IT IS TIME TO CHANGE THE METRIC FOR SUCCESS: HOW MEASURING AIRCRAFT AVAILABILITY WILL ENABLE LEADERS TO IMPROVE READINESS

Graduate Research Paper

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Abstract

A key strength of the ANG is that Airmen remain with a single unit for most, if not all, of their careers enabling them to become experts in their field and mission design series. This strength can also be a weakness as this stability has led to stagnation and a focus on short-term solutions to long-term logistical problems. Units are aware of the known deficiencies: age of the fleet, lack of required maintenance assets, and a lack of qualified, skilled maintainers. Although some of these factors are outside of the unit's control, adjustments are required if the ANG is to succeed in completing its duel missions.

Funding/Availability Multi-Method Allocator for Spares (FAMMAS) and Logistics Composite Model (LCOM) forecasting models use algorithms to predict mission capability (MC) rates based on past values. However, there are other factors such as maintenance manning, skill levels, personnel retention rates, break rates, fix rates, spare parts issues, and reliability and maintainability (RM) of aircraft that are not taken into account by FAMMAS (Chimka, J., Nachtmann, H). To account for these gaps, effective studies on non-mission capability (NMC) rates of weapon systems have accounted for variables such as inadequate manning and essential skill level availability. Units need to internalize processes that are standardized across the fleet to mitigate these issues.

Focusing on the ANG's twelve F-16 C/D units, the purpose of this GRP is to examine the relationship between multiple variables within maintenance and the supply chain and their impacts to the unit's MC rate and aircraft availability. The results of this

study will provide insight and explain why the ANG should pivot from using MC rates as its benchmark of success to aircraft availability rates in conjunction with predetermined mission essential levels (MEL) and aircraft availability targets for their weapons system. The adoption of this new philosophy will enable units to strategically focus resources, increase unit mission capability through process improvement, minimize exploitable gaps available for near peer competitors, and improve the ANG's lethality.

To my family.

Acknowledgments

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Jeffrey Haynes

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I. Introduction

Background

In the mid-1990s, the Department of Defense (DoD) began a sustained effort to improve its supply chain through process improvements, rationalizing functional activities across organizations, and integrating functions and organizations within those processes. Initiated in 1991 to replace fill rate targets used by variable safety level (VSL), aircraft availability targets were instantiated by operational units. As a metric, aircraft availability targets (AAT) "reflect the preferred aircraft fleet availability and safety stock levels for individual mission design series (MDS) by means of operational requirements." (Blazer, D., Randall, K., O'Malley, T., Reynolds, S., 2002). Like its private sector counterpart bill of material (BOM), AATs enable maintenance planners to perform their job more effectively and efficiently by creating a clear picture of which equipment parts require servicing. In turn, the maintenance planner can accurately check the readiness of the team to carry out tasks considering the availability of parts (Ghobbar, A, Friend, C., 2004).

Concurrently, studies on maintenance metrics at the highest levels of the Air Force have been accomplished to minimize known fiscal, mechanical, personality and manpower constraints. Since the terrorist act of September 11, 2001, the ANG's transition from a strategic to an operational force has accounted for approximately 20%

of joint force operations (Lengyel, J., 2017). According to statistics provided by NGB/A4, the Regular Air Force's (RegAF) F-16C/D models overall mission-capable rate of 70% (ACC goal for the weapons system) is roughly 19% greater than that of the ANG's twelve F-16C/D fleet average over the last six fiscal years (14-19). This delta between the Active Duty's and National Guard's MC rates may be a troubling indicator for ANG readiness; however, MC rates do not communicate the unit's ability to execute their design operational capability (DOC) statements and Organize, Administer, Recruit, Instruct and Train (OARIT) requirements. Additional quantitative and qualitative data from non-mission capable (NMC), aircraft availability (AA), non-mission capability supply (NMCS), primary aircraft authorization (PAA), sorties flown, Mission Impaired Capability Parts (MICAPS), phase time (days) and manpower by unit were explored to examine unit readiness capabilities.

The variables identified in Table 1 were chosen from past field studies identifying behaviors and philosophies that influenced the perceived or actual importance of this data. For example, the study "Beyond Authorized Versus Assigned, Aircraft Maintenance Personnel Capacity" demonstrated how the perceived importance of manning shortages was the root cause to their readiness. Howe, Thoele, Pendley, Antoline, and Golden, (2008) cited units expressing this perception with quotes such as, "hard-broke tails and tails in ISO (isochronal inspection) and phase get less priority than the flyers. We run out of physically run out of people." Again, Pendley (2008), in "Aligning Maintenance Metrics, Improving C-5 TNMCM", along with Thoele, Albrecht, Howe, and Golden, (2008), identify unit emphasis on daily operations effecting NMC rates. Subject matter experts (SME) interviewed for this paper echo the finding of Mattila, Virtanen, and Raivio (2008), in "Improving Maintenance Decision Making in the Finnish Air Force Through Simulation" where it was identified that high sortie operations tempo has a snowball effect on required maintenance actions that influences aircraft readiness.

Table 1

***Excluding the 162nd Wing (61 PAA), Pilot Training (Primary), Test, Air Sovereignty, the avg unit PAA is 24**

ANG F-16 MDS Average							
NMC% 48%	AA% 61%	NMCS% 5%	PAA 27*	Sorties Flown 3004	MICAP (Days) 7	Phase Time (Days) 38	Manning 94%

Given the deficiency of MC rate as a true performance metric and known challenges, the ANG cannot afford to continue to do business as usual while also fulfilling its mission requirements. According to a 2001 Maintenance Metrics handbook, MC rates were considered, "the best known yardstick for measuring a unit's performance." It went on to state that, "a low MC rate may indicate a unit is experiencing many hard (long fix) breaks that don't allow them to turn an aircraft for many hours or several days. It may also indicate serious parts supportability issues, poor job prioritization, lack of qualified technicians, or poor sense of urgency. The key here is to focus on the negative trends and top system problems that lower the MC rate. Examining the 8-hour (fighter) or 12-hour (all other aircraft) fix rates may provide clues to a low MC rate." Considering additional issues such as short-term availability of new aircraft, fleet age, and manning/funding shortages required to support their missions, the ANG must pivot from the 2001 Maintenance Metrics handbook mindset to maximize allocated resources and remain ahead of their near peer competitors.

Problem Statement

Chief of Staff Gen. Charles Q. Brown Jr. stated, "Today we operate in a dynamic environment with factors that have us taking various actions to continue the mission and take care of Airmen and families," Brown wrote. "As a result, we have a window of opportunity. Our Air Force must accelerate change to control and exploit the air domain to the standard the nation expects and requires from us. If we don't change—if we fail to adapt—we risk losing the certainty with which we have defended our national interests for decades. We risk losing a high-end fight. We risk losing quality Airmen, our credibility, and our ability to secure our future." Incongruency between maintenance units' emphasis on MC rates with that of higher-level leadership's focus of aircraft availability results in a reactive maintenance approach where concentration on NMCS, MICAPS, sorties flown and manning are negatively impacting availability, serviceability and sustainability of the fleet (Pendley, S. Major, Thoele, B., Albrecht, T., Howe, J., Antoline, A. Major, USAF, Golden, R, 2008).

Purpose Statement

The purpose of this research is to investigate the feasibility and validity of using AATs in conjunction with aircraft mission essential limits (MEL) as a benchmark of success in identifying a unit's performance in regard to executing its daily mission, meeting DOC statement/aviation package requirements, and encouraging systemic progression in maintenance and logistics processes.

Research Question

1. What actions should units take to better identify and increase unit readiness?

Investigative Questions

1. Is AA rate a better indicator of readiness then MC rates?

2. How can aircraft availability targets and MEL improve readiness?

Methodology

Given the quantitative focus of this study, this research will focus on the use of quantitative data and analyzed trends to evaluate the overall research question and outlined investigative questions. A mixed methodology research design using correlation analysis and ethnographic qualitative techniques is used to test and validate proposed hypotheses.

The correlation analysis achieved by using multiple linear regression analysis to assist in the explanation of the variation in the dependent variables. This study performs linear regression of non-mission capable rates and aircraft availability rates against the independent variables of NMC rate percentage (NMC%), AA rate percentage (AA%), MICAP receipt time in days, NMCS, sorties flown, PAA, average phase times and manning. The results of this analysis is used to provide recommendations and courses of action. The coefficient of determination range for the regression performed ranged from 40-65%, indicating the proposed independent variables explain a substantial portion of the variation in non-mission capability and aircraft availability targets of studied units. The independent variables with a significant correlation ($p < 0.05$) indicates strong evidence in favor of proposed hypotheses. Statistically insignificant independent variables ($p > 0.05$) indicate weak support of a hypothesis and consideration of an alternative hypothesis.

Assumptions/Limitations

The majority of the data utilized in this paper, with the exception manning percentages, range from fiscal years 2014-2019. Values for manning percentages were limited to the current year. The potential exists for inaccurately reported data from the units. In the event data obtained from field-level units, the NGB, and the 635th Supply Chain Operations Wing (SCOW) differ, data from the NGB and 635 SCOW were considered for this analysis.

Implications

This research could highlight deficiencies in the priorities of field level maintenance. It could also highlight the need to revamp or validate metric priorities. Moreover, findings could provide recommendations to enhance the ANG's utilization of resources. Identifying best practices implemented by the other ANG F-16C/D units can spread to their F-16C/D active duty and reserve units, then throughout ACC and potentially the DoD.

II. Literature Review

Chapter Overview

The purpose of this chapter is to establish why shifting from MC rate to aircraft availability rates as the standard for readiness could benefit the ANG. Air Force Instruction (AFI) 21-101 describes maintenance management metrics as the central form of information used by maintainers to improve the performance of maintenance organizations, equipment, and airmen when compared with established goals and standards. The desired outcome is for maintenance leadership to make accurate, useful, and consistent decisions that clearly links goals and standards. This information is to be clearly understood and well-defined (Pendley, S. Major, Thoele, B., Albrecht, T., Howe, J., Antoline, A. Major, USAF, Golden, R.). This chapter will build an understanding of the study's variables and present research done on this topic as well as provide a hypothesis on which variables, if any, are meeting AFI 21-101's intent.

Aircraft Availability Rates

Aircraft Availability is defined by AFI 21-101 as, "the number of times per month an aircraft is removed from the schedule due to scheduled maintenance requirements." In a similar study conducted by the Mobility Air force (MAF) for the C-5 MDS, Major General McMahon, then AMC Director of Logistics (AMC/A4), identified aircraft availability (as opposed to MC rates) as the future cornerstone maintenance metric. Similarly, the AMC/A4M office stated that aircraft availability is the number one concern for AMC Headquarters as opposed to MC rates (Pendley, S. Major, Thoele, B., Albrecht, T., Howe, J., Antoline, A. Major, USAF, Golden, R.).

As indicated by Mattila, Virtanen, and Raivio (2008), the time between flight missions has the largest effect because flight intensity governs the amount of all maintenance needs. In order to maximize the capabilities of the logistical process, all organizations must have aligned goals. These goals require the supply chain to be aligned with the customer and the strategy utilized by maintenance to satisfy internal and external training requirements intended to support the logistics process. This is known as obtaining strategic fit (Chopra, S., Meindl, P., 2016). According to Chopra and Meindl (2016), in order to achieve strategic fit, the process must:

1. Understand the customer and supply chain uncertainty
2. Understand the supply chain capabilities
3. Achieve strategic fit

Before this paper discusses how to better understand customer and supply chain uncertainty, supply chain capabilities and strategic fit for aircraft availability, an understanding of MC rates and how this metric does not achieve strategic fit is necessary.

Mission Capability (MC) Rates

Determined by the amount of aircraft able to meet any of its wartime missions, MC rates currently are used to indicate the health of the fleet. An MC Rate is acquired by dividing the number of serviceable MDS by the total number of possessed MDS and multiplying the result by a factor of 100 to obtain a percentage (Pendley, S. Major, Thoele, B., Albrecht, T., Howe, J., Antoline, A. Major, USAF, Golden, R., 2008). A fleet's MC rate and the ability of each aircraft to perform its assigned mission is briefed daily to maintenance and supporting units as fully mission capable. An aircraft's ability to execute its mission is categorized into three groups. Fully Mission Capable (FMC) aircraft are defined to be aircraft that can perform all assigned missions. Partially Mission Capable (PMC) aircraft is defined as those aircraft that can perform only a subset of assigned missions, while Non-Mission Capable (NMC) aircraft are those aircraft unable to perform any assigned missions. ANG maintenance units use MC rates and categories of aircraft mission capability for internal mission prioritization, justification and advocating for manning, spectrum support requirements, and readiness levels. The use of the former motives (manning and support requirements) can cause consternation between maintenance and support if an aircraft is non-mission capable due to supply (NMCS), specifically as it pertains to aircraft grounding MICAPS. MC rates do not appear to achieve strategic fit with the centralized supply management strategy executed by the 635 SCOW who utilizes peacetime metrics to determine AAT. For the units, the 70% MC rate requirement exceeds the 15 PAA requirements of the mission capability (MISCAP). On average, 70% of 24 is roughly 17 PAA and exceeds MISCAP requirements. Based on the way field units use this metric, this study proposes the following hypothesis:

Hypothesis 1: A base's MC rate is negatively correlated with its AA rate.

Sorties Flown

Maintenance units strive and practice for high sortie production which requires timely launch of initial combat sorties and subsequent rapid recovery, repair, and relaunch of aircraft. Units feel this simulated combat concept are necessary in order to validate its effectiveness.

Combat aircraft sorties requirements are forecasted to accomplish their continuation training and governed by the Ready Aircrew Program (RAP), which defines the number of aircraft sorties and simulator missions a pilot must complete annually and how this training should be distributed among missions, events, and skills. Additionally, sortie requirements stem from non-RAP types of flying training such as new and continuation pilot training. The best pilots receive additional formal training to become instructor pilots and mission commanders (Walsh M., Taylor W., Ausink, J., 2019).

Unit's prioritization of sortie generation can project perceived or real pressure on maintenance units to "green up" jets. Strategic fit between Fighter, Maintenance and Logistics Squadrons is not achieved when sortie requirements do not consider maintenance and supply chain capabilities. Therefore, this study proposes the following hypotheses:

Hypothesis 2: A base's sortie generation is weakly correlated to its MC rate.

Hypothesis 3: A base's sortie generation is weakly correlated to its AA rate.

Mission Impaired Capability Parts (MICAPS)

The Air Force Global Strike Command Handbook 23-007 Materiel, (2017), Management Customer Service Handbook defines a MICAP as, "the highest priority asset type of expedited requests and are used to order parts required for the repair of mission essential equipment. Requests for items to satisfy MICAP conditions are processed by the Customer Service Section of field-level Logistics Readiness Squadrons. If the requested item(s) are available in stock, they are issued to customer and no further action is required." If not, the Customer Service Section coordinates with the Supply Chain Operation Squadron (SCOS) and item manager to identify the availably/status of the MICAP. This information is provided daily to maintenance leadership. MICAP data is tracked in the Integrated Logistics System Supply (ILS-S).

Misconceptions of NMCS' impact on unit readiness can result in a strained relationships between maintenance and customer support by misguiding blame or worse, resources that degrade mission execution. Although delays in the supply chain can cause significant problems and incur additional delays to maintenance logistical operations, consternation occurs if assets are not available as units overemphasize the impact a MICAP has on their OARIT mission. The data indicates NMCS' impact on aircraft availability, although correlated, does not have the perceived effect on the overall health of the fleet. This study proposes the following hypotheses:

Hypothesis 4: MICAP rates are weakly correlated with a base's MC rate.

Hypothesis 5: MICAP rates are weakly correlated with a base's AA rate.

Phase Maintenance

Each unit is required to conduct local aircraft phase inspections derived from a predetermined number of flying hours for their entire fleet. The in-depth nature of these inspections of aircraft systems, components, and overall structural integrity makes the aircraft non-mission capable. Although there is no expected completion time, the active duty average of five to seven days is roughly thirty five days less than the average ANG time (Powell, M. 2007). Aircraft that are hard broke tend to receive less priority than others to get the less broke aircraft repaired more quickly and ready for the next flight. Unit's SMEs stated that skill levels gaps prohibited dedicated crew chiefs to focus on the phase aircraft because their leadership's priority is to fix a NMC jet with available parts resulting in longer phase times. On average, manpower studies determined that each fighter wing's Aircraft Phase Inspection Section should consist of twelve to fifteen aircraft crew chiefs as well as every system on the aircraft.

Maintenance leadership's misaligned focus may have led to an internal overemphasis on the effects of external variables such as NMCS percentage and MICAPS have on their ability to achieve readiness and support their units OARIT mission. This overemphasis may have resulted over production of aircraft creating lost opportunities to increase their net effective personnel (NEP), decreasing phase times while simultaneously increasing the long-term health of the fleet. Therefore, this study proposes the following hypothesis:

Hypothesis 6: A base's phase times is highly correlated to its MC rate.

Hypothesis 7: A base's phase time is highly correlated with its AA rate.

Primary Authorized Aircraft

The ANG force structure consists of 91 flying units that have a total of 1,730 combat aircraft distributed among all the states. According to Air Force Instruction 16-402, ACC/A5/8B controls the transfer and loan of ACC combat air force (CAF) Total

Aircraft Inventory (TAI) to include all aircraft assigned for mission, training, test, and maintenance functions. In coordination with the using command, ACC distributes aircraft to fill inventory requirements (authorizations) in the following priority: combat units, training units and test units.

According to the maintenance SMEs, one of the perceived causes for low MC rates is that Base Relocation and Closure (BRAC) actions caused an increase of F-16 MDS at some ANG units without a subsequent increase in manning allocations to support the additional aircraft. Based on this perception of maintenance SMEs, this study proposes the following hypotheses:

Hypothesis 8: A base's authorized aircraft level is weakly correlated to its MC rate.

Hypothesis 9: A base's authorized aircraft level is highly correlated its AA rate.

Manning Impact

Air National Guard military personnel and civilian employees authorizations are determined by NGB/A1 through processes developed for quantifying operational and, maintenance workforce needs. Prioritization among requirements is reached through the programming and budgeting processes of the Air Force Corporate Structure, but that structure depends on the development of manpower standards, manpower modeling, and other similar processes to identify the unconstrained manpower costs of executing and supporting various missions. Those authorizations are then communicated to the units to allocate as they see fit. The determined manning authorizations do not equate to manning funded allocations. Following the BRAC of Burlington, Vermont ANG's unit transition to the F-35 from the F-16 weapons system, units in the paper received additional PAA without additional manning or funding support. Studies have correlated the changes in manning levels, experience, morale and retention to NMC rates, specifically to the 2A and 2W career fields. Notwithstanding, the impediment of their airmen's daily missions as well as their professional growth is attributed to an over-emphasis on executing the mission portion of the major graded areas (MGAs) and rewarding this area at the expense of managing resources, improving the unit, and leading people (Oliver, S., 2001). The culture of greening up jets has not achieved established MC rate goals because it does lend to the maximization of resources. This focus has resulted in overproduction. In the private industry, overproduction occurs when manufacturing a product or an element of the product before it is being asked for or required. Taiichi Ohno, the inventor of the Toyota Production System (TPS) considered the fundamental waste to be overproduction, as it is the root cause for most other wastes (Liker, J. K., 2004). Moreover, over-production increases the likelihood that the product or quantities of products through a push production system are beyond the customer's requirements that generates wastes such as overstaffing. Nevertheless, units tend to ignore this imbalance to justify additional manning. This study proposes the following hypotheses:

Hypothesis 10: A base's manning percentages is weakly correlated to its MC rate.

Hypothesis 11: A base's manning percentages is weakly correlated to its AA rate.

III. Methodology

Chapter Overview

The purpose of this chapter outlines and describes the design and methodology that was used to develop the research findings. The chapter will also cover the data collection, methods, and interview question development. The chapter will conclude by identifying how NMC%, AA%, PAA, sorties flown, average MICAP/Phase time (in days), NMCS% and manning correlate to NMC% and AA%. The independent variables selected were chosen as the perception or actual effects of these variables can be viewed as limitations to OARIT and readiness.

Research Design

This research's intent is to examine the impacts of identified variables on MC and AA rates to answer the primary research and investigative questions. In addition to looking at correlations amongst chosen variables, subject matter experts from the field provided insight to further illustrate and support quantitative findings. These interviews were designed to understand the unintentional, negative effects of using MC versus AA rates as a barometer of readiness by identifying variables of focus based on their correlation to MC and AA rates. The intended result is to provide areas of focus for leaders to consider when maximizing resources and increasing readiness.

Data Collection

Working with F-16C/D ANG unit POCs, NGB/A3 and A4 to acquire data from fiscal years 2014-2019 for twelve F-16 ANG units, this research utilizes linear regression to discover if there is a correlation between the independent variables with two dependent variables: NMC% and AA%. These quantitative findings will be complemented by answers acquired from six enlisted maintenance SMEs and two officers who participated in the interview process to provide insight to the independent variable's correlation to the dependent variables.

Interview Question Development

Participants in this study answered the same questions asked of all participants. Unsolicited information/perspective were also noted. All interviews were conducted using a structured format entirely over the phone. To avoid bias, while obtaining honest feedback, the researcher utilized techniques similar to the Sociology Department from Harvard University. The intent of the questions was to:

1. Tap into their unique experiences and expertise of the interviewees
2. This also provided the respondent the opportunity to add information not asked for as well as closing remarks

IV. Analysis and Results

Chapter Overview

This chapter discusses the results of the quantitative and qualitative data identified in the methodology chapter of this paper. The outcomes obtained quantitatively were compared with the information obtained qualitatively designed to test the hypothesis that AA will benefit ANG unit readiness.

Variable Correlation

Mathematically the independent variable is the explanatory variable upon/against which dependent variable is regressed. The statistical relationship, determined by a correlation coefficient, between the two variables is the subject of interest.
The independent variable is used to explain the variation in proposed dependent variables. The p-value is the measure of the probability that an observed difference could have occurred just by random chance. The lower the p-value, the greater the statistical significance of the observed difference. The outcomes of the independent variables with NMC% and AA% as dependent variables are identified in the synapsis preceding the graphically depicted figure. It is important to note that the intended use was not to be predictive but only to make a comparison between the seven independent and two dependent variables relative to the data collected.

The baseline correlation of NMC% to AA%, depicted as a scatter plot in Figure 1, visually depicts as AA% increases NMC% decreases. Averaging 61% across the ANG's weapons system, throughout the studied timeframe, no unit's AA% was below 50%.

Pursuing high percentage levels in either variable looks to result in a negative effect on the other variable, supporting the study's initial hypothesis that these two metrics are negatively correlated.

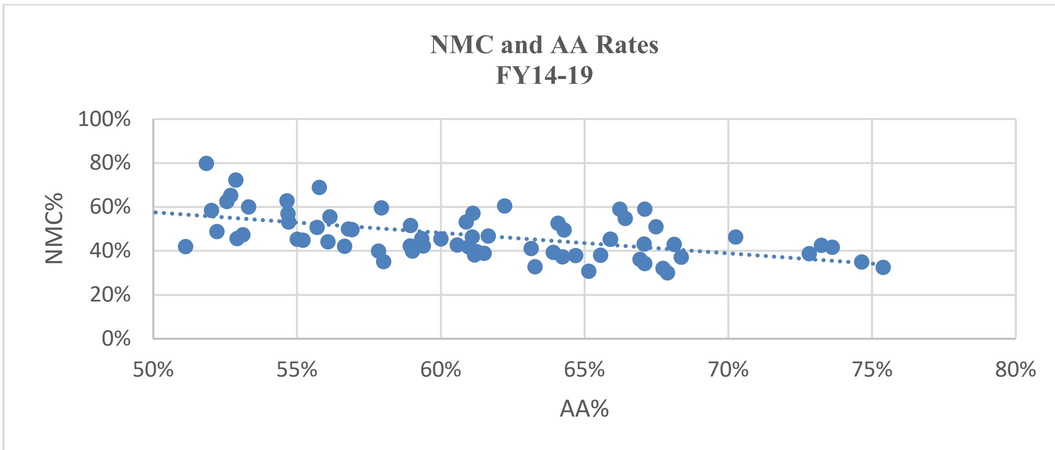


Figure 1

The current effective fly-hour rate for these aircraft is forecasted to remain relevant and within service life until the late 2020s (Wittkowski, 2014). Given this forecast, Figures 2-4 compares wing performance for MC rates versus AA rates, average AA against average sorties per day and MC rate versus AA rate by unit. As expected, AA meets or exceeds the MC rate at every unit. For OARIT, and as applicable ACA, mission partners within the units need to know that the aircraft are available to meet their mission requirements. If their aircraft are provided, they are content. The data from Figure 3 indicates ANG are meeting their OARIT, ACA and other requirements. As previously indicated, the 70% MC rate requirement exceeds the requirements of the MISCAP. This may indicate why the units are falling short of ACC' standards. Measuring readiness by the MC rate does not display a full understanding of the customer and supply chain uncertainty, specifically during peacetime.

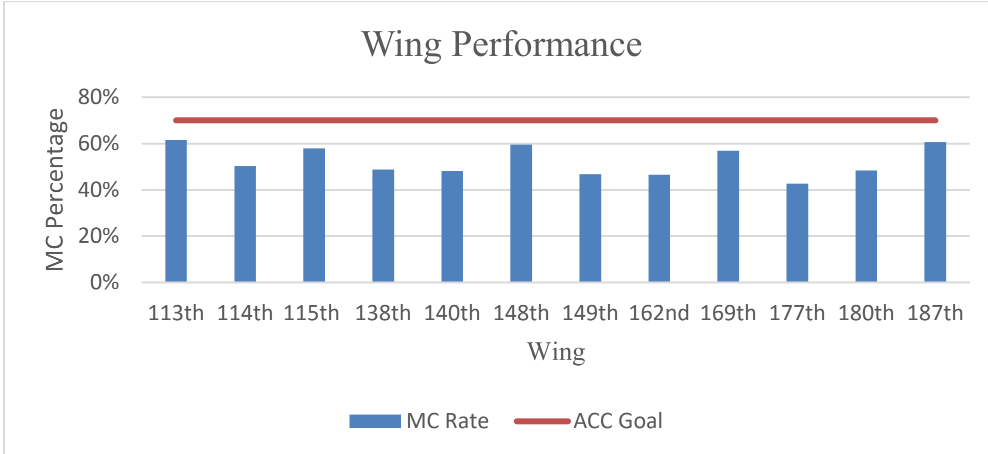


Figure 2 FY14-19

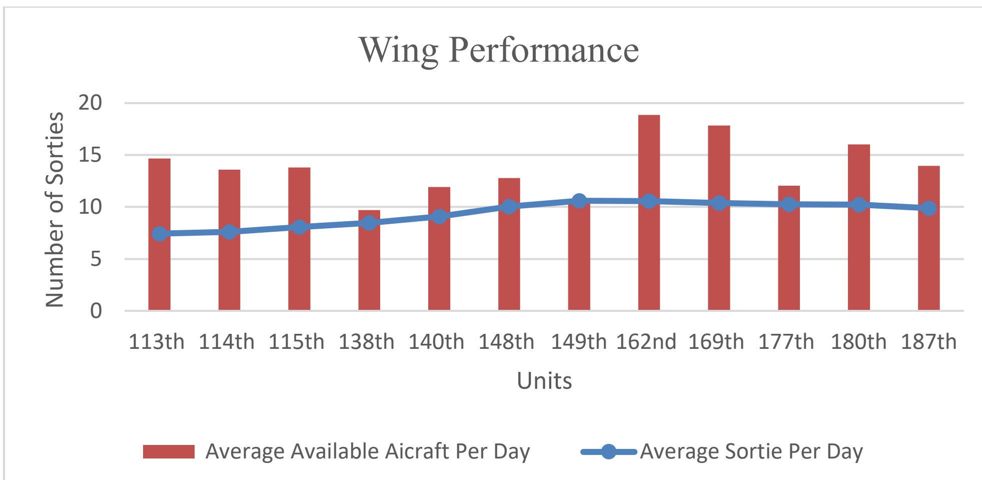


Figure 3 FY14-19

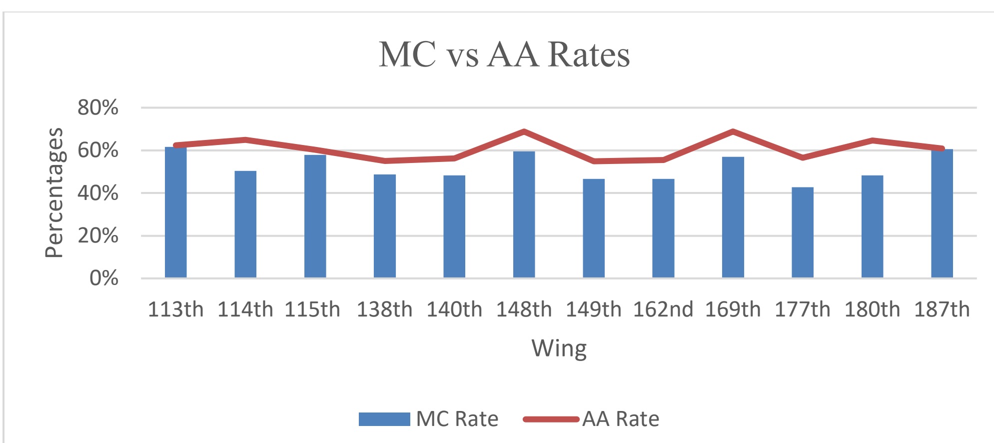


Figure 4 FY14-19

Next, the examination of the correlation between sorties flown and NMC% and AA%, depicted as a scatter plot in Figure 5 that visually depicts sorties flown as having little influence on NMC% or AA%. Sortie generation levels for either variable looks to have minimal influence on the other variables. These scatterplots portray no discernable correlation between the two variables, with p-values of .342 and .618 respectively. The graphical analysis and resulting statistical analysis support Hypotheses 2 and 3 which states that these two metrics are weakly correlated.

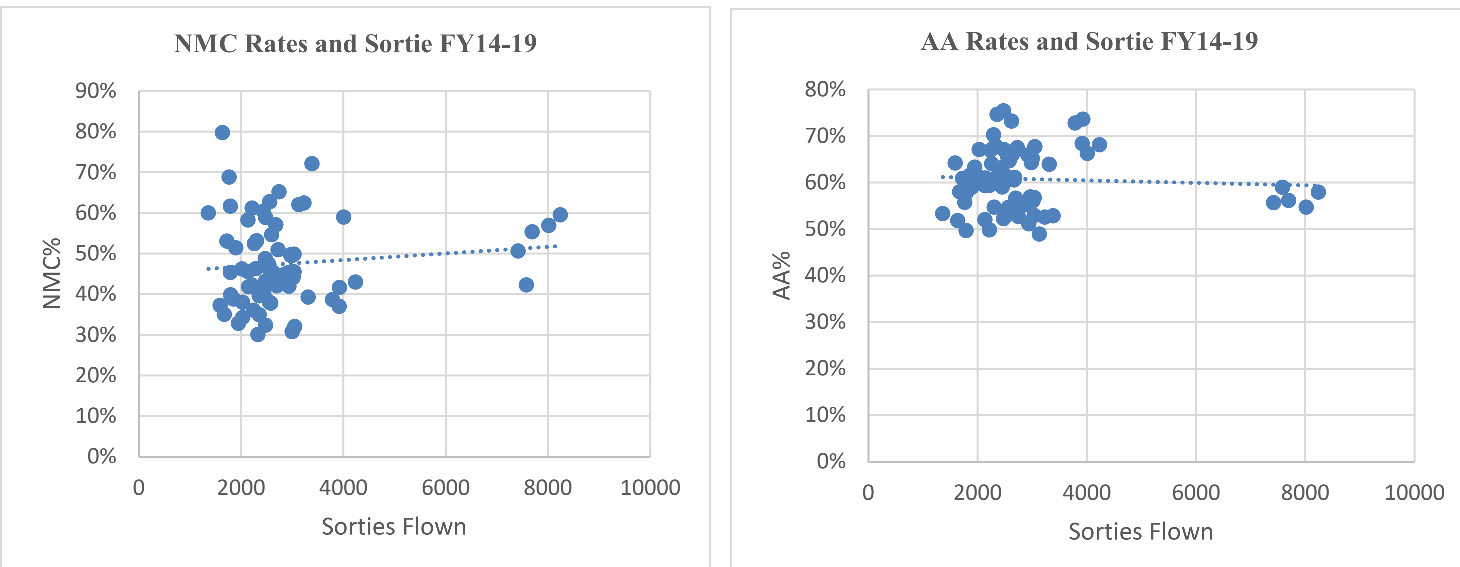


Figure 5

Following the examination of sorties flown, the subsequent correlation observes the relationship between MICAPs and NMC% and AA%. The scatter plot depicted in Figure 6 demonstrates little influence on NMC% or AA% due to the amount of days a MICAP takes to arrive. Like sorties flown, these plots again resemble indiscernible, random pattern with a p-value of .306 and .100 indicating randomness with no discernable correlation supporting the study's hypothesis that these two metrics are weakly correlated to MICAPS. Because it is integrated fully within the DoD, the supply chain processes and forces are intertwined in a way that process design and execution must consider the impacts on everyone involved in the supply chain to achieve optimal supply chain performance and efficiency rather than focusing on the success of individual processes, functions, and organizations (Peltz, E., Robbins M., McGovern, G., 2012).

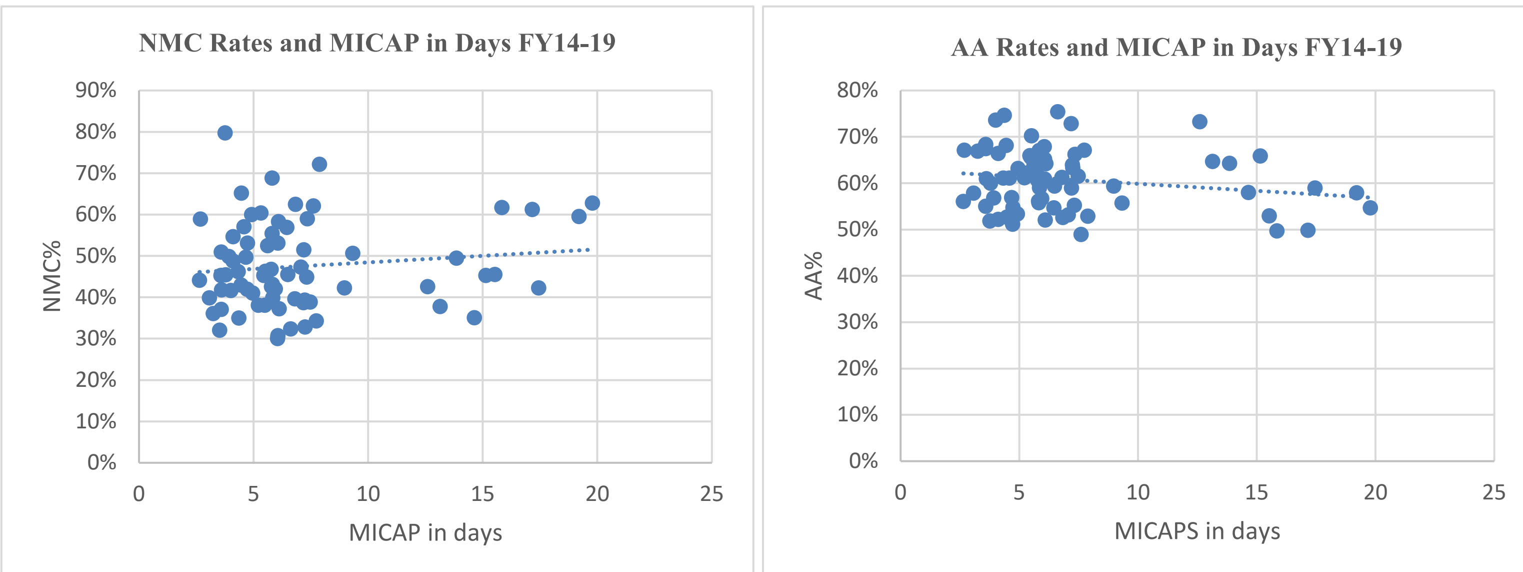


Figure 6

In order to understand customer and supply chain uncertainty and supply chain capabilities, it is important to understand the supply chain's system priorities. Deployed aircraft receive the highest priority followed by Continental United States (CONUS) units with an alert mission who have increased priority over those that do not. For CONUS units, the SCOW's goal for units to receive MICAPS is seven days. As seen in Figure 7, overall the SCOW has met this goal.

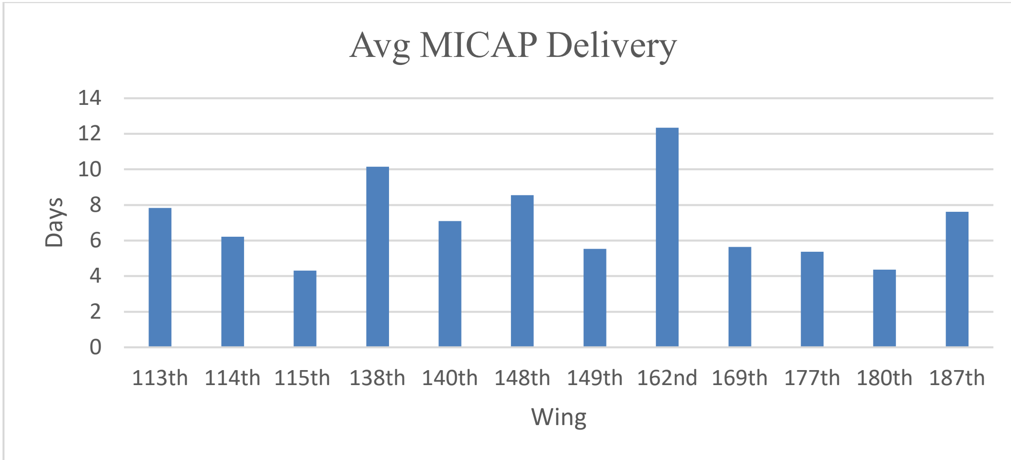


Figure 7, Average days for units to receive MICAPS

In support of OARIT missions, referencing Figure 7, on average, it takes roughly seven calendar days before units receive the requested mission impaired capability part (MICAP). As the primary driver of non-mission capability due to supply (NMCS), MICAPS' impact on mission capability is a priority for MC rates. Referencing Figure 2, on average, no ANG unit in this study have achieved ACC's MC rate goal. This should indicate the health of these fleets is poor. However, Figures 3 and 4, using aircraft availability as the metric to determine health, units routinely meet or exceed maintenance requirements providing the aircraft needed to meet their OARIT mission.

The difficulty in obtaining assets in support of maintenance activities on their MDS increases each year (Wittkowski, 2014), therefore it is important to analyze the impact on NMCS% and its correlation to NMC% and AA%. As depicted as a scatter plot in Figure 8, pursuing respective low and high percentage levels in either variable looks to results in minimal influence on the other variables. The p-value for NMCS, .056 does not meet the criteria for a strong p-value for this study. This was expected given reported unit performance. However, at $p = 0.10$, there is statistical significance for NMCS indicating the need for future exploration.

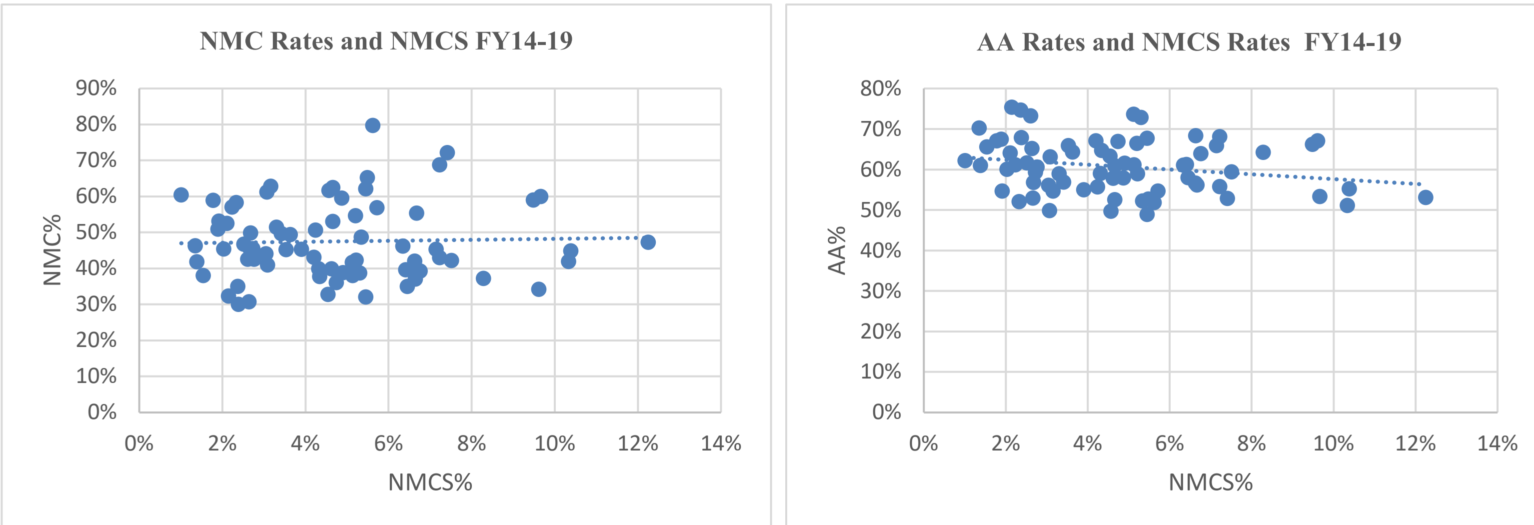


Figure 8

The above correlations observed variables external to maintenance. The next correlation, the impact of phase times on NMC% and AA%, depicted as a scatter plot in Figure 9 visually depicts the impact on NMC% or AA% due to the amount of days an aircraft remains in phase. Unlike the prior variables, the graphical depiction coincides with its statistical significance as both variables $p < 0.05$. Phase times for either variable looks to have a negative effect on the other variables, supporting the study's hypothesis that these two metrics are highly correlated the phase times. Considering the average phase times of the units, the correlation of phase times with NMC% and AA% was expected. Units have indicated a similar maintenance mindset of those found in "Aligning Maintenance Metrics, Improving C-5 TNMCM," which identified that focus on day-to-day operations at the expense of the long-term health of the fleet (Pendley, S. Major, Thoele, B., Albrecht, T., Howe, J., Antoline, A. Major, USAF, Golden, R, 2008). The correlation of

MICAPS to NMC% and AA% does not to imply that improvements from unit supply, maintenance and SCOW are not necessary. Considering NMCS% p-value of .056 at a p < .05 warrants attention if AA is the metric units utilize to indicate readiness.

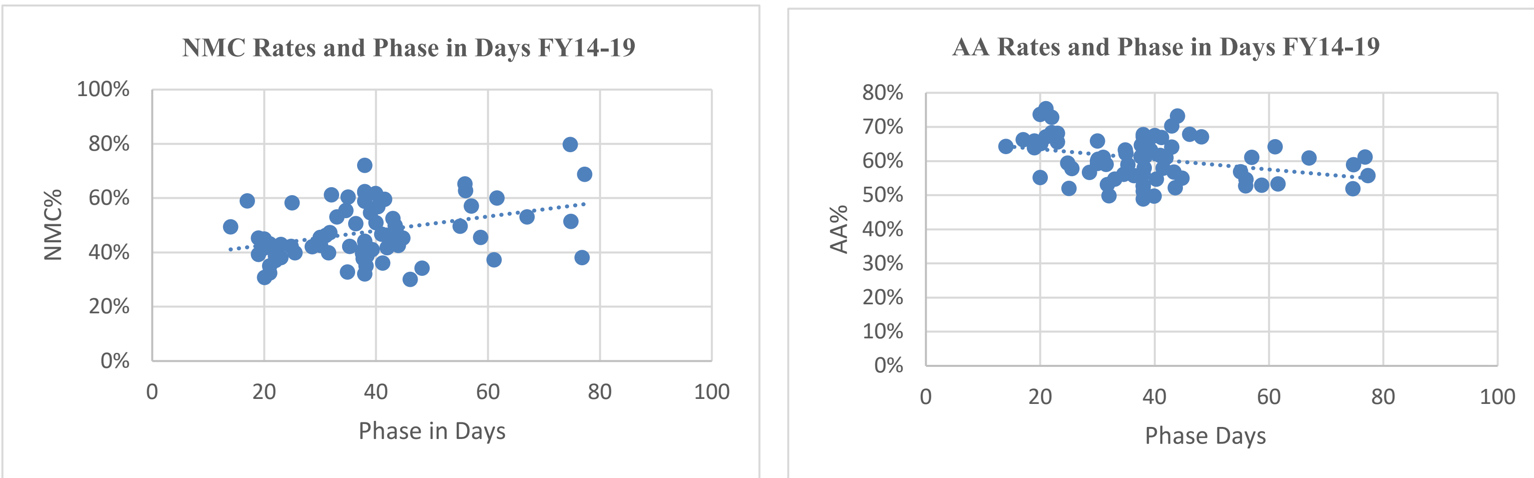
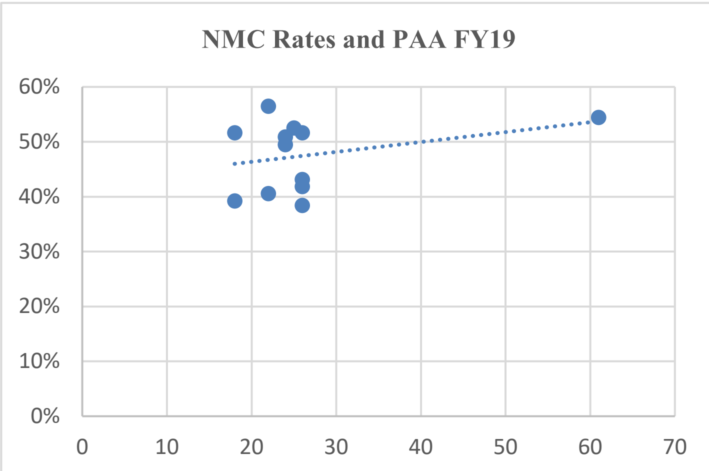


Figure 9

As the BRAC action on Burlington VTANG increased the aircraft inventory of some of the ANG F-16 units. The correlation of a bases authorized aircraft levels to NMC% and AA%, depicted as a scatter plot in Figure 10 visually depicts the impact on NMC% or AA% due to the amount of aircraft in the unit's inventory. The authorized aircraft variable looks to have a minimal effect on NMC%. This is reflected in its p-value of .118. This is reflected in its p-value of .118. However, the authorized aircraft variable looks to have a negative impact on AA% and a p < .05, supporting the study's hypothesis that these two metrics are weakly and highly correlated with PAA. The units indicated that the additional PAA is a detriment to their retention as the responsibility to green up jets increases. This may be attributed to unit emphasis on MC rates. However, the strong correlation of PAA with AA% lend to the validation of the hypotheses as the additional PAA provides the units increased flexibility/opportunity to meet their OARIT demands providing the opportunity for additional training.



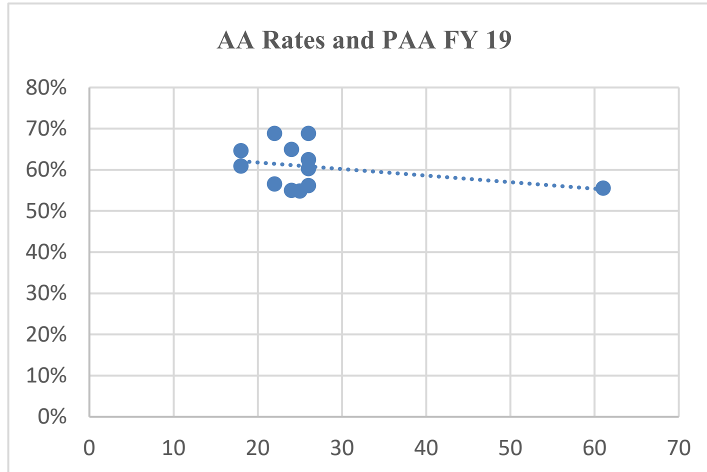


Figure 10

Finally, manning's p-value of .363 was not strong indicating a weak correlation to NMC% or AA%. Because this study was not able to obtain the data over the same period of time, the scatter plots were not included. On average, the units are manned at 94% which indicates adequate to meet their MISCAP requirements. The operations tempo, to include sortie generation, and manning had the highest p-values amongst the independent variables. This may indicate that sortie generation and manning shortages are not an issue of focus for the units. Instead, NEP utilization may require examination.

An Air Force Logistics study found that SNCOS 2A personnel in ANG units routinely perform hands-on maintenance. There are cases where this is not just practical but necessary. However, this finding aligned with the majority of the maintainers interviewed for this paper who attribute the motivation of the behavior to the culture of "greening up jets" at all costs. They expressed that this practice inhibits the growth of their SNCO force because they are promoted because of their ability to maintain jets, not supervising their sections. This aligns with the study performed by Pendley, Thoele, Albrecht, Howe, Antoline, and Golden (2008) who found the focus on day-to-day practices may have a direct effect on prioritizing unscheduled maintenance actions to best meet the flying schedule. This optimization can cause an aircraft that is hard broke to be prioritized below another airplane in order to get the less broke aircraft repaired more quickly and readied for the next flight.

Summary

The decision to prioritize the MC rate may actually have a negative effect on the health of the fleet as it does not maximize allocated resources. The regression indicates that the utilization of PAA and the performance of phase maintenance could improve readiness without increased resources. Decisions to focus on these other variables not aligned with NMC and AA may not achieve the desired impact unit operations.

V. Conclusions and Recommendations

Chapter Overview

This chapter will discuss the overall conclusions of using AA to measure unit success as the best way ahead for ANG units. Next, it will identify the significance of the research. It will then provide recommendations for action. Lastly, it will conclude by making recommendations for further research.

Conclusions of Research

This paper demonstrated that sorties flown, MICAPs in days, manning and NMCS' correlation with NMC and AA may not warrant the prioritized attention some units have granted. If the ANG's goal is to improve the readiness of their F-16 fleet, the priorities of all involved with the logistics process must change. Moreover, as discussed, the correlation of NMCS and AA should be further examined. The results suggest that although units are able to meet their OARIT and DOC aviation package requirements, current maintenance priorities do not ensure AA rate improvement. A dynamic that appears to be overlooked is that the MC rate is based on War and Mobilization Plan (WMP)-5 wartime requirements designed to be sustained for 30-days. In many cases, the MAJCOM 70% requirement exceeds the WMP-5 requirement.

Since readiness is an ANG priority and the MC rate for peacetime is founded by a wartime WMP-5 requirement, the study recommends that in order to increase unit readiness, ANG should adopt the AA rate as its readiness metric. As demonstrated by unit performance, AA rate is a better indicator of readiness then MC rates as it better identifies unit's ability to OARIT.

In order to increase their AA rates, individual units need to identify their MEL. They can accomplish this by calculating their Direct Support Objective (DSO) by the information identified by the RAP. Defined in the, "Optimizing Spares Support: The Aircraft Sustainability Model, (1996)," DSO is calculated utilizing the formula, NAC - D, where NAC = Number of aircraft, and D equals number of aircraft allowed to be down for parts while still meeting the availability rate (Slay, Bachman, Kline, O'Malley, Eichorn, King, 1996). Establishing MELs to identify AATs is the type of change General Brown discussed in his first directive to the service. "The Air Force, risks losing its superiority and a future conflict if change does not begin immediately, from how the service evaluates weapons to how it trains and deploys Airmen" (Everstine, B. Aug 2020). MEL will encourage the production of aircraft when they are needed under the 'Just In Time' philosophy versus the current unit philosophy of 'Just In Case.' For context, "Just In Time' enables OARIT as well as the ability to meet DOC statements. The current "Just In Case' exceeds the aircraft required for OARIT and DOC statements for the purpose of meeting a potentially excessive MC rate. This leads a host of problems including preventing smooth flow of work, hiding defects inside the work in progress (WIP) and other processes requiring more capital expenditure to fund the production process, and excessive lead-time.

Like private industry, adopting the Just In Time philosophy to production can increase unit readiness. The Just In Time philosophy requires units to assess their AA, DSO and maintenance capabilities in order to meet their RAP and wartime requirements. Wartime requirements are supported by the aviation package embedded in a unit's DOC statement which is made up of three MISCAPS consisting of two 6 ships and one 3 ship unit type codes (UTCs) supported by primarily maintenance, logistics and operations squadron equipment and personnel UTCs. UTCs are assigned codes, consisting of five characters that uniquely identifying the amount of personnel or asset being tasked.

Similarly, maintenance DOC statements require mobilizing roughly 120 airmen within 72 hour notice. Maintenance is tasked to provide/deploy:

- Mission ready lead aircraft maintenance package
- Mission ready follow one aircraft maintenance package
- Mission ready follow two aircraft maintenance package
- Mission ready follow three aircraft maintenance package
- Aircraft maintenance and sortie generation and provide weapons load crews

The ability to support an aviation package is a good indicator that the unit's maintenance capabilities are, at minimum, adequate evidence they have the ability to meet their DOC statements. Additionally, according to the SCOW, if units are activated, they could provide the required assets, as activated units receive increased priority, by laterally shipping to home location or having the asset in place to the deployed location.

Although the ANG has not achieved the established ACC mission capability rates, their AA rate indicates that they are meeting aircraft readiness requirements and the logistics process is meeting customer demand. The negative perception created by MC rates generates an unsustainable operations tempo potentially connecting the ANG's behavior in asking their airmen to maintain a year-round sprinters wartime requirement pace for the purposes of readiness and OARIT. At this pace, units will struggle to retain talent, develop airmen who excel beyond executing the mission where they manage resources, improve their unit and lead their people. It also disincentives leadership to, in the words of General Brown, "innovate or lose."

Measuring unit success with AA metrics by establishing MEL and adjusting AAT to actual mission requirements permits leaders to expand their corporate logistical knowledge and maximize SCOW support in order to make data driven decisions that will improve long-term maintenance requirements (the quantity and quality of maintainers) and the overall health of the fleet. In order to achieve this understanding, a change has to be made. As stated by Albert Einstein, "We can't solve the problems of today by using the same kind of thinking we used when we created them." Human nature struggles to adapt to things counter to what they are used to. To be deliberate in implementing this change, we have to remember, "what gets measured gets done" (Peters, T., 1986). Airmen will prioritize what their leadership prioritizes (Quion, L., 2020). If units want to see increase unit readiness, their priorities have to change.

Recommendation for Action

Establish MEL and AATs at the unit level to achieve not only optimal health for the fleet, but for their airmen which will increase retention. It will also aid in achieving:

1. Strategic fit within and between ANG organizations Fighter Squadrons, Maintenance and supply chain capabilities

2. Decrease overproduction

Coordination and communication will be key to the success of any new implementation or change. The transfer of information between units to discuss best practices, based on the success and shortcomings will strengthen the overall ANG fleet. As it relates to improved supply chain support, units should begin coordination by block (for example, F-16 block 50 units coordinate with other block 50 units before coordinating with block 30 units) with other ANG units to create scorecards designed to expedite and support all maintenance process. In coordination with supply and the SCOW, units can identify assets with high probability requirement to be in place as the aircraft enters phase. This recommendation requires extensive coordination supported by analysis, experience and an understanding of the limitations within the supply chain. Mitigating controllable unit behaviors such as hording of parts from the customer support section, enabling improved coordination with the SCOW, can increase the potential for assets to be in place on time to begin the phase process.

In addition to establishing MEL and AAT, units should analyze the regression figures to uncover the best practices of units who are achieving greater aircraft availability then predicted. This paper suggests starting with the following two analyses: the effects established MEL and AATs on NMCS% and phase maintenance. Adopting AA rates enable units to withstand the ebbs and flows of the other variables contributing to retention.

Summary

The ANG cannot enhance their state of readiness without each organization in the logistics process first addressing internal shortfalls. Operations, Maintenance, Logistics squadrons and the SCOW can improve if they achieve the former while obtaining an understanding each other's processes and shortfalls. Otherwise, the ANG cannot meet the Chief of Staff's intent. "The Air Force has made improvements in the readiness of its units. However, the continued high demand for Air Force capabilities continues to impact recovery," General C. Q. Brown wrote. "If confirmed, I will continue the effort [Chief of Staff] Gen. [David] Goldfein has put on readiness recovery with a focus on recruiting, training, and retaining high-quality Airmen, driving down the average age of our aircraft fleets through modernization, and working with our combatant commanders on balancing current operations tempo with time for our Airmen to train for full-spectrum combat operations."

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14. ABSTRACT

A strength of the ANG is that Airmen remain with a single unit for most, if not all, of their careers enabling them to become experts in their field and mission design series. This strength can also be a weakness as this stability has led to stagnation and a focus on short-term solutions to long-term logistical problems. Units are aware of the known deficiencies and although some of these factors are outside of the unit's control, adjustments are required if the ANG is to succeed in completing its duel missions. Focusing on the ANG's twelve F-16 C/D units, the purpose of this GRP is to examine the relationship between multiple variables within maintenance and the supply chain and their impacts to the unit's MC rate and aircraft availability. The results of this study will provide insight and explain why the ANG should pivot from using MC rates as its benchmark of success to aircraft availability rates in conjunction with predetermined MEL and AAT for their weapons system. The adoption of this new philosophy will enable units to strategically focus resources and improve the ANG's lethality.

15. SUBJECT TERMS

Aircraft Availability, Mission Essential Limit, Direct Support Objective, Mission Capability

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