17 | 4.33 |
| Wheel and Tire | 3.32 | | 3.67 | 2.89 | 3.75 | 3.67 | 3.40 | 2.33 | 3.50 | 3.23 |
| Sheet Metal | 1.89 | | 2.00 | 1.78 | 2.00 | 1.83 | 2.10 | 1.33 | 2.00 | 1.85 |
| Fuel Cell | 2.58 | | 3.00 | 2.44 | 2.25 | 2.83 | 2.80 | 1.33 | 3.00 | 2.38 |
| Age | 1.74 | | 2.17 | 1.44 | 1.75 | 1.83 | 1.80 | 1.33 | 2.33 | 1.46 |
| E/E | 1.89 | | 2.00 | 2.00 | 1.50 | 1.83 | 1.78 | 2.33 | 1.83 | 1.92 |
| TCTO | 3.33 | | 4.00 | 3.00 | 3.25 | 4.20 | 3.30 | 2.00 | 3.20 | 3.38 |
| Hydraulics | 2.58 | | 3.00 | 2.44 | 2.25 | 2.67 | 2.60 | 2.33 | 2.00 | 2.85 |
| Avionics | 2.21 | | 1.83 | 2.67 | 1.75 | 1.50 | 2.60 | 2.33 | 1.50 | 2.54 |
| All scheduled maintenance that will require more that 48 hrs to complete | 3.26 | | 3.33 | 3.00 | 3.75 | 2.67 | 4.00 | 2.00 | 2.67 | 3.54 |
| | Panel Mean | | Squadron | Group | Wing, HQ, School | O-4 | O-5 | O-6 | Tankers | Airlift |
| Please rank order each of the 15 maintenance functions based on how you feel their consolidation will help the KC-46A maintenance enterprise. (1 being help the most and 15 being help the least) | | | | | | | | | | |
| ISO/HSC | 4.06 | | 1.17 | 6.00 | 4.50 | 5.67 | 1.89 | 7.33 | 2.17 | 5.00 |
| A-Checks | 6.94 | | 5.50 | 5.63 | 11.75 | 7.50 | 6.56 | 7.00 | 2.50 | 9.17 |
| B-Checks | 5.67 | | 6.33 | 3.88 | 8.25 | 6.00 | 6.67 | 2.00 | 3.33 | 6.83 |
| C-Checks | 4.61 | | 7.67 | 3.25 | 2.75 | 7.83 | 3.67 | 1.00 | 5.00 | 4.42 |
| Wash | 7.33 | | 6.17 | 7.38 | 9.00 | 7.17 | 6.11 | 11.33 | 5.50 | 8.25 |
| Composites/Paint | 6.61 | | 5.67 | 8.00 | 5.25 | 6.17 | 7.11 | 6.00 | 8.83 | 5.50 |
| Wheel and Tire | 8.06 | | 9.33 | 7.50 | 7.25 | 7.50 | 8.56 | 7.67 | 8.50 | 7.83 |
| Sheet Metal | 10.78 | | 11.33 | 11.13 | 9.25 | 9.83 | 11.22 | 11.33 | 12.17 | 10.08 |
| Fuel Cell | 9.72 | | 8.83 | 11.25 | 8.00 | 8.50 | 9.56 | 12.67 | 11.00 | 9.08 |
| Age | 10.06 | | 10.00 | 10.50 | 9.25 | 9.67 | 10.00 | 11.00 | 8.50 | 10.83 |
| E/E | 10.44 | | 11.50 | 9.75 | 10.25 | 10.17 | 11.33 | 8.33 | 12.00 | 9.67 |
| TCTO | 7.61 | | 7.00 | 8.00 | 7.75 | 6.83 | 8.22 | 7.33 | 9.17 | 6.83 |
| Hydraulics | 11.00 | | 11.67 | 10.75 | 10.50 | 9.50 | 12.11 | 10.67 | 11.50 | 10.75 |
| Avionics | 10.94 | | 12.50 | 10.38 | 9.75 | 11.17 | 11.56 | 8.67 | 13.00 | 9.92 |
| All scheduled maintenance that will require more that 48 hrs to complete | 6.17 | | 5.33 | 6.63 | 6.50 | 6.50 | 5.44 | 7.67 | 6.83 | 5.83 |

6. Please rate how much you agree with the following, If AMC were to consolidate maintenance activities they should consolidate:

| | Strongly Disagree | Disagree | Neutral | Agree | Strongly Agree |
|---|---|---|---|---|---|
| ISO/HSC | ○ | ○ | ○ | ○ | ○ |
| C-Checks | ○ | ○ | ○ | ○ | ○ |
| Composite/Paint | ○ | ○ | ○ | ○ | ○ |

Please explain if you disagree with the panel recommendation.

## KC-46A Enterprise Fleet Management Round Three

### Questions

**In Round 2 the panel identified a number of barriers to consolidation**

| | Panel Mean | | Squadron | Group | Wing, HQ, School | O-4 | O-5 | O-6 | Tankers | Airlift |
|---|---|---|---|---|---|---|---|---|---|---|
| Please rate how much you agree the following are roadblocks to consolidation. | | | | | | | | | | |
| Congress | 4.26 | | 4.17 | 4.22 | 4.50 | 4.67 | 4.10 | 4.00 | 4.33 | 4.23 |
| State Interests | 4.42 | | 4.33 | 4.33 | 4.75 | 4.50 | 4.60 | 3.67 | 4.17 | 4.54 |
| Air National Guard | 4.16 | | 3.67 | 4.22 | 4.75 | 4.17 | 4.30 | 3.67 | 4.00 | 4.23 |
| Air Force Reserve | 3.42 | | 3.00 | 3.44 | 4.00 | 3.00 | 3.80 | 3.00 | 3.17 | 3.54 |
| Mission Priority | 2.68 | | 3.00 | 2.89 | 1.75 | 2.67 | 2.60 | 3.00 | 3.33 | 2.38 |
| Communication | 2.84 | | 3.00 | 2.67 | 3.00 | 2.33 | 3.10 | 3.00 | 3.17 | 2.69 |
| Leadership | 3.68 | | 3.50 | 3.67 | 4.00 | 3.67 | 3.90 | 3.00 | 4.00 | 3.54 |
| Organizational Resistance | 4.00 | | 3.67 | 3.89 | 4.75 | 4.17 | 4.00 | 3.67 | 4.50 | 3.77 |
| Priority Management | 2.84 | | 3.17 | 3.11 | 1.75 | 2.83 | 2.70 | 3.33 | 3.83 | 2.38 |
| Lack of Manning | 2.79 | | 2.83 | 3.22 | 1.75 | 2.83 | 2.70 | 3.00 | 4.17 | 2.15 |
| Lack of Funding | 2.89 | | 3.17 | 2.78 | 2.75 | 3.67 | 2.60 | 2.33 | 3.67 | 2.54 |
| Training | 2.17 | | 2.33 | 2.13 | 2.00 | 1.83 | 2.33 | 2.33 | 2.83 | 1.83 |
| | Panel Mean | | Squadron | Group | Wing, HQ, School | O-4 | O-5 | O-6 | Tankers | Airlift |
| Please rank the 12 roadblocks from 1 most inhibiting to 12 least inhibiting. | | | | | | | | | | |
| Congress | 2.68 | | 1.83 | 3.56 | 2.00 | 2.33 | 2.30 | 4.67 | 3.17 | 2.46 |
| State Interests | 2.68 | | 1.83 | 3.67 | 1.75 | 2.83 | 1.90 | 5.00 | 3.83 | 2.15 |
| Air National Guard | 4.58 | | 6.33 | 4.00 | 3.25 | 5.83 | 3.80 | 4.67 | 7.00 | 3.46 |
| Air Force Reserve | 5.95 | | 7.83 | 5.33 | 4.50 | 6.33 | 5.30 | 7.33 | 8.17 | 4.92 |
| Mission Priority | 6.79 | | 5.67 | 6.56 | 9.00 | 6.33 | 7.10 | 6.67 | 5.83 | 7.23 |
| Communication | 6.84 | | 6.50 | 7.22 | 6.50 | 6.67 | 7.10 | 6.33 | 7.50 | 6.54 |
| Leadership | 6.06 | | 5.50 | 6.25 | 6.50 | 6.00 | 5.67 | 7.33 | 5.50 | 6.33 |
| Organizational Resistance | 6.11 | | 7.33 | 5.88 | 4.75 | 7.67 | 5.78 | 4.00 | 5.83 | 6.25 |
| Priority Management | 7.67 | | 8.17 | 6.63 | 9.00 | 7.50 | 8.67 | 5.00 | 6.33 | 8.33 |
| Lack of Manning | 9.28 | | 9.17 | 8.63 | 10.75 | 10.17 | 9.33 | 7.33 | 6.67 | 10.58 |
| Lack of Funding | 8.83 | | 7.67 | 9.63 | 9.00 | 7.50 | 9.67 | 9.00 | 7.17 | 9.67 |
| Training | 10.06 | | 10.17 | 9.50 | 11.00 | 8.83 | 10.67 | 10.67 | 11.00 | 9.58 |

7. Please rate your level of agreement with the following, The largest barrier to maintenance consolidation is:

| | Strongly Disagree | Disagree | Neutral | Agree | Strongly Agree |
|---|---|---|---|---|---|
| Congress | ○ | ○ | ○ | ○ | ○ |
| States Interests | ○ | ○ | ○ | ○ | ○ |
| Air National Guard | ○ | ○ | ○ | ○ | ○ |

Please explain if you disagree with the panel recommendation.

## KC-46A Enterprise Fleet Management Round Three

### Questions

**In Round 2 the panel identified a number of disadvantages to centralized repair facilities.**

| | Panel Mean | | Squadron | Group | Wing, HQ, School | O-4 | O-5 | O-6 | Tankers | Airlift |
|---|---|---|---|---|---|---|---|---|---|---|
| Please rate your level of agreement with the following DISADVANTAGES of centralized repair facilities. | | | | | | | | | | |
| Aircraft availability during wartime and natural disasters | 2.53 | | 2.00 | 3.22 | 1.75 | 2.00 | 2.40 | 4.00 | 3.17 | 2.23 |
| Prioritization conflicts | 3.47 | | 3.00 | 3.78 | 3.50 | 3.00 | 3.60 | 4.00 | 3.50 | 3.46 |
| Increased shipping costs | 3.32 | | 4.00 | 3.11 | 2.75 | 3.50 | 2.90 | 4.33 | 3.67 | 3.15 |
| Increased time for repairs | 3.21 | | 3.67 | 2.89 | 3.25 | 3.67 | 2.80 | 3.67 | 4.17 | 2.77 |
| Complicated organizational structure | 2.16 | | 1.67 | 2.44 | 2.25 | 1.83 | 2.20 | 2.67 | 2.50 | 2.00 |
| Reduced enterprise manning | 2.32 | | 2.50 | 2.33 | 2.00 | 2.50 | 2.10 | 2.67 | 3.00 | 2.00 |
| Lack of funding | 2.53 | | 2.50 | 2.78 | 2.00 | 2.67 | 2.30 | 3.00 | 3.33 | 2.15 |
| Logistics Challenges | 3.37 | | 3.50 | 3.11 | 3.75 | 3.50 | 3.10 | 4.00 | 3.33 | 3.38 |
| Loss of expertise | 3.26 | | 3.67 | 2.78 | 3.75 | 3.50 | 2.90 | 4.00 | 3.83 | 3.00 |

8. Please rate your level of agreement with the following: "Prioritization conflicts are the greatest DISADVANTAGE of consolidating maintenance activities.

| Strongly Disagree | Disagree | Neutral | Agree | Strongly Agree |
|---|---|---|---|---|
| ◯ | ◯ | ◯ | ◯ | ◯ |

Please explain if you disagree with the panel recommendation.

## KC-46A Enterprise Fleet Management Round Three

### Questions

**In Round 2 the panel identified a number of ADVANTAGES of centralized repair facilities.**

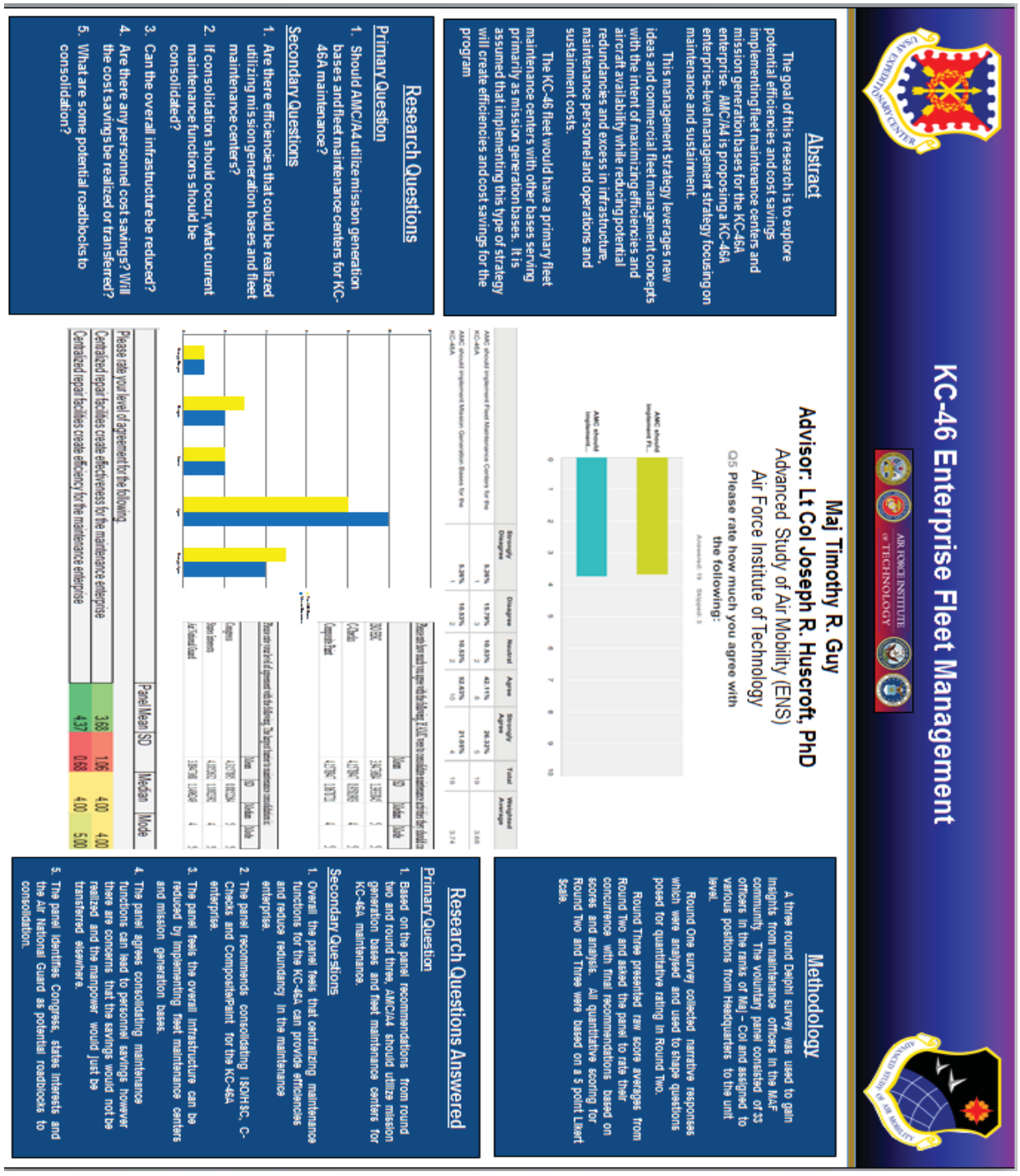
| | Panel Mean | | Squadron | Group | Wing, HQ, School | O-4 | O-5 | O-6 | Tankers | Airlift |
|---|---|---|---|---|---|---|---|---|---|---|
| Please rate your level of agreement with the following ADVANTAGES of a centralized repair facility | | | | | | | | | | |
| Efficient | 3.95 | | 3.83 | 3.89 | 4.25 | 4.17 | 4.00 | 3.33 | 3.50 | 4.15 |
| Reduces enterprise costs | 3.63 | | 3.50 | 3.67 | 3.75 | 4.00 | 3.50 | 3.33 | 2.83 | 4.00 |
| Create expertise | 3.16 | | 2.83 | 3.33 | 3.25 | 3.33 | 3.20 | 2.67 | 2.33 | 3.54 |
| Take advantage of economies of Scale | 4.05 | | 4.00 | 4.11 | 4.00 | 4.17 | 4.10 | 3.67 | 3.67 | 4.23 |
| Reduced infrastructure | 3.84 | | 4.00 | 3.56 | 4.25 | 4.50 | 3.70 | 3.00 | 3.67 | 3.92 |
| Repair process improvements | 3.63 | | 3.67 | 3.67 | 3.50 | 3.50 | 4.00 | 2.67 | 3.00 | 3.92 |
| Reduced enterprise manning | 2.95 | | 3.33 | 2.67 | 3.00 | 3.17 | 3.10 | 2.00 | 2.17 | 3.31 |
| Simplified Supply Chain | 3.11 | | 3.17 | 3.11 | 3.00 | 3.33 | 3.20 | 2.33 | 3.33 | 3.00 |

9. Please rate your level of agreement with the following, "The largest ADVANTAGE of consolidating maintenance functions is taking advantage of economies of scale."

| Strongly Disagree | Disagree | Neutral | Agree | Strongly Agree |
|---|---|---|---|---|
| ○ | ○ | ○ | ○ | ○ |

Please explain if you disagree with the panel recommendation.

## Appendix D: Quad Chart



## Bibliography


Adams, M. (2003). Contractors might pick up more plane maintenance. *USA Today.*

Adams, M. (2005). Delta plans to outsource more jet maintenance. *USA Today.*

Adams, M. (2007). Maintenance of jets still under fire. *USA Today.*

Armacost, A. P., Barnhart, C., Ware, K. A., & Wilson, A. M. (2004). UPS Optimizes Its Air Network. *Interfaces*, 34(1), 15-25.

Atasoy, B., Salani, M., & Bierlaire, M. (2014). An Integrated Airline Scheduling, Fleeting, and Pricing Model for a Monopolized Market. *Computer-Aided Civil & Infrastructure Engineering*, 29(2), 76-90.

Baldwin, H. (2013). Airframe MRO Opportunities. *Aviation Week & Space Technology*, 175(45), 10.

Barnhart, C., Farahat, A., & Lohatepanont, M. (2009). Airline Fleet Assignment with Enhanced Revenue Modeling. *Operations Research*, 57(1), 231-244.

Broderick, S. (2013). In Or Out?. *Aviation Week & Space Technology*, 175(12), MRO28.

Edmondson, D. R., Edwards, Y. D., & Boyer, S. L. (2012). LIKERT SCALES: A MARKETING PERSPECTIVE. *International Journal Of Business, Marketing, & Decision Science*, 5(2), 73-85.

Ford, J. T. (2007). State Department: State Has Initiated a More Systematic Approach for Managing Its Aviation Fleet: GAO-07-264. *GAO Reports*, 1.

Hecker, J. Z. (2004). Federal Aircraft: Inaccurate Cost Data and Weaknesses in Fleet Management Planning Hamper Cost Effective Operations: GAO-04-645. *GAO Reports*, 1.

HQ/AMC. (2013). KC-46A ENTERPRISE PERSPECTIVE MAINTENANCE AND SUSTAINMENT STRATEGY.

HQ/AMC/A4. (2014). KC46 SO 1.1 Senior Leader LB Brief.

Jacobs, T. L., Smith, B. C., & Johnson, E. L. (2008). Incorporating Network Flow Effects into the Airline Fleet Assignment Process. *Transportation Science*, 42(4), 514-529.

Jamieson S. (2004). Likert scales: how to (ab)use them. *Medical Education [serial online]*. 38(12):1217-1218.

Kelly, E. (2015). Meeting the maintenance challenge. (cover story). *Asian Aviation Magazine*, 13(9), 24-26.

Kozanidis, G., Gavranis, A., & Liberopoulos, G. (2014). Heuristics for flight and maintenance planning of mission aircraft. *Annals Of Operations Research*, 221(1), 211-238.

*Logistics Composite Model Analysis Toolkit (LCOM ATK)*. (2015). Retrieved from Acquisition Community Connection: https://acc.dau.mil/CommunityBrowser.aspx?id=470290.

McGarvey, R. G., Carrillo, M., Cato Jr, D. C., Drew, J. G., Lang, T., Lynch, K. F., . . . Van. (2009). Analysis of the Air Force Logistics Enterprise Evaluation of Global Repair Network Options for Supporting the F-16 and KC-135. *RAND Corporation.*

SAE Aerospace. (2010). Maintenance Life Cycle Cost Model. *SAE International*.

Tripp, R. S., McGarvey, R. G., Van Roo, B. D., Masters, J. M., & Sollinger, J. M. (2010). A Repair Network Concept for Air Force Maintenance Conclusions from Analysis of C-130,F-16, and KC-135 Fleets. *RAND Corporation.*

Van Roo, B. D., Carrillo, M. D., Lang, T., Maletic, A. L., Massey, H. G., Masters, J. M., Tripp, R. s. (2011). Analysis of the Air Force Logistics Enterprise Evaluation of the Global Repair Network Options for Supporting the C-130. *RAND Corporation.*

# REPORT DOCUMENTATION PAGE

*Form Approved*
*OMB No. 074-0188*



| 1. REPORT DATE *(DD-MM-YYYY)* | 2. REPORT TYPE | 3. DATES COVERED *(From – To)* |
|---|---|---|
| 17-06-2016 | GRP | MAY 2015- JUN 2016 |

**4. TITLE AND SUBTITLE**
KC-46 Enterprise Fleet Management

**5a. CONTRACT NUMBER**

**5b. GRANT NUMBER**

**5c. PROGRAM ELEMENT NUMBER**

**6. AUTHOR(S)**
Guy, Timothy R., Major, USAF

**5d. PROJECT NUMBER**
AFIT-ENS-MS-16-J-023

**5e. TASK NUMBER**

**5f. WORK UNIT NUMBER**

**7. PERFORMING ORGANIZATION NAMES(S) AND ADDRESS(S)**
Air Force Institute of Technology
Graduate School of Engineering and Management (AFIT/EN)
2950 Hobson Way, Building 640
WPAFB OH 45433-8865

**8. PERFORMING ORGANIZATION REPORT NUMBER**
AFIT-ENS-MS-16-J-023

**9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)**
Headquarters Air Mobility Command
Walter L. (Ike) Isenhour, Colonel, USAF, Deputy Director of Logistics
HQ AMC/DA4
Scott AFB IL 62225-5001
walter.isenhour@us.af.mil

**10. SPONSOR/MONITOR'S ACRONYM(S)**
HQ AMC/DA4

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

12. DISTRIBUTION/AVAILABILITY STATEMENT
Distribution Statement A. Approved for Public Release; Distribution Unlimited

**13. SUPPLEMENTARY NOTES**
This work is declared a work of the U.S. Government and is not subject to copyright protection in the United States

**14. ABSTRACT**
The goal of this research is to explore potential efficiencies and cost savings implementing fleet maintenance centers and mission generation bases for the KC-46A enterprise. AMC/A4 is proposing a KC-46A enterprise-level management strategy focusing on maintenance and sustainment. This management strategy leverages new ideas and commercial fleet management concepts with the intent of maximizing efficiencies and aircraft availability while reducing potential redundancies and excess in infrastructure, maintenance personnel and operations and sustainment costs (HQ/AMC, 2013). The KC-46 fleet would have primary fleet maintenance centers with other bases serving primarily as mission generation bases. It is assumed that implementing this type of strategy will create efficiencies and cost savings for the program.

**15. SUBJECT TERMS**
KC-46, Maintenance, Consolidation, Delphi

| 16. SECURITY CLASSIFICATION OF: | | | 17. LIMITATION OF ABSTRACT | 18. NUMBER OF PAGES | 19a. NAME OF RESPONSIBLE PERSON |
|---|---|---|---|---|---|
| a. REPORT | b. ABSTRACT | c. THIS PAGE | | | Joseph R. Huscroft,Jr. AFIT/ENS |
| U | U | U | UU | 75 | 19b. TELEPHONE NUMBER *(Include area code)* (937) 255-3636 x4533 joseph.huscroft@afit.edu |