KC-46 Workforce Requirements for Depot Maintenance Activation[1,2]

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ABSTRACT

The United States Air Force plans to establish an organic KC-46 aircraft depot maintenance capability at Oklahoma City Air Logistics Complex (OC-ALC) in 2018. However, KC-46 maintenance requirements are currently unknown. We conducted multiple case studies on the maintenance operations used by eight organizations for similar aircraft; including four third-party maintenance, repair and overhaul (MRO) agencies, three airline MROs, and the KC-135 maintenance program at OC-ALC. This paper presents our recommendations for initial staffing levels, required workforce skill grouping, and supervisor - technician ratios.

INTRODUCTION

The Air Force is purchasing a new-generation KC-46 tanker aircraft that is a commercial derivative of the Boeing 767 (B-767). The KC-46 deviates from its commercial equivalent in several areas including the refueling boom, avionics, landing gear, and infrastructure requirements. After the initial delivery of aircraft and as part of the purchase agreement, Boeing will provide five 1-year options of initial contract service (ICS) for full service KC-46 maintenance. The Air Force will assume maintenance responsibility after all ICS options are expended or declined. The majority of this maintenance will be performed at the Oklahoma City Air Logistics Complex (OC-ALC).

KC-46 maintenance activation at OC-ALC brings many challenges. One is that the aircraft is too large to fit in existing facilities; therefore the KC-46 program office is planning and budgeting for needed infrastructure. A second problem, and the focus of our research, is that the workforce requirements needed to perform required maintenance activities are unknown. A reasonable approach would be for OC-ALC planners to simply examine the lessons learned from prior experience. The B-2 bomber is the most recent aircraft brought into OC-ALC for initial maintenance, but this event happened over 20 years ago. The KC-46 program office attempted to draw lessons from the B-2 or other OC-ALC new-aircraft experiences, but found that no collective memory or documentation was available to show how the new work was initiated at

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the depot. In sum, very little can be drawn from OC-ALC's prior experiences with integrating new aircraft into its work structure.

Each aircraft type brings unique, airframe-specific maintenance characteristics. Instead of using maintenance generalists, OC-ALC trains and manages "stovepiped" staff such as electronic integrated systems technicians, aircraft engine mechanics, aircraft pneudraulic systems mechanics, aircraft repair and reclamation mechanics, surface maintenance mechanics, powered support systems mechanics, aircraft sheet metal mechanics, and many more.[1] This "functional silos" approach partitions the maintenance work into simplified tasks to ensure that the work can be performed by anyone properly trained to do it.[2] However, the KC-46 depot maintenance program can learn from the B-767's accumulated 20 years of commercial-sector operating history. OC-ALC can choose to operate as it has in the past by replicating current maintenance processes, or it can implement a new maintenance approach by benchmarking other methods used in commercial aviation.

A workforce complication is that a transition period is needed to establish organic maintenance operations. The KC-46 program's favored transition solution is to conduct a series of C-check inspections on each aircraft at two-year intervals, where these inspections become more intensive as the aircraft ages. A C-check involves inspecting multiple aspects of the aircraft to ensure its continued serviceability and addressing any identified maintenance issues. The C-check approach is different than the more traditional programmed depot maintenance accomplished for other aircraft at OC-ALC.[3]

KC-46 maintenance specifics and C-check inspection requirements are yet unknown. However, the dilemma of identifying the difference between what OC-ALC's personnel are capable of and what the KC-46 will require still exists. This is key because part of the depot's process of activating new work is relying on more senior, highly experienced technicians to learn the differences, before they then train others. The depot ensures these senior technicians are trained by a reputable source, be it the original equipment manufacturer or by some other means, and then they become a cadre of trainers to help others perform the work. On-the-job training (OJT) is typically used for knowledge-sharing. OJT is a training technique in which trainees receive guidance from a trainer on how to complete work tasks at the same time the work is being done.[4]

A 2007 RAND study examined workforce planning in Air Force Materiel Command. It proposed a four-step model that serves as the core for workforce planning.[5] A similar workforce planning study was done by Pynes, but she focuses more generally on the public sector. Pynes cites five steps from the National Academy of Public Administration to discuss workforce and succession planning.[6] Portions of another RAND study conducted on AFMC in 2006 focused on workforce sizing. It notes that aggregate manpower constraints are often set at Air Force, Department of Defense, and even congressional levels, thereby limiting manpower flexibility.[7]

METHODOLOGY

We chose a case study methodology for our research. Eight cases were selected for study to give us a range of potential observations on organization scale, workforce design, and market focus. Responses from a set of 12 questions were collected through personal interviews and site visits where feasible. Further data were obtained from in-depth study of organizational procedural

documents. The intended result is that the data gleaned from the individual cases provides comparative study and allows us to benchmark these practices with those found at the OC-ALC. The results can provide a source for determining a course of action that KC-46 decision makers can implement to activate maintenance activities at the depot. Of the eight organizations participating in our study, four are third party commercial MRO organizations that provide contract service, three are commercial airlines that provide their own MRO service, and the other is an OC-ALC group that conducts KC-135depot maintenance. Summary data are provided in Table 1. We used this data to address the three research questions that follow.

Table 1. Responses, by organization.
(NP refers to not provided and N/A refers to not applicable)

Org.	Size (personnel)	Number of Clientele	B-767 years of Experience	B-767 Qty. per year	Light C-check Qty. of personnel	Heavy C-check Qty. of personnel	Tech. to Sup. Ratio	Calculated Light C-check Hours
A	260	13 airline & cargo transport organizations	9 years	54 to 113 aircraft	70	70	12 to 1	7,448
B	1300	NP	23 years	30 to 60 aircraft	40	200	10 to 1	1300
C	1000 to 1200	3 core customers & all of the major air carriers	13 years	0 to 5 aircraft	40 to 60	100	6 -8 to 1	5,963
D	400 reg. & up to 1000 temporary workers	6 airline & cargo transport orgs.	10 years	3 to 4 aircraft	20	60	15-20 to 1	2,275
E	438	NP	NP	NP	140	140	25 to 1	NP
F	NP	Only internal to the org. maintenance provided	20 years	NP	≥ 60	≥ 60	12 to 1	NP
G	1350	NP	1 to 26 years	129 aircraft	106	106	35 to 1	6,572
OC-ALC	1340 (KC-135)	N/A	N/A	90 KC-135 aircraft	N/A	58 (PDM)	15 to 1	N/A

Table 1. Responses, by organization (continued).

Org.	Calculated Heavy C-check Hours	Years of Experience when 1st hired	Ratio of A&Ps	Division of work	Hiring Requirements	Task Centric or Multi-skilled	Yield (out of 8 hour shift)
A	22,344	8 to 10	10 to 0 10 to 6 structures	Zonal	At least A certificate	Multi-skilled (primary/ secondary skill)	.95
B	41,600	>1 to 30	65%	Task Groups	Preference for A&P or repairman certificate	Task centric	.8125
C	26,500	> 1	25% 5% repairman	Trade Groups	Preference for A&P or repairman certificate	Partial hybrid	.828125
D	9,750	< 2	80%	Task Groups	A&P required unless hired in apprenticeship program	Partial hybrid	.8125
E	NP	7 to 20	99%	Skill Groups	A&P certificates	Hybrid	.85
F	NP	2 to 5	Almost no non-A&P	Zonal	A&P certificates	Multi-skilled	NP
G	18,402	< 1	99%	Task Groups	A&P certificates or seniority	Hybrid	.775
OC-ALC	33,640 (PDM)	0 to < 20	20%	Task Groups	A&P certificates optional	Task centric	.625

Question 1: How many personnel are required to activate KC-46 C-check operations?
The results suggest a wide range exists in the initial staffing quantity for KC-46 C-check maintenance. Organizations A and F use a zonal approach to assign approximately 20 to 23 personnel to one aircraft per work shift. Organization A is able to produce 400 man-hours per day with 70 personnel assigned to an aircraft. Although OC-ALC does not operate 24 hours per day and has only two shifts, the 60 to 70 personnel agrees with the number assigned to perform maintenance on the KC-135. It is also consistent with the quantities provided by Organizations B, C, and D. The KC-46 maintenance program can start by assigning 30 to 35 personnel per shift and per aircraft but adjustments to the total number per aircraft can be made once a desired quantity of production man-hours and flow days is established.

Question 2: How should KC-46 maintenance technicians be skilled: task centric, generalist, or a hybrid?
The commercial airline MROs reported that they rely on maintenance generalists, whereas the third party commercial MROs use more task-centric maintenance technicians. However, when specifics were discussed we found that the airline MROs typically assign their "generalist" personnel to perform specific tasks. A minor difference was noted in how flexible supervisors are in allowing the technicians to choose where they work. In some cases the technicians choose which skill group they join and they tend to work in areas where they have the most experience, or they may be capable of working in many areas but want to maintain particular competencies. In another case, the supervisor has discretion to determine where technicians are assigned each day. Ultimately the same work is completed, it just depends on how an organization's personnel structure is set up and the type of flexibility they need to accomplish their maintenance objectives. The KC-135 maintenance technicians are assigned to specific skill sets and thus follow a task-centric model. C-check maintenance for the KC-46 is planned to be performed by technicians also located at OC-ALC; therefore this model would seem the easiest to apply because it is already integral to operations, but evidence suggests that more flexibility is needed.

Our interviewed commercial aviation maintenance organizations routinely noted that they can not compete on cost with the third party commercial MROs. These organizations, with one exception, all follow a task centric model. They have a smaller ratio of airframe and powerplant (A&P) certificated personnel to non-certificate personnel, and they build flexibility into their labor model by hiring temporary technicians to fill in when operations must expand rapidly. These temporary personnel are then laid off when operations ebb. This offers cost flexibility to these organizations but can be disruptive to morale, and other organizations with unionized workforces find it difficult to follow these same practices.

The commercial airline maintenance organizations have unionized labor and have found alternative ways to add flexibility into their workforce models. They hire personnel who are mostly or all A&P certificated, meaning that they are qualified to perform any of the C-check work. They follow a task-centric method but not in the same way that the third party commercial MROs do. Interviewee responses suggest that they use a hybrid model, one in which generalist technicians with multiple certifications are assigned to one skill group so supervisors have the discretion to cross-use their personnel in different skill sets when needed. This model offers flexibility and can save on personnel costs while leveraging the benefits of specializing technicians in specific skill sets.

OC-ALC does not employ primarily A&P certificated technicians, nor does it use temporary labor. Therefore, what model makes the most sense for the KC-46? A strictly task-centric model would fit the current OC-ALC culture, but the planned initial work volume does not justify hiring only task-centric technicians. On the other-hand, hiring strictly generalist A&P certificated maintenance technicians is problematic. There are no OC-ALC positions that require generalist A&P certificated technicians and KC-46 managers would need to work closely with union representatives to make this an option.

Third party commercial MROs follow Federal Aviation Administration (FAA) regulations by employing an adequate blend of A&P certificated and non-A&P certificated personnel. They ensure that key supervisory positions are filled with technicians who hold A&P licenses or repairman certificates so they can sign for any completed work. OC-ALC exhibits characteristics that fall between commercial airline MROs and third party commercial MROs. It uses unionized labor that restricts some flexibility, but their military aircraft mission does not require FAA regulations compliance.

Therefore, we recommend that the KC-46 maintenance program follow a hybrid model. Hiring a blend of A&P licensed and non-licensed maintenance technicians offers the ability to be cross-used while the demand for routine work grows. Initially the ratio of A&P certificated personnel should be high because the required work levels will be low. A higher blend will enable supervisors the ability to use fewer personnel to do more until there is sufficient work in the future to justify reducing the ratio of A&P certificated personnel by hiring more non-certificated personnel. The initial higher ratio of A&P certificated personnel enables the KC-46 maintenance planners to identify and prepare personnel for supervisory positions as C-check lines expand.

Question 3: How many management personnel are required to activate depot operations?
We examine *supervisory level* management--not the upper level management that govern the entire maintenance operation. A supervisor is defined, according to the KC-135 maintenance organization interviewees, as someone who has senior level maintenance experience and is placed in a position to direct onsite maintenance operations for a particular aircraft. Commercial maintenance organizations also place personnel with senior-level experience in supervisory positions, but they also require these individuals to hold either A&P licenses or repairman certificates. This is to ensure that supervisors are set up with qualifications to oversee their subordinates and to sign for work completed if the subordinates do not hold licenses or certificates.

Our case studies provided a broad range of ratio responses. The ratios start as low as 10 to 1 and increase to 35 to 1. OC-ALC's ratio of technicians to supervisors is about 15 to 1 and falls close to the middle of the range of other responses. This spread is most likely the result of the two different types of MROs in our study: commercial airline MROs and third party commercial MROs. The commercial airline MROs (who employ mostly A&P certificated personnel) had higher technician to supervisor ratios and the third party commercial MROs (who have lower numbers of A&P certificated personnel) had lower technician to supervisor ratios. Additionally, the organizations with the lowest supervisor to technician ratios also have the lowest A&P certificated to non-certificated technician ratio (Organizations B and C). Organizations B and C

admit that they intentionally hire few certificated maintenance technicians to keep costs down since they do not have to pay these technicians as much as they would pay A&P certificated technicians. However, they must still fill supervisory positions with certificated personnel to sign for the work that the non-certificated personnel accomplish.

KC-135 maintenance supervisors are not required to hold A&P certificates and in addition are not required to sign for the work of non-certificated subordinates. Hence their technicians' level of experience supports the 15 to 1 ratio. However, if the KC-46 maintenance program decides to "meet the intent" of FAA regulations to expand their spare parts pool, then supervisors will need to be certificated. In this case, a 10 to 1 ratio seems more reasonable because it adds additional supervision at the beginning until the C-check line matures.

SUMMARY

We used case study research to benchmark practices from organizations that perform maintenance on B-767 aircraft for potential adaptation to KC-46 heavy maintenance. OC-ALC planners are in a unique position to design a maintenance workforce that combines the best practices used today by the US Air Force, commercial airlines, and third-party commercial MROs.

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