C-130J FLIGHT PILOT DEVELOPMENT: AN EMPIRICAL MIXED METHOD ANALYSIS ON AIRCRAFT COMMANDER UPGRADE

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Abstract

Position upgrades have been the focus for many firms and ensuring that the right training is in place, ensures that the member is ready for the increased complexity of their new role. This is no different for upgrading pilots. The focus of this research is to improve the C-130J flight pilot development process by identifying and subsequently controlling the variance in the upgrade process. In the literature, the variance within manufacturing products presents many different problems such as inefficiencies and waste. In this research, the products are C-130J aircraft commanders. The data in this study were the aviation flight records of C-130J flight pilots (n=90), with a focus on flight hours. As a percentage of total C-130J flight and simulator time, 11 categories of hours were established. The data analysis of this study found that 10 of the 11 categories had statistically significant variances. In attempts to identify the causal factors for the variances, qualitative data provided by subject matter experts were collected. With the differences identified, this study recommends employing the Six Sigma DMAIC (Define-Measure-Analyze-Improve-Control) methodology to the current upgrade processes. This research provides the C-130J community with three critical findings regarding flight pilot development. First, it highlighted that variances are occurring in upgrade training. Second, based on statistical results, the research generated minimum recommended flight hours in each of the 11 categories. Finally, the research proposes a process improvement methodology that could be implemented within the C-130J community and more importantly, in any upgrade training where people advance into higher echelons of a business.

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I. Introduction

General Issue

Today, a C-130J flight pilot (commonly known as co-pilot) must obtain 700 Primary Aircraft Authorization hours before being eligible for an upgrade to mission pilot (commonly known as aircraft commander). Flight pilots are continuously monitored through their development with instructor pilot feedback provided to squadron leadership. Once the individual has obtained 700 hours in C-130J, and the prerequisites have been met, the decision to upgrade the individual falls on the squadron commander. Besides the number of hours, 700 in this case, the majority of data the squadron commander has been provided to make this decision is qualitative. What if 30% of those 700 hours were obtained not at the controls of the aircraft or in a primary crew position, which is known as other time? Or, what if a young aircraft commander has never airdropped actual personnel and was now scheduled to command a Joint Airborne or Air Transportability Training? Unfortunately, these scenarios are real and are the motivation for this research. The qualitative data provided to squadron commanders have proven to be useful, but there is room for process improvement. By implementing the DMAIC methodology, this research provides quantitative tools to improve the C-130J upgrade process.

The results of this research will establish that there are statistical differences between the individual squadrons and provide subject matter expert input to establish why this is occurring. Additionally, the data will highlight where the significant variances are occurring between individual pilots within the respective squadrons. These variances could limit the ratio of quality flight hours individual pilots are obtaining as they accumulate 700 hours.

The C-130J community does not currently have a standardized method to measure the quality of flight hours each pilot obtained. A similar problem occurred in the civil aviation community and sparked debate in 2010 after a law was signed that increased the minimum flight time requirement of pilots seeking to be hired by U.S. air carriers (Werfelman, 2010). Opponents of this law believe that the quality of flight hours should be the measurement of experience, not a specific quantity. The results of these debates led to the Federal Aviation Administration (FAA) establishing minimum hours required in specific categories of flight hours. By analyzing 90 samples, this research established an average percentage of total hours for 11 categories of flight hour within the C-130J community. These averages can now be used by squadron commanders to gauge how their flight pilots are developing their experience quantifiably.

Variance reduction and quality products are terms used extensively in the manufacturing world. However, they are not such standard terms when considering C-130J pilot production. Leading manufacturing companies have turned to Six Sigma to enhance their productivity and enhance their products (Chakrabortty, Biswas, and Ahmed, 2013). Researchers have applied Six Sigma in many businesses because there is always room for improving a product (Tonini, Spinoloa, and Laurindo, 2006). When C-130J pilot production is considered as a product, it can quickly be recognized where Six Sigma's DMAIC methodology can improve the process.

Problem Statement

Currently, there is not a standardized method for squadron commanders to ensure the 700 hours obtained by one flight pilot are of the same quality of flight hour as the next flight pilot. Additionally, there is no quantifiable information available that flight pilot seasoning at one location is equal to the next location. Variances in flight pilot development should be identified and continuously monitored to ensure changes in pilot training, budget constraints, or unforeseen issues do not impact flight pilot development. The only way to monitor the future is to standardize and understand the process of today.

Research Objectives/Questions

The main objective of this research is to provide the C-130J community an approach to more effectively monitor flight pilot seasoning and reduce variances between the squadrons and pilots within the individual squadrons. This will be accomplished by first establishing averages for 11 different categories of flight hours based on a sample size of 90. These flight hour categories are defined below:

<u>Primary Flight Time</u> -As defined in AFI11-401 is "time logged by a member occupying a designated duty station identified in AFI 65-503, and actively performing the duty associated with their aircrew specialty" (AFI11-401, 2010:60).

Secondary Flight Time - As defined in AFI11-401 is "flight time logged by a crewmember who is performing inflight duties related to the crewmember's specialty, but who is not controlling the function of that specialty" (AFI11-401, 2010:62).

Other Flight Time - As defined in AFI11-401 is "flight time flown by members who are on the flight authorization, but who are not occupying a designated duty station or conforming to the requirements of primary, secondary, instructor, or evaluator time" (AFI11-401, 2010:64). Other Time is a category of flight time that should be limited compared to Primary and Secondary Time as the pilot is not at the controls of the aircraft and not receiving the highest quality of flight hour.

Night Time - As defined in AFI11-401 is "the portion of primary, secondary, instructor, or evaluator flight time logged between the end of evening civil twilight and the beginning of morning civil twilight, as published in the American *Air Almanac*" (AFI11-401, 2010:66).

Instrument Time - As defined in AFI11-401 is "the portion of primary, instructor, or evaluator flight time logged when external conditions require that the aircraft attitude be maintained primarily by reference to the flight instruments." (AFI11-401, 2010:66).

NVG Time - As defined in AFI11-401 is "the portion of flight time logged by an aircrew member wearing night vision goggles between the end of evening civil twilight and the beginning of morning civil twilight, as published in the American *Air Almanac*" (AFI11-401, 2010, pg 66).

Training Flight Time – Training time is not explicitly defined in AFI11-401. Instead, this research defined Training Flight Time as flight hours with Mission Symbols starting in N1, N2, and T1-T3 based on definitions in AFI11-401, Table A2.2 "Authorized Mission Symbols" (AFI11-401, 2010, Attachment 2).

Tasked Flight Time – Tasked or operational flight time is not explicitly defined in AFI11-401. Instead, this research defined Tasked Flight Time as any flight hours obtained with Mission Symbols starting in A1-9, C2-C9, L1-L8, M1-M7, P7-P9, and O3 based on definitions in AFI11-401 Table A2.2 "Authorized Mission Symbols" (AFI11-401, 2010, Attachment 2).

Simulator Time – Simulator time is not explicitly defined in AFI11-401. Instead, this research defined Simulator Time as any hours obtained with Mission Symbols starting in Q1-Q3, based on definitions in AFI11-401 Table A2.2 "Authorized Mission Symbols" (AFI11-401, 2010, Attachment 2).

Joint Airborne or Air Transportability Training - JA/ATT time is not explicitly defined in AFI11-401, but AMCI10-2101 defines JA/ATT as the "Air Force managed and funded program designed to provide airborne and proficiency/continuation training in a joint environment" (AMCI 10-2101, 2018:4). To extract JA/ATT Time from flight records, Mission Symbols starting with M8, defined in AFI11-401 Table A2.2 "Authorized Mission Symbols," were utilized (AFI11-401, 2010, Attachment 2).

Combat and Combat Support Flight Time – Combat and combat support time, as defined in AFI11-401, are "Combat. Aerial activity, engagements, or attacks conducted by aircraft against an enemy of the US or an opposing foreign force when there is risk of exposure to hostile fire" and "Combat Support. Aerial activity, engagements, or attacks conducted by aircraft against an enemy of the US or an opposing foreign force that operate outside the designated hostile airspace, where there is no risk of exposure to hostile fire" (AFI1-401, 2010, pg 64).

The data analysis of these 90 flight records within the 11 categories will then enable the following research questions to be answered.

1. Are there significant statistical variances between the C-130J squadrons in regards to how their respective flight pilots are obtaining their flight hours?

2. What is the correct distribution of flight hours a C-130J flight pilot should obtain to reduce variance and provide commanders full confidence the individual has received a sufficient amount of quality flight hours?

3. Can the Six Sigma DMAIC methodology be applied to C-130J flight pilot development, and if so, what results will emerge?

Methodology

A mixed methodology was employed through three distinct phases of research to answer the research questions. Phase I involved data collection and quantitative analysis of 90 C-130J flight pilots' aviation records. After analysis and sorting of the flight hours within each record, all 90 samples were combined to establish C-130J flight pilot averages for each of the 11 categories. Additionally, averages for each squadron were established that would enable the next phase of the research.

Phase II of the research involves statistically testing the data retrieved from the flight records. The Levene Test and Kruskall-Wallis H Test (discussed in Chapter 3) were utilized to statistically evaluate the variances and means within each squadron and statistically compare the squadrons in each of the 11 categories. The final step in Phase

II was the qualitative input of subject matter experts on the results in hopes of determining what the causal factors were. The following three levels of subject matter experts were utilized, squadron commander, squadron director of operations, and squadron chief of training. Having identified the variances and been provided answers to why they were occurring, the research moved onto the final phase.

Phase III was the study and proposed implementation of Six Sigma's DMAIC methodology into the C-130J upgrade process. Phase I and II results indicated there were significant statistical differences between and within the six squadrons, which defined the problem. DMAIC has five distinct steps for process improvement, and defining the problem is step 1. Below each step is briefly defined as it relates to the C-130J upgrade process and a full discussion of each step is developed in the final chapter of this research.

Definition: Establish a way to reduce variance in flight pilot seasoning
Measurement: The 11 categories will be used as the selected measurement items
Analysis: Data analysis and subject matter expert input will identify root causes
Improvement: Significant variance should be reduced to improve the process
Control: Recommendations will be made to Air Mobility Command on how to implement and monitor this process improvement

Assumptions/Limitations

There were limited assumptions made or limitations encountered within this research project. The few that were encountered are discussed in this section. First is the sample size in which this research was conducted. The data was drawn from the flight records of 90 C-130J flight pilots. 90 is statistically a large sample size, but there are only 15 samples from each squadron. This small size may skew some of the squadron results. In attempts to limit the possibility of skewness, 5 of the 15 samples were nominated by the respective squadron commander as either just completed upgrade or an individual who was next in the queue. This maximized the number of hours that would be analyzed. The remaining 10 pilots were selected at random but were all in their final phase of development, which again maximized the number of flight hours they have.

The second limitation has to do with the seasonality of the data. Each of the 90 samples started from October and November 2019, then went back to their first recorded flight in their respective squadron. For some samples, this could be nearly two years of data, but for some, this is closer to a year of data. Deployments can also have a type of seasonality impact on flight pilot seasoning. For deployments, not all flight pilots will have the opportunity to accompany the squadron on their deployment. This could cause a variance between the amount and type of flight hours obtained between the pilots that deploy versus those who do not. With two years of data, the impact of seasonality should be minimal, but with a year of flying, the data could see more of an impact

Implications

This research is the first known attempt to quantifiably analyze the variances in training between the six C-130J squadrons. This is noteworthy for the fact that squadrons could use these results to not only monitor flight pilot development but also create data-informed arguments to higher headquarters concerning their needs. The implementation of Six Sigma by business industries has resulted in billions of dollars in productivity gains, such as GE's $1.5 billion (Tonini, Spinoloa, and Laurindo, 2006). Although it will be challenging to measure the initial monetary benefits within the C-130J community, variance reduction could lead to a significant savings. The hours that all USAF aviation units utilize to train their pilots comes at a significant cost. This research proposes a method to more efficiently monitor those flight hours and eliminate waste when it is identified. The proposed variance reduction methods developed in this project could potentially be utilized by all Department of Defense aviation communities, or any community that utilizes hours as a measure of experience. A more methodical analysis of how flight hours are being consumed will result in a cost savings through variance reduction.

II. Literature Review

The purpose of this chapter is to prepare the reader with background information to assist in understanding why this research was conducted and to appreciate the impact of the results. The chapter will be broken down into four separate sections that relate to the research. First, the current C-130J flight pilot upgrade requirements will be presented for a background understanding. The second section will focus on variances in production and why the variances in flight hours should be scrutinized in the C-130J community. The third section will examine the relevant Federal Aviation Administration (FAA) literature that relates to establishing minimum flight hour requirements in different categories and discuss quality flight hours. Finally, the last section will explain the Six Sigma's DMAIC method for a better understanding of how the C-130J community could utilize it.

C-130J Upgrade Requirements

This section provides the requirements that are currently in place for a C-130J flight pilot to upgrade to aircraft commander. The governing regulation for these requirements is the AFMAN 11-2C-130J Volume 1, dated 10 February 2020. Figure 1 is from AFMAN 11-2C-130J Volume 1 and provides the "minimum flying-hour requirements and prerequisites" that flight pilots must meet before being considered for upgrades (AMC/A3TA, 2020:46).

From	To	Prerequisites	Tasks and Events Required Before Certification	Notes
UNQ	FP	UPT Graduate	C-130J FTU	1, 4
FP	MP	Total Time / PAA 1300 / 300 or 900 / 700	-MPD Phase I, II & III	4, 5, 6
UNQ/FP	MP	Previously certified MP's in any manned MWS 1000 total flying hours (800 FAIP/OSA) And 150 PAA.	-Initial qualification course at FTU -MPD Phase II guide, if required -In-unit MP qualification.	1, 4, 5, 6
MP	IP	200 PAA hours since AC Certification	-PIN course and IP Eval	4
UNQ	FL	Basic LM Course Graduate	-LIQ	
UNQ	ML	Loadmaster with 2 years' experience in any cargo aircraft	-LXA	
UNQ	ML	Tactically qualified C-130 E/H Loadmaster (Minimum of 200 Hours in C-130 E/H)	-LXB	
ML	IL	200 PAA	-LIN	2, 3
IP/IL Instructor	EP/EL Evaluator	Sq/CC recommendation	-In-unit Flight Examiner checkout -Sq/CC certification	

Notes:
1. Refer all Rotary Wing pilots to MAJCOM/A3T (or equivalent) for a training recommendation.
2. ML will have a X1A251 primary AFSC (or higher). **(T-2).**
3. Airdrop qualified ML will have a minimum of 15 actual aerial delivery sorties of which a minimum of 10 will be some combination of actual equipment or CDS events. **(T-2).**
4. C-130J simulator time is creditable towards PAA Time. Simulator time is creditable towards total flying hours.
5. Total flying time (TFT) represents all flying time logged aboard a fixed wing aircraft as a military pilot including UPT, Student, and "Other" time. **Exception:** TFT does not include time in another aircrew specialty or time flying unmanned aircraft.
6. For MAF cross-flow with similar skill set (e.g., C-17, C-5, KC-135), MPD Phase II guide is not required. Pilots with dissimilar background (e.g., OSA/FAIP, F-16), accomplish MPD Phase II guide in-unit.

Figure 1: AFMAN 11-2C-130J Upgrade Requirements (AMC/A3TA, 2020)

The focus of this research is on the FP to MP section that is highlighted in Figure 1, specifically the 700 hours. From AFMAN 11-2C-130J Volume 1, all flight hour prerequisites are "based on a crewmember having gained the knowledge and judgment required to safely and effectively perform assigned duties in support of the unit's mission" (AMC/A3TA, 2020:46). Through email correspondence, Air Mobility Command's Chief of Aircrew Force Management Branch explained how 700 hours would ensure the right mix of experience and knowledge was obtained. It was explained that 700 hours is the result of decades of inputs from subject matter experts through the Realistic Training Review Board process (Personal Correspondence, December 2019). He went on to explain the Realistic Training Review Board process is a yearly procedure that brings together training representatives from each Air Mobility Command wing and each type of aircraft in the command. Additionally, it was explained how hours are not the only requirement utilized to ensure the right mixture of experience was obtained, and the development of the Mobility Pilot Development guides reinforced this (Personal Correspondence, December 2019). The Mobility Pilot Development program is directed by AFMAN11-2C-130J Volume 1 and "flows from Pilot Initial Qualification formal training courses through continuation training is upgrade selection and culminates in certification as an Aircraft Commander" (AMC/A3TA, 2020:46).

This research does not intend to debate this number, but rather provide additional metrics within the 700 hours to analyze pilot progression and reduce variances. Standardization is significant in the aviation community, and with standardization comes a reduction in variances amongst the units and within the unit. The next section highlights why the C-130J should look for ways to reduce the variances in experience gained by flight pilots.

Variance Reduction in Production

C-130J flight pilots arrive at their first squadron with very similar training and flight experience from undergraduate pilot training. Once at the unit is where variation starts to occur in their development. This research argues that one goal of flight pilot development should be to reduce variation in the seasoning process between individuals in the squadron and between squadrons. If flight pilot development is considered a form of production, it should be quite obvious why reducing variation in development is so important. A vast amount of research has been conducted on the reduction of variation in production and supply chains. This section will focus on some of that research as it can be related to C-130J flight pilot development.

It is first essential to understand why identifying variances in production is important. In an article titled *Understanding Variation*, Thomas Nolan and Lloyd Provost emphasize many of these reasons (Nolan and Provost, 1990). These authors, as they discuss managers, explain that they must be able to interpret variation within their organizations. Additionally, they describe how managers should determine whether observed variances are based on a trend or possibly a random variation (Nolan and Provost, 1990). Mackay and Steiner make a similar argument as they believe a more consistent output can improve a product's performance (Mackay and Steiner, 1997). Eric Matson and Laurence Prusak authored an article titled *The Performance Variability Dilemma* establishes that the impact of variations is not all equal for each category (Matson and Prusak, 2003). They argue that managers should decide on which areas need the greatest attention through key metrics (Matson and Prusak, 2003). The results of this research have identified key metrics and where variation occurs in C-130J flight pilot development.

Variation in flight pilot development can come from a multitude of factors, such as location, deployments, time of year, flight availability, weather, and many other factors. Studies of production have shown there are also multiple reasons for variation in products. In a dissertation from the University of Vienna, Martin Poiger highlighted significant studies on this matter and how variability is characterized. Poiger's research found that the majority of work in this field categorized variation into two main types (Poiger, 2010:38). One example of this classification is variability due to common causes or due to special causes (Poiger, 2010:38). The next classification fits more closely with the C-130J community, "controllable variation, arising directly from decisions and random variation, arising from events beyond immediate control," as defined by Hopp and Spearman (Poiger, 2010:38).

Thus far, the C-130J upgrade requirements have been provided along with how variance in production should be a focus. The next section of this chapter focuses on the civilian aviation sector, specifically how it has moved to evaluate the quality of flight hours versus the number of flight hours while establishing hour requirements for different categories.

Civil Aviation Experiences

The C-130J community currently uses the number of flight hours as the primary indicator of when a flight pilot is ready to upgrade. As was pointed out earlier in this section, prerequisites are in place to ensure flight pilots are gaining the right amount of knowledge and experience before upgrading. Nevertheless, this research hopes to demonstrate that there are quantifiable means to improve this process. This section will use civil aviation experiences as a guide to understanding why the C-130J community should consider more emphasis to be placed on the quality of flight hours.

A law was signed in 2010, increasing the minimum flight time requirement of pilots seeking to be hired by U.S. air carriers (Werfelman, 2010). This new requirement has sparked debate in the civilian aviation community of whether the number of flight hours should be the correct measurement of the experience of the pilot. Opponents of this requirement state quality of flight hours are more important than quantity. This section will look deeper into the studies that found the quality of flight hours should be more of the deciding factor when considering experience. Additionally, the Federal Aviation Administration's (FAA) regulation Title 14, Part 61, Subpart G – Airline Transport Pilots (ATP) guidance will be laid out as this will be a basis for the final recommendations of this research.

Over 20 years ago, a study was endorsed by the Senate Committee on Commerce, Science, and Transportation concerning the adequacy of Federal standards and programs (U.S. Congress, 1988). Although this was a comprehensive study of the civilian aviation community, there was a significant portion dedicated to pilot selection and training. The study analyzed numerous factors concerning pilots, such as age, health, experience, training programs, and total time. The conclusion of this stated:

> Total time, whether hours in a logbook or years in a crew position, does not give the complete picture of pilot experience, skill, or quality of training. For example, full motion flight simulators or advanced training devices enable a pilot to meet with more emergencies and unusual situations in a 4-hour training session than he may experience on the line during a 20-year career. However, few measures of pilot ability other than flight-time have been collected broadly and consistently. Alternative measures or tests of skill and experience could prove useful (U.S. Congress, 1988, pg 122).

An additional study on quality flight hours came in 2012 and focused on analyzing pilot performance based on previous aviation experience. Relevant to this research, the study found that total flight hours produced inconclusive results (Smith, Herchko, Bjerke, Niemcyk, Nullmeyer, Paasch and NewMyer, 2013). The study highlighted the quality of the experience, not the total number of hours to be a better predictor of pilot performance (Smith, Herchko, Bjerke, Niemcyk, Nullmeyer, Paasch and NewMyer, 2013). Finally, the 2012 study found, "that using a quantity measure of total flight hours as the predictor of success is not suitable for the aviation industry that constantly strives to improve safety and training performance" (Smith, Herchko, Bjerke, Niemcyk, Nullmeyer, Paasch and NewMyer, 2013:22)

This section of the chapter looks into the FAA's updated Code of Federal Regulations Title 14, Part 61, Subpart G – Airline Transport Pilots (ATP). In 2012, the FAA released "Proposed Rules" following the 2009 Colgan Air accident near Buffalo, NY. This accident brought attention to air carriers' processes of training and developing their pilots (Department of Transportation, 2012). The FAA adopted many of the "Proposed Rules," and this research focuses specifically on Part 61, Subpart G – Airline Transport Pilots. Their research resulted in recommending a breakdown in the types of flight hours required before being eligible to apply for an ATP. Their breakdown of types of flight hours includes total time, cross-country time, night time, multiengine time, instrument time, and a maximum amount of simulator time. Figure 2 displays the requirements that came from the "Proposed Rules" and are current as of 15 January 2020 (Electronic Code of Federal Regulations, 2020).

§61.159 Aeronautical experience: Airplane category rating.

(a) Except as provided in paragraphs (b), (c), and (d) of this section, a person who is applying for an airline transport pilot certificate with an airplane category and class rating must have at least 1,500 hours of total time as a pilot that includes at least:

(1) 500 hours of cross-country flight time.

(2) 100 hours of night flight time.

(3) 50 hours of flight time in the class of airplane for the rating sought. A maximum of 25 hours of training in a full flight simulator representing the class of airplane for the rating sought may be credited toward the flight time requirement of this paragraph if the training was accomplished as part of an approved training course in parts 121, 135, 141, or 142 of this chapter. A flight training device or aviation training device may not be used to satisfy this requirement.

(4) 75 hours of instrument flight time, in actual or simulated instrument conditions, subject to the following:

(i) Except as provided in paragraph (a)(4)(ii) of this section, an applicant may not receive credit for more than a total of 25 hours of simulated instrument time in a full flight simulator or flight training device.

(ii) A maximum of 50 hours of training in a full flight simulator or flight training device may be credited toward the instrument flight time requirements of paragraph (a)(4) of this section if the training was accomplished in a course conducted by a training center certificated under part 142 of this chapter.

(iii) Training in a full flight simulator or flight training device must be accomplished in a full flight simulator or flight training device, representing an airplane.

(5) 250 hours of flight time in an airplane as a pilot in command, or when serving as a required second in command flightcrew member performing the duties of pilot in command while under the supervision of a pilot in command, or any combination thereof, which includes at least—

(i) 100 hours of cross-country flight time; and

(ii) 25 hours of night flight time.

(6) Not more than 100 hours of the total aeronautical experience requirements of paragraph (a) of this section or §61.160 may be obtained in a full flight simulator or flight training device provided the device represents an airplane and the aeronautical experience was accomplished as part of an approved training course in parts 121, 135, 141, or 142 of this chapter.

Figure 2: FAA Directive 61.159 (Electronic Code of Federal Regulations, 2020)

Although the previous studies in this section recommend different measures to determine experience versus the number of hours, the FAA still utilizes a number of flight hours as a significant factor. What the FAA did change though, and this research utilizes in later chapters, is a breakdown in the type of flight hour obtained towards the total hour requirement. The final section in this review of literature is the basis for the recommendations of this research project, Six Sigma's DMAIC methodology.

Six Sigma's DMAIC

To this point, literature has been reviewed on current upgrade requirements, variance reduction, and experiences within the civil aviation community. This section will conclude with gaining an understanding of Six Sigma's DMAIC methodology. This methodology will be applied to the results of this research and are presented in the final chapter of this research.

The results of this research indicate that there are significant variances in how C-130J flight pilots are obtaining their hours. The variances are occurring within the individual squadrons, between the squadrons and between locations. Variance reduction is a heavily researched topic, and many times an internet search for "variance reduction" will include results with Six Sigma. Six Sigma was introduced in the 1980s with the primary goal of improving products through variance reduction and has since been utilized with significant improvements to some well-known companies (Klefsjo, Wiklund and Edgeman, 2001). "Six Sigma makes use of sound statistical methods and quality management principles to improve processes and products via the Define–Measure–Analyze–Improve–Control (DMAIC) quality improvement framework" (Tang, Goh, Lam, and Zhang, 2007:3).

Numerous studies were reviewed with five studies selected to enable this research to recommend how to implement the DMAIC methodology into C-130J upgrades. The first study, *An analysis of the Six Sigma DMAIC method from the perspective of problem-solving* compares DMAIC to scientific theories in the field of problem-solving (Mast and Lokkerbol, 2012). This study highlights what type of problems the DMAIC method works well in improving, but also takes a critical analysis of problems where the method proved to be ineffective (Mast and Lokkerbol, 2012). A second study focused on implementing the Six Sigma approach to reduce the variability of processes in food processing (Chakrabortty, Biswas, and Ahmed, 2013). An additional study that has an impact on this research focuses on appropriately scoping DMAIC projects. The authors believe that scoping the define phase is the most critical and can have long term impacts on the project at hand (Lynch, Bertolino, and Cloutier, 2003). The final two studies that were reviewed for this research were implementation examples from the software development industry and the aviation safety industry (Tonini, Spinola and Laurindo, 2006) (Panagopoulos, Atkin, and Sikora, 2016). From these examples, a framework will be developed in Chapter V. Conclusions and Recommendations.

Summary

This chapter reviewed the C-130J flight pilot upgrade process for the reader to provide background on the current process. Next, variance in production was analyzed as flight pilot development can also be considered a production process of pilots. This research project establishes the variances in C-130J flight pilot development, and with this knowledge, the community can use variance reduction to ensure flight pilot flight hours are more standardized. Next, the steps taken within the civil aviation community were examined, as they looked to improve their flight hour requirements. Finally, the DMAIC method was examined as this research will culminate in a recommended framework utilizing this method.

III. Methodology

This research was conducted by employing a mixed methodology through three distinct phases to answer the research questions. The samples for this research were flight records from 90 C-130J flight pilots from the six active-duty squadrons spread amongst four locations. Phase I was the data collection phase, which involved extracting 90 flight records from the Automated Aircrew Management System and importing them into Microsoft Excel. Phase II involved running statistical software to conduct both the Levene Test (test for variance) and the Kruskal-Wallis H Test (test of the means) amongst the six squadrons. To complete Phase II, subject matter experts' qualitative inputs were collected to determine why these differences occurred. Finally, Phase III incorporated the DMAIC methodology to establish a recommendation to Air Mobility Command with a way to improve the C-130J upgrade process.

Phase I

Data Collection

Initially, 5 flight pilots were selected from each of the six squadrons for a sample of 30. Their respective squadron commander named these 30 flight pilots as either being a recent aircraft commander certification or soon to be. These requirements ensured approximately 700 flight hours in the C-130J, which both standardized and maximized the sample's amount of flight hours. Next, 10 pilots from each location were selected randomly, with the only standardization being they were listed as a Flight Qualified Pilot. Utilizing this group of pilots in the research ensures the maximum number of flight hours, as these individuals are in the last phase of development before starting the aircraft commander upgrade.

Once the samples were identified, the Automated Aircrew Management System was utilized to extract each of the 90 flight records into Microsoft Excel. Within Excel, Pivot Tables were created for each sample to sort the flight hours into the 11 categories to begin the data analysis.

Data Analysis

The data analysis began by determining which flight hours would fall into each category. This was established following the direction in AFI 11-401, Table A2.2, "Authorized Mission Symbols" (HQ USAF/A3O-T, 2010:83-88). The first two digits of the mission symbols (which determines the mission type) used in this research are depicted in Table 1.

Table 1: Mission Symbol Listing

MSN Symbol	Hour Category
M8	JAATT
N2	Training
N1	Training
T1-3	Training
A1-9	Operational
C2-9	Operational
L1-8	Operational
M1-7	Operational
P7-9	Operational
O3	Operational
Q1-3	Simulator

In an effort to limit the categories, the terms Training and Operational were utilized. For the purpose of this research, Training was any mission symbol starting with N2 (Tactical Training), N1 (Training and Standardization), T1 (Student Training), T2 (Formal MWS Training), and T3 (Operational Training). In this research, all other mission symbols were given the term “Operational.” In this research, the term “Operational” and “Tasked” are equivalent and are used interchangeably throughout. Examples of “Operational” include Positioning, Repositioning, Air Evacuation, as directed by HQ USAF, Cargo, Passenger or Patients, Contingency, TWCF, SAAM, and Channels where aircrew training is unlikely to occur. Joint Airborne or Air Transportability Training and Simulator times were assigned their own categories, and the mission symbols start with M8 and Q1-3, respectively.

Once all 90 records were sorted by mission symbols, total hours for each of the 11 categories were calculated. Next, these totals were combined for each of the six squadrons to determine a squadron average. Finally, the total for each squadron was combined to determine a C-130J average. These averages were then utilized to set recommended minimum hours for each category and additionally move on to Phase II, statistically analyzing each squadron. The complete step by step processes that were conducted to collect and analyze the data for this project can be found in Appendix B: How to Guide on Obtaining the Data.

Phase II

The first step in this phase was to perform normality tests on the data to determine what type of statistical test would be utilized to test for a variance. This research used the

Kolmogorov-Smirnov test within STATEXT ©, and it was determined that not all of the data fell into a normal distribution. This resulted in using a nonparametric test to explore for variances within the data. Again, STATEXT was utilized and performed the Levene Test for each category. The Levene's Test is utilized to verify that variances are equal for all samples when the data comes from a non-normal distribution (Glen, 2014), and it tests for variances amongst two or more groups (NIST, 2020). Although the Levene's Test is most commonly followed up with an additional statistical test, the focus of the research was to determine where variances occur between the squadrons. After completing the tests for variances, a similar test was conducted to test the mean from the squadrons within each category and determine if they were significantly different. The final step in Phase II was the qualitative input of subject matter experts on the results in hopes of determining what the causal factors were. Three levels of subject matter experts were utilized, squadron commander, squadron director of operations, and squadron chief of training. This information was then combined with additional research in an attempt to define why each variation existed.

Phase III

The final phase of this research combined the statistical results and subject matter expert input to establish a DMAIC method for the C-130J flight pilot upgrade process. Figure 3 displays the model that will be utilized in this research. This model was developed in a study titled, *A case study: CRM adoption success factor analysis and six sigma DMAIC application* (Pan, Ryu, and Baik, 2007). This model was chosen as it closely relates to the C-130J flight pilot development process. Minor modifications to this model were conducted, and the results are discussed in Chapter V. Conclusions and Recommendations.

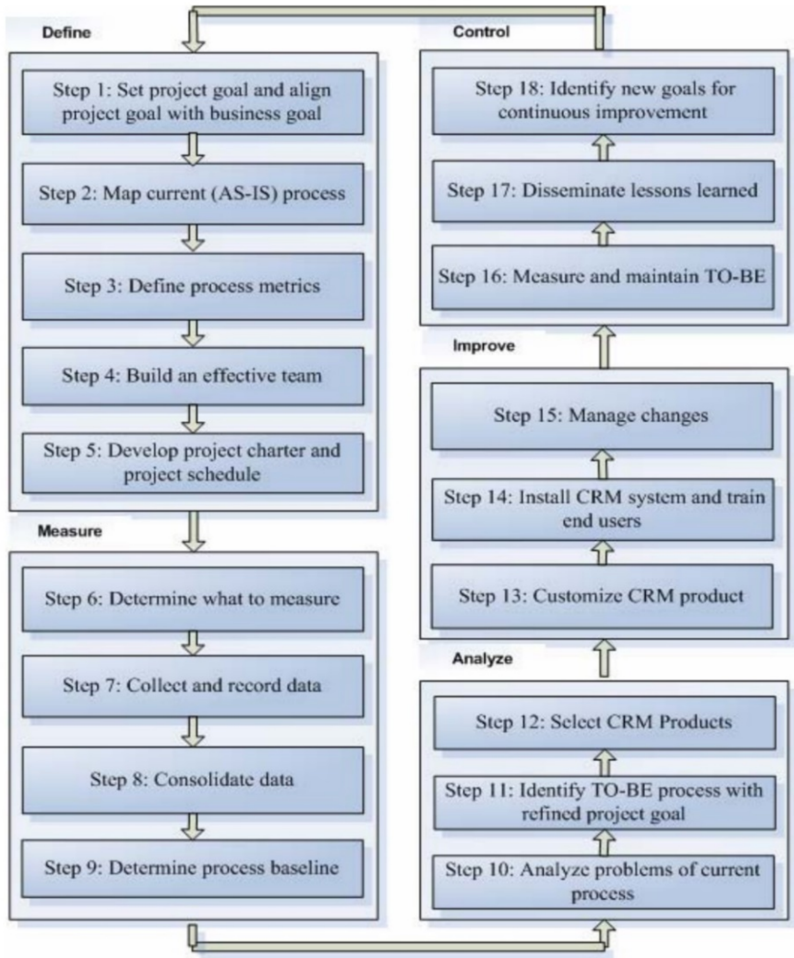


Figure 3: DMAIC Method Example (Pan, Ryu and, Baik, 2007)

Summary

This is the first known attempt to conduct in-depth research regarding the flight hours of C-130J flight pilots. Through this data collection and analysis, for the first time, the C-130J community can gain more insight into flight pilot development. The results of this research are presented in the next chapter.

IV. Analysis and Results

This research was conducted by performing statistical tests on the flight records of 90 C-130J flight pilots and then adding subject matter expert input on the results. The research categorized the flight hours into 11 categories as percentages of total C-130J flight hours. STATEXT © software was utilized to perform both the Levene Test (based on variance) and the Kruskal-Wallis H Test (based on mean), resulting in basic statistical data for each category. The results indicate where statistical differences occur between the six C-130J squadrons.

Categories of Fight Hours

This section presents each of the 11 categories of flight hours and the results of the statistical tests. First, the Levene Test was performed under the hypothesis that all six population (squadrons) variances are equal at a 0.05 significance level. Next, the Kruskal-Wallis H Test was performed under the hypothesis that each sample (squadron) came from the same distribution based on the means at a 0.05 significance level. If either test resulted in a rejection of the null hypothesis, post hoc analysis was employed to determine which population(s) variance or mean caused the rejection of the null hypothesis. Finally, subject matter expert inputs were gathered in attempts to determine the reasons for the significant differences.

In the following sections, each flight hour category will be represented with a scatter plot for all 90 flight pilots. The figure is then broken up into six sections referencing each of the six C-130J squadrons and is labeled to reflect those squadrons. The green line on each figure is the C-130J average based on the 90 flight pilots' flight hours for each respective category (as a percentage of total C-130J flight hours). Within each squadron's block, a box with a red line across the middle is displayed. The red line is the squadron average, while the width of the box indicates the standard deviation for each category.

Primary Flight Time

Table 2 displays the basic statistical data derived from the 90 flight pilots, while Figure 4 visually portrays this data. The statistical tests revealed that Ramstein 37 AS is significantly different from the other squadrons based on the mean of primary flight time obtained. Ramstein 37AS flight pilots are logging more primary flight time than flight pilots in the other five squadrons. Through post hoc analysis, the higher than average mean is the result of lower than average other time that will be discussed later in this section.

Table 2: Primary Flight Time Basic Statistics

Unit Tested	Sample Size from Unit	Mean of Sample	Median of Sample	Variance of Sample	Standard Deviation
RMS37	15	70.87	73	33.27	5.77
YOK36	15	58.8	57	32.31	5.68
DYS39	15	58.8	58	64.31	8.02
DYS40	15	54.13	56	30.7	5.54
LRF41	15	54.93	57	27.78	5.27
LRF61	15	52.73	53	33.64	5.8

Levene Test results: P-Factor = 0.339559, fails to reject the null hypothesis (variances are not significantly different between the squadrons).

Kruskall-Wallis H Test results: P-Factor = 6.9e-7, reject the null hypothesis (means are significantly different between the squadrons).

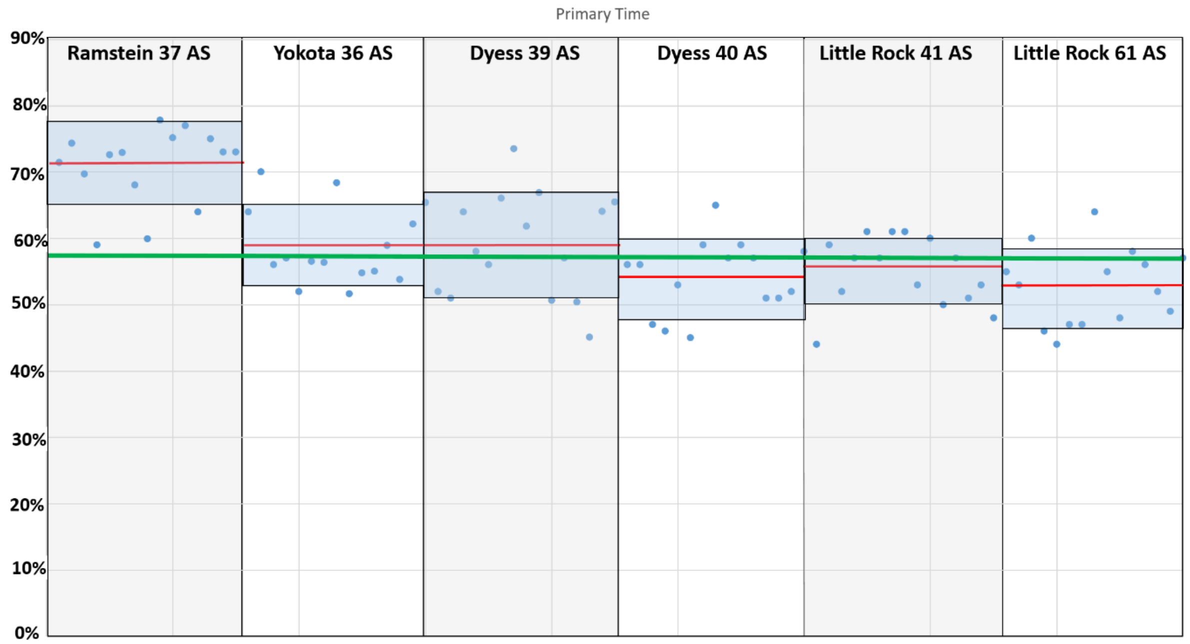


Figure 4: Primary Flight Time as a Percentage of Total C-130J Hours

Secondary Flight Time

Table 3 displays the basic statistical data derived from the 90 flight pilots, while Figure 5 visually portrays this data. The statistical tests revealed that Ramstein 37AS, Yokota 36AS, and Dyess 39AS are significantly different based on means than Dyess 40AS, Little Rock 41AS, and Little Rock 61AS. The means of the first three squadrons are lower than that of the last three and are a result of a similar split in primary time. The first three squadrons have higher amounts of primary time than that of the last three squadrons.

Table 3: Secondary Flight Time Basic Statistics

Unit Tested	Sample Size from Unit	Mean of Sample	Median of Sample	Variance of Sample	Standard Deviation
RMS37	15	22.27	22	31.21	5.59
YOK36	15	20.2	21	18.89	4.35
DYS39	15	24	25	39.14	6.26
DYS40	15	30	31	24.29	4.93
LRF41	15	32	32	40.14	6.34
LRF61	15	31.53	31	25.12	5.01

Levene Test results: P-Factor = 0.495458, fails to reject the null hypothesis (variances are not significantly different between the squadrons).

Kruskall-Wallis H Test results: P-Factor = 8.016e-8, reject the null hypothesis (means are significantly different between the squadrons).

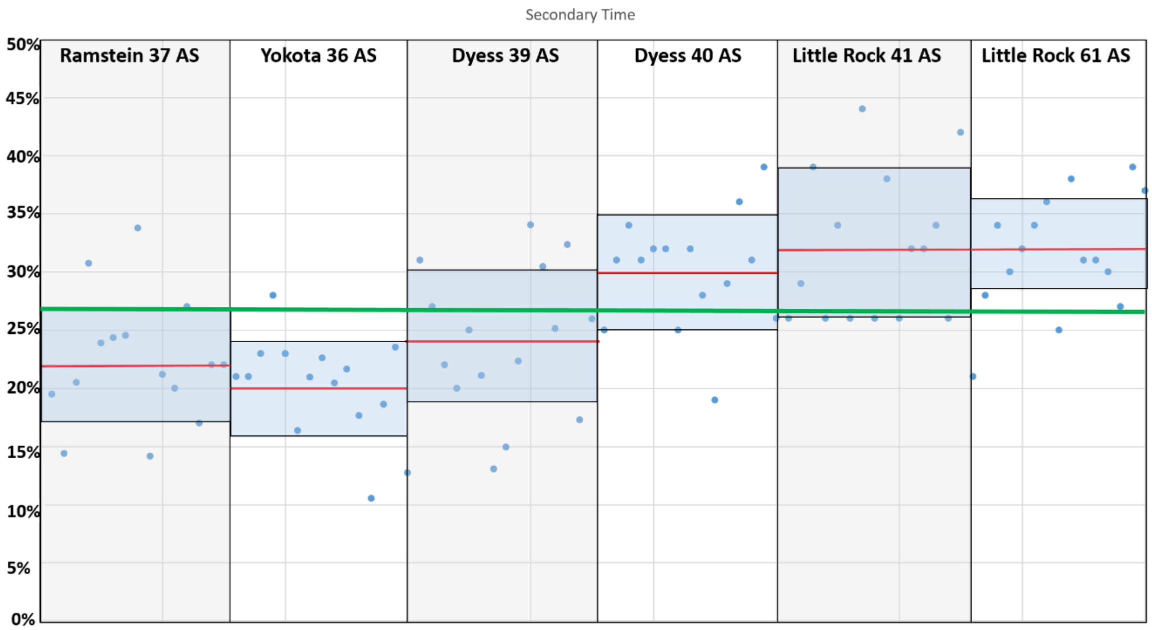


Figure 5: Secondary Flight Time as Percentage of Total C-130J Hours

Other Flight Time

Table 4 displays the basic statistical data derived from the 90 flight pilots, while Figure 6 visually portrays this data. The statistical tests revealed there are significant differences in both variance and means between the squadrons. Ramstein 37AS and Yokota 36AS differed from the other four squadrons in their respective means. Regarding variance, Yokota 36AS and Little Rock 41AS are significantly different from the other four squadrons. Because other time should be limited, subject matter expert insight was collected on Ramstein 37AS' low mean and variance.

First, the low mean is the result of a high percentage of the primary time, which results in less opportunity to log other time. A subject matter expert provided additional factors that limit the amount of other time logged at Ramstein 37AS. The first point provided was direction within the squadron to limit "bleacher flights" (Personal Correspondence, March 2020). Bleachers flights are a common term used in the Mobility Air Force community and are flights where extra pilots are on board the aircraft to accomplish one or two specific training events. An example would be five pilots onboard, two primary and three extra. The extra pilots would rotate occupying a primary crew position to accomplish their specific training event(s), then turn the controls over to the next pilot. On a standard training sortie of 4 hours, the extra pilots may only occupy a primary crew position for 0.5 hours as an example. The remaining 3.5 hours would be logged as other time. Hence, with the direction of limiting bleacher flights, Ramstein 37AS results are lower than average other time. The second reason provided by the subject matter expert was the number of operational taskings and efficient scheduling focused on accomplishing AFMAN 11-2C-130JV1 requirements, which both contribute to a limited amount of Other Time (Personal Correspondence, March 2020).

From the definition within the governing regulation, other time is logged when not in a primary crew position. A C-130J flight pilot could log other time when in the augmented seat, still actively engaged in the mission or it could be logged when in the back of the aircraft, not engaged in the mission. For these reasons, other time should be limited in a flight pilot's development if it can be avoided. Visually depicted in Figure 6, some sampled pilots have over 25% of their total C-130J flight time as other time. In the case of other time, a low mean and low variance would assist in ensuring the flight pilots are acquiring quality flight hours.

Table 4: Other Flight Time Basic Statistics

Unit Tested	Sample Size from Unit	Mean of Sample	Median of Sample	Variance of Sample	Standard Deviation
RMS37	15	6.8	7	7.89	2.81
YOK36	15	21.13	23	50.12	7.08
DYS39	15	17.13	17	24.27	4.93
DYS40	15	16.13	17	27.55	5.25
LRF41	15	13.07	13	8.64	2.94
LRF61	15	15.93	17	41.78	6.46

Levene Test results: P-Factor = 0.000512, reject the null hypothesis (variances are significantly different between the squadrons).

Kruskall-Wallis H Test results: P-Factor = 3.644e-7, reject the null hypothesis (means are significantly different between the squadrons).

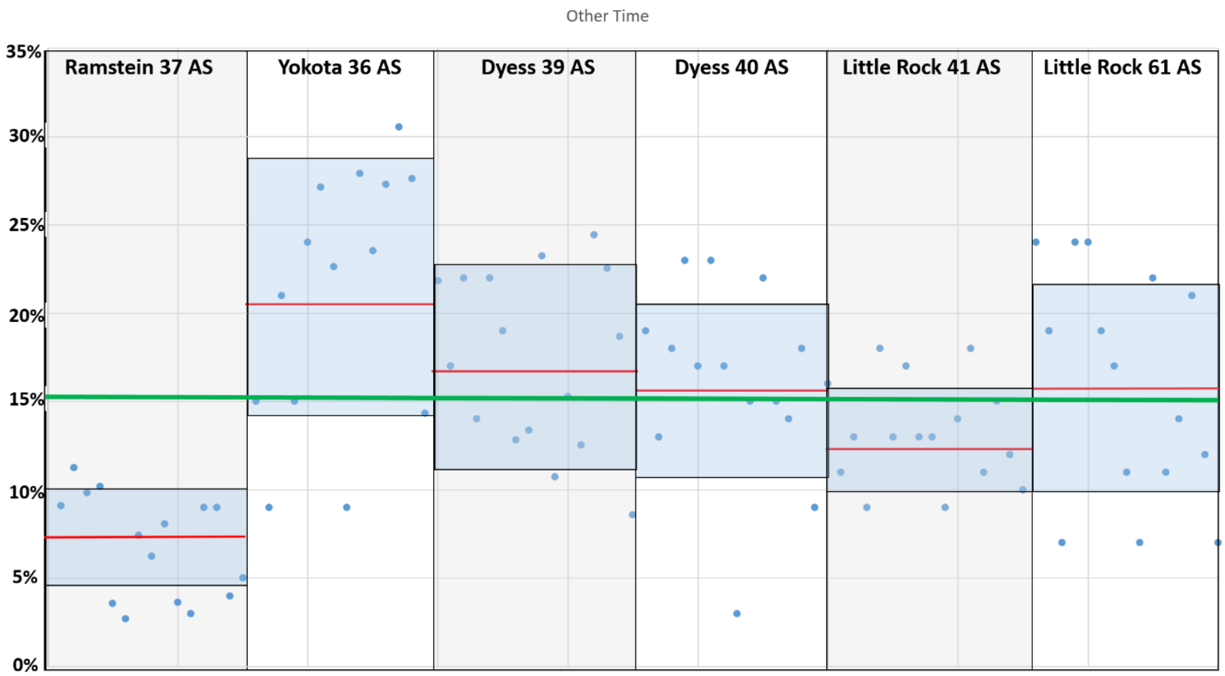


Figure 6: Other Flight Time as a Percentage of Total C-130J Hours

Night Time

Table 5 displays the basic statistical data derived from the 90 flight pilots, while Figure 7 visually portrays this data. The statistical tests revealed there are significant differences in both variance and means between the squadrons. Ramstein 37AS and Yokota 36AS differed from the other four squadrons in their respective low mean. Furthermore, Dyess 39AS differed from the other five squadrons due to their high mean. Regarding variance, Ramstein 37AS and Yokota 36AS are significantly different from the other four squadrons. Subject matter expert insight was collected on Ramstein 37AS and Yokota 36AS low mean and variance.

The subject matter expert pointed out that these low means are caused by the host nation restrictions related to noise abatement procedures directed in their respective aviation regulations (Personal Correspondence, March 2020). In both Japan and

Germany, the squadrons are restricted in the amount of night time they can legally fly. In these locations, training flights are only authorized between the hours of 0600 – 2200 local time, directed in each of their respective DoD Flight Information Publication (AP/3, 2019:3-77) (AP/2, Feb 2020:B-422). These host nation restrictions impact the amount of "night" and "NVG" flight time that can be accomplished. At stateside locations, there is no limit to the time the training has to end. Hence there is more opportunity to log night and NVG flight time.

Table 5: Night Flight Time Basic Statistics

Unit Tested	Sample Size from Unit	Mean of Sample	Median of Sample	Variance of Sample	Standard Deviation
RMS37	15	12.93	13	7.35	2.71
YOK36	15	12.13	12	2.12	1.46
DYS39	15	31.4	31	56.69	7.53
DYS40	15	27.67	28	30.67	5.54
LRF41	15	26.47	27	15.7	3.96
LRF61	15	24	25	19.14	4.38

Levene Test results: P-Factor = 0.001198, reject the null hypothesis (variances are significantly different between the squadrons).

Kruskall-Wallis H Test results: P-Factor = 3.755e-12, reject the null hypothesis (means are significantly different between the squadrons).

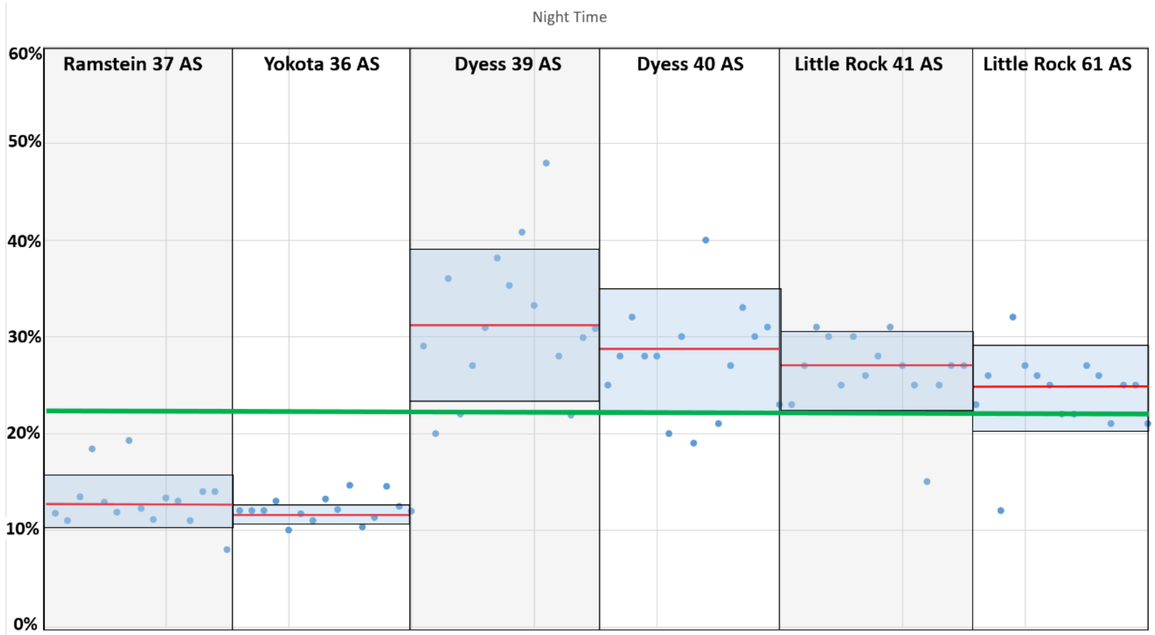


Figure 7: Night Flight Time as a Percentage of Total C-130J Hours

Instrument Time

Table 6 displays the basic statistical data derived from the 90 flight pilots, while Figure 8 visually portrays this data. The statistical testing confirmed there is not a significant difference in neither variance nor mean between any of the squadrons. Instrument flight time as the only category that did not indicate a significant statistical difference between any of the squadrons.

Table 6: Instrument Flight Time Basic Statistics

Unit Tested	Sample Size from Unit	Mean of Sample	Median of Sample	Variance of Sample	Standard Deviation
RMS37	15	29.47	29	59.41	7.71
YOK36	15	26.73	26	25.21	5.02
DYS39	15	29.73	30	32.35	5.69
DYS40	15	25.87	25	48.41	6.96
LRF41	15	28.07	29	16.78	4.1
LRF61	15	25.27	24	39.21	6.26

Levene Test results: P-Factor = 0.146468, fails to reject the null hypothesis (variances are not significantly different between the squadrons).

Kruskall-Wallis H Test results: P-Factor = 0.249367, fail to reject the null hypothesis (means are not significantly different between the squadrons).

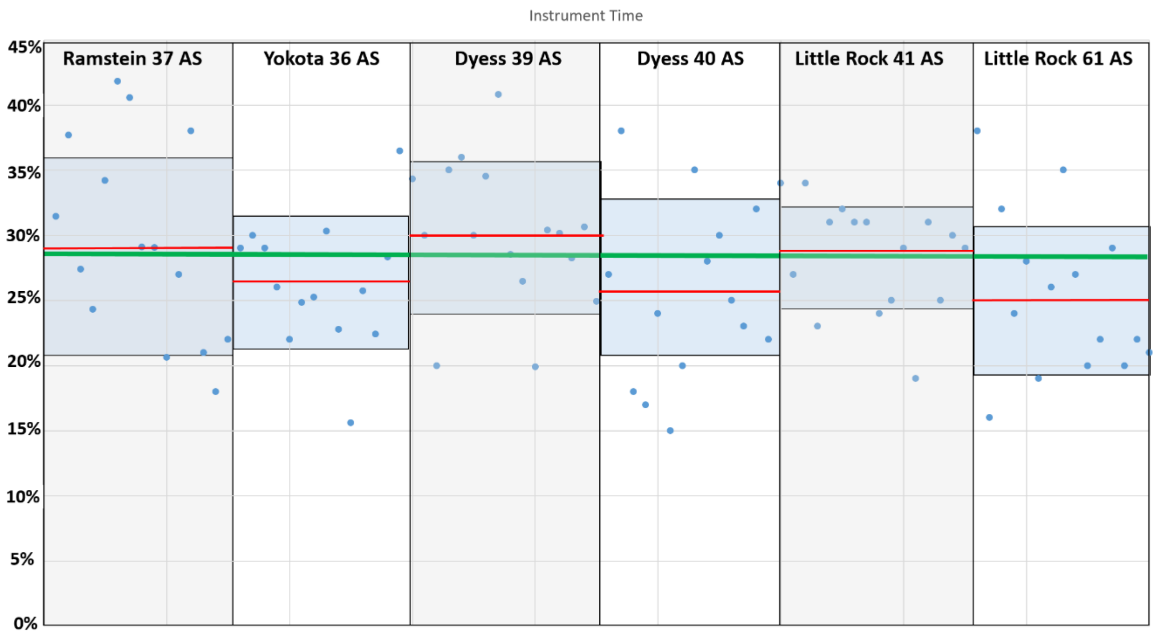


Figure 8: Instrument Flight Time as a Percentage of Total C-130J Hours

Night Vision Goggle (NVG) Time

Table 7 displays the basic statistical data derived from the 90 flight pilots, while Figure 9 visually portrays this data. The statistical test results show that Ramstein 37AS and Yokota 36AS are statistically different in the equality of variances and their respective mean, compared to the other four squadrons. Similar to the night time flight hours, the subject matter expert suggested NVG time is limited in Japan and Germany due to the host nation restrictions and noise abatement procedures (Personal Correspondence, March 2020).

Table 7: NVG Flight Time Basic Statistics

Unit Tested	Sample Size from Unit	Mean of Sample	Median of Sample	Variance of Sample	Standard Deviation
RMS37	15	6.2	6	1.89	1.37
YOK36	15	5.8	6	2.74	1.66
DYS39	15	22.07	22	45.07	6.71
DYS40	15	18.6	20	29.69	5.45
LRF41	15	18.33	19	20.81	4.56
LRF61	15	14.2	14	22.03	4.69

Levene Test results: P-Factor = 2.051e-6, reject the null hypothesis (variances are significantly different between the squadrons).

Kruskall-Wallis H Test results: P-Factor = 3.83e-12, reject the null hypothesis (means are significantly different between the squadrons).

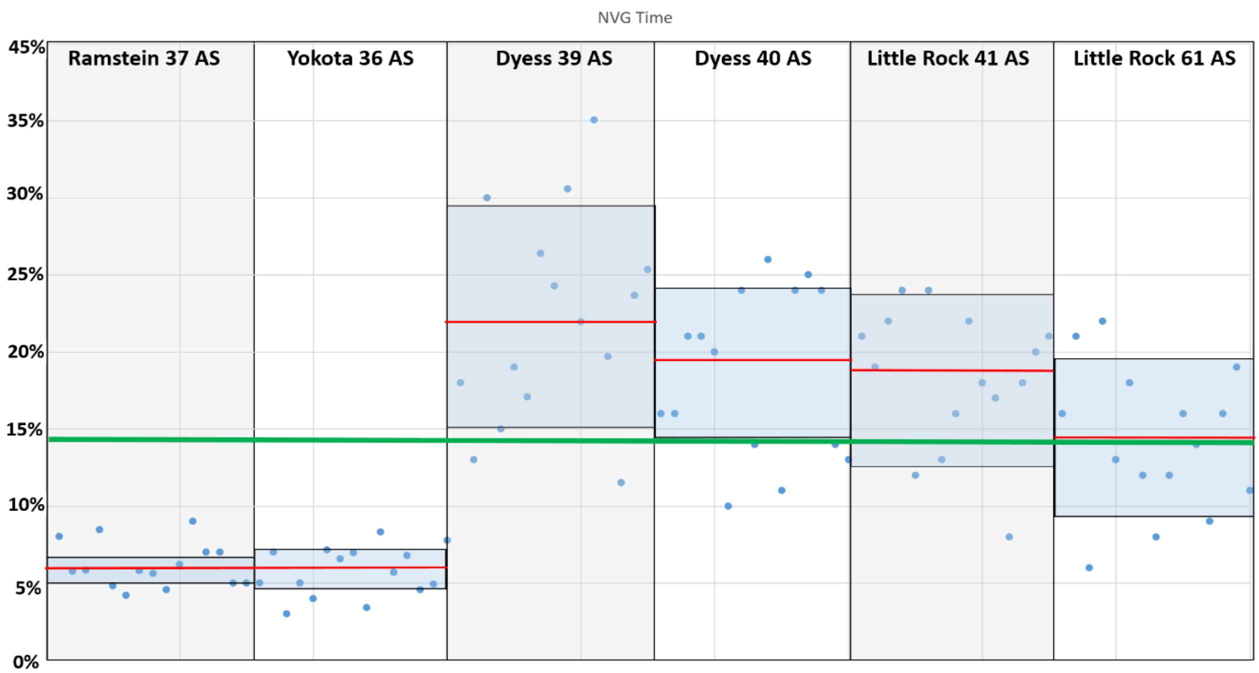


Figure 9: NVG Flight Time as a Percentage of Total C-130J Hours

Training Flight Time

Table 8 displays the basic statistical data derived from the 90 flight pilots, while Figure 10 visually portrays this data. Statistically, Yokota 36AS and Dyess 39AS are different from the other four squadrons based on their respective means. The data presented indicate that Yokota 36AS is different due to a high mean, and Dyess 39AS differs due to a low mean. Both cases can be explained due to their respective tasked time ratios. A subject matter expert from Yokota suggested during the timeframe of data collection; the squadron was receiving fewer than average tasked missions from its' tasking authority. No specific reason could be provided for this lower tasking rate.

Table 8: Training Flight Time Basic Statistics

Unit Tested	Sample Size from Unit	Mean of Sample	Median of Sample	Variance of Sample	Standard Deviation
RMS37	15	28.4	30	54.11	7.36
YOK36	15	55.93	57	104.35	10.22
DYS39	15	17.33	17	44.81	6.69
DYS40	15	21.67	21	70.38	8.39
LRF41	15	26.33	25	58.38	7.64
LRF61	15	28.27	26	111.92	10.58

Levene Test results: P-Factor = 0.372307, fails to reject the null hypothesis (variances are not significantly different between the squadrons).

Kruskall-Wallis H Test results: P-Factor = 3.424e-9, reject the null hypothesis (means are significantly different between the squadrons).

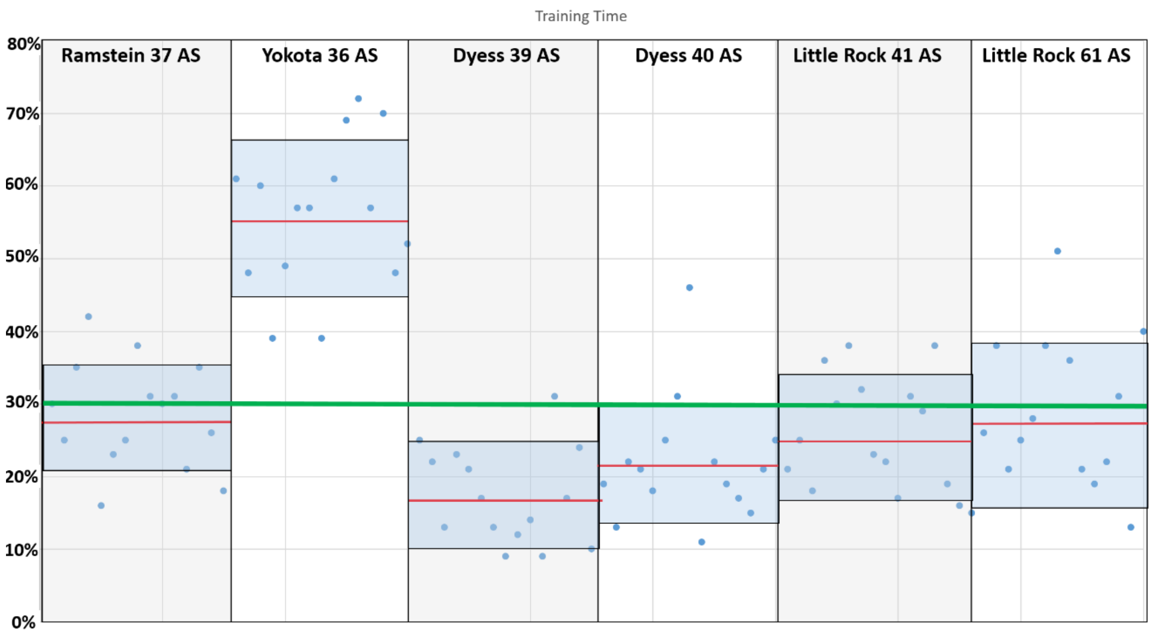


Figure 10: Training Flight Time as a Percentage of Total C-130J Hours

Tasked Flight Time

Table 9 displays the basic statistical data derived from the 90 flight pilots, while Figure 11 visually portrays this data. Statistically, Little Rock 61AS is significantly different based on variance than the other five squadrons. Based on means, the squadrons are divided in half with three squadrons having a significantly higher mean of tasked time compared to the other three squadrons. This is highlighted in Table 9, with those squadrons having a high mean boxed with red and those with a low mean boxed in blue. Subject matter experts were not available to comment on this variance.

Table 9: Tasked Flight Time Basic Statistics

Unit Tested	Sample Size from Unit	Mean of Sample	Median of Sample	Variance of Sample	Standard Deviation
RMS37	15	56.53	56	60.84	7.8
YOK36	15	36.53	37	88.84	9.43
DYS39	15	69.73	70	153.21	12.38
DYS40	15	65.13	67	138.55	11.77
LRF41	15	48.4	51	121.83	11.04
LRF61	15	49.67	57	453.1	21.29

Levene Test results: P-Factor = 0.002751, reject the null hypothesis (variances are significantly different between the squadrons).

Kruskall-Wallis H Test results: P-Factor = 1.986e-8, reject the null hypothesis (means are significantly different between the squadrons).

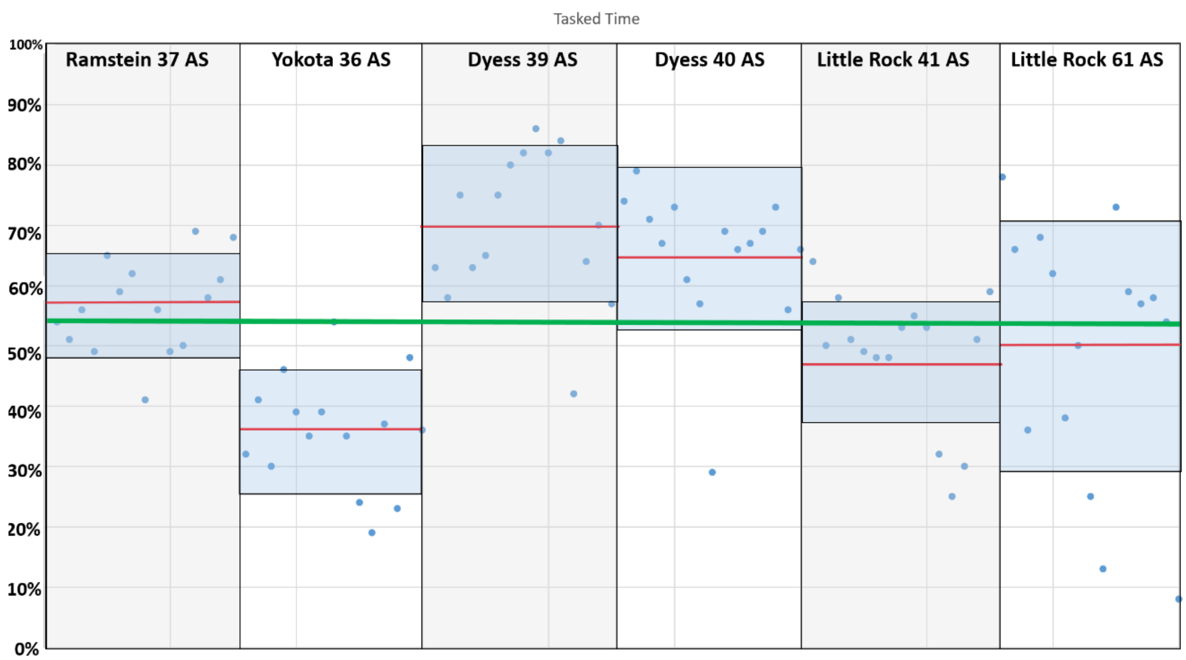


Figure 11: Tasked Flight Time as a Percentage of Total C-130J Hours

Simulator Time

Table 10 displays the basic statistical data derived from the 90 flight pilots, while Figure 12 visually portrays this data. The statistical test results indicate both squadrons at Little Rock, 61AS, and 41AS are significantly different in both equality of variance and means from the other locations. Dyess 40AS differs significantly from the other five squadrons based on variance. A subject matter expert at Little Rock explained that at Little Rock, there are more simulators than other locations. Little Rock AFB is host to the C-130J schoolhouse, where all pilots and loadmasters begin their C-130J training. For this reason, Little Rock has four simulators compared to one simulator at the three other locations (Personal Correspondence, March 2020). With more simulators come more opportunities for the squadrons to complete simulator training and explains the high variance and mean for the two Little Rock squadrons. A subject matter expert from Dyess confirmed this analysis by explaining Dyess has two squadrons using one simulator. Additionally, this individual explained that occasionally their single simulator is utilized by crews from Germany or Yokota due to availability at their respective locations. These explanations confirm the statistical results; Little Rock squadrons are obtaining more simulator hours, which in turn increases the opportunity for variance (Personal Correspondence, February 2020).

Table 10: Simulator Time Basic Statistics

Unit Tested	Sample Size from Unit	Mean of Sample	Median of Sample	Variance of Sample	Standard Deviation
RMS37	15	8.07	7	17.5	4.18
YOK36	15	7.07	7	10.64	3.26
DYS39	15	8.73	7	68.21	8.26
DYS40	15	8.6	8	8.26	2.87
LRF41	15	19.53	21	79.27	8.9
LRF61	15	14.8	7	163.6	12.79

Levene Test results: P-Factor = 1.253e-6, reject the null hypothesis (variances are significantly different between the squadrons).

Kruskall-Wallis H Test results: P-Factor = 0.001482, reject the null hypothesis (means are significantly different between the squadrons).

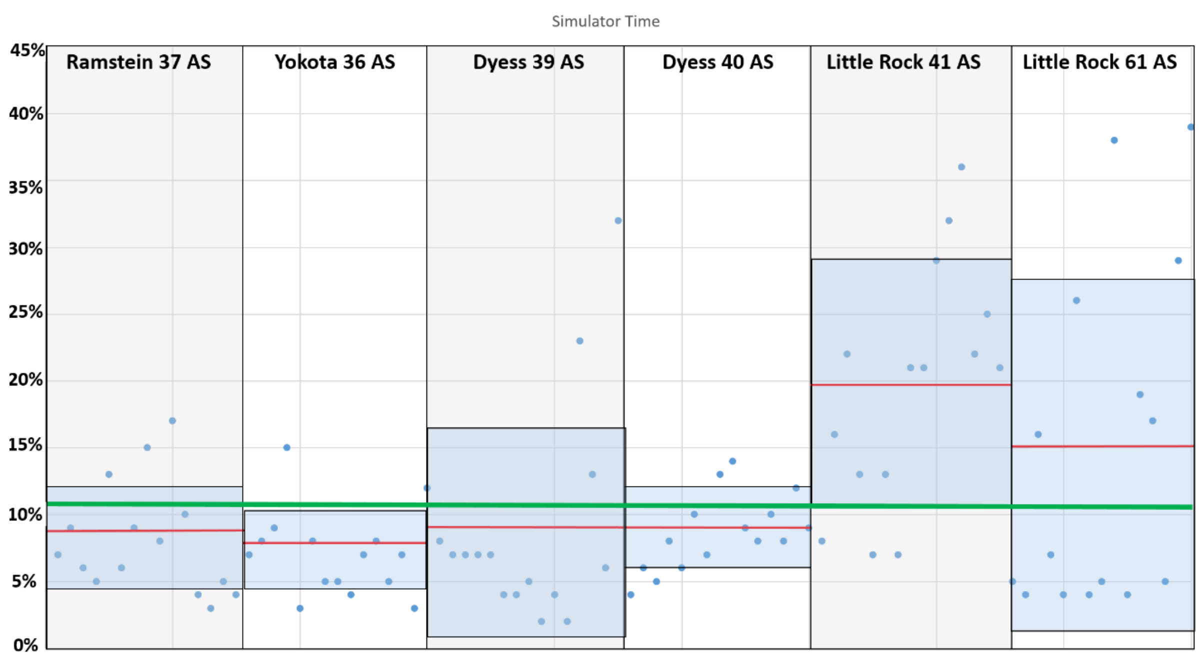


Figure 12: Simulator Time as a Percentage of Total C-130J Hours

Joint Airborne or Air Transportability Training Time

Table 11 displays the basic statistical data derived from the 90 flight pilots, while Figure 13 visually portrays this data. Statistically, Yokota 36AS is significantly different based on variance and mean from the other five squadrons. Of the 15 samples from Yokota 36AS, only one had any Joint Airborne or Air Transportability Training time, which results in a significantly low mean and variance.

Table 11: Joint Airborne or Air Transportability Flight Time Basic Statistics

Unit Tested	Sample Size from Unit	Mean of Sample	Median of Sample	Variance of Sample	Standard Deviation
RMS37	15	6.87	6	11.27	3.36
YOK36	15	0.4	0	2.4	1.55
DYS39	15	4	4	11.86	3.44
DYS40	15	4.8	4	11.6	3.41
LRF41	15	5.67	5	19.38	4.4
LRF61	15	7.33	6	22.24	4.72

Levene Test results: P-Factor = 0.003458, reject the null hypothesis (variances are significantly different between the squadrons).

Kruskall-Wallis H Test results: P-Factor = 4.435e-6, reject the null hypothesis (means are significantly different between the squadrons).

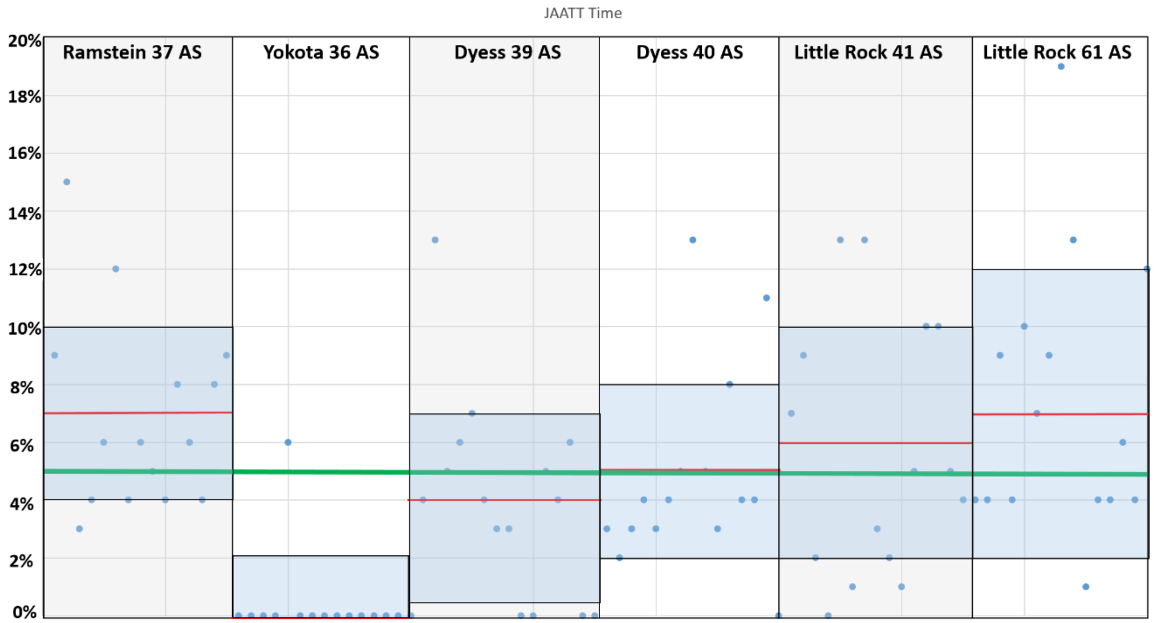


Figure 13: Joint Airborne or Air Transportability Flight Time as a Percentage of Total C-130J Hours

Combat and Combat Support Flight Time

Table 12 displays the basic statistical data derived from the 90 flight pilots, while Figure 14 visually portrays this data. Statistically, Ramstein 37AS and Yokota 36AS are significantly different from the other four squadrons based on variance and their respective mean. Little Rock 61AS is also significantly different than the five other squadrons based on a high variance. Yokota 36AS had zero combat or combat support flight time within the sample of 15, while Ramstein 37AS recorded the next lowest mean of 7.07. A subject matter expert explained Ramstein 37AS and Yokota 36AS are not in a theater of operations that are currently supporting operations that would result in significant combat or combat support flight time. Little Rock 61AS's high variance can be explained by examining the samples collected. Of the 15 samples, four had zero combat time while the remaining 11 did, and some with considerable amounts, which is the cause for the significant level of variance.

Table 12: Combat / Combat Support Flight Time Basic Statistics

Unit Tested	Sample Size from Unit	Mean of Sample	Median of Sample	Variance of Sample	Standard Deviation
RMS37	15	7.07	4	93.64	9.68
YOK36	15	0	0	0	0
DYS39	15	45.07	50	366.78	19.15
DYS40	15	31.6	38	205.4	14.33
LRF41	15	29.33	32	155.95	12.49
LRF61	15	29.13	38	449.84	21.21

Levene Test results: P-Factor = 4.556e-9, reject the null hypothesis (variances are significantly different between the squadrons).

Kruskall-Wallis H Test results: P-Factor = 5.457e-9, reject the null hypothesis (means are significantly different between the squadrons).

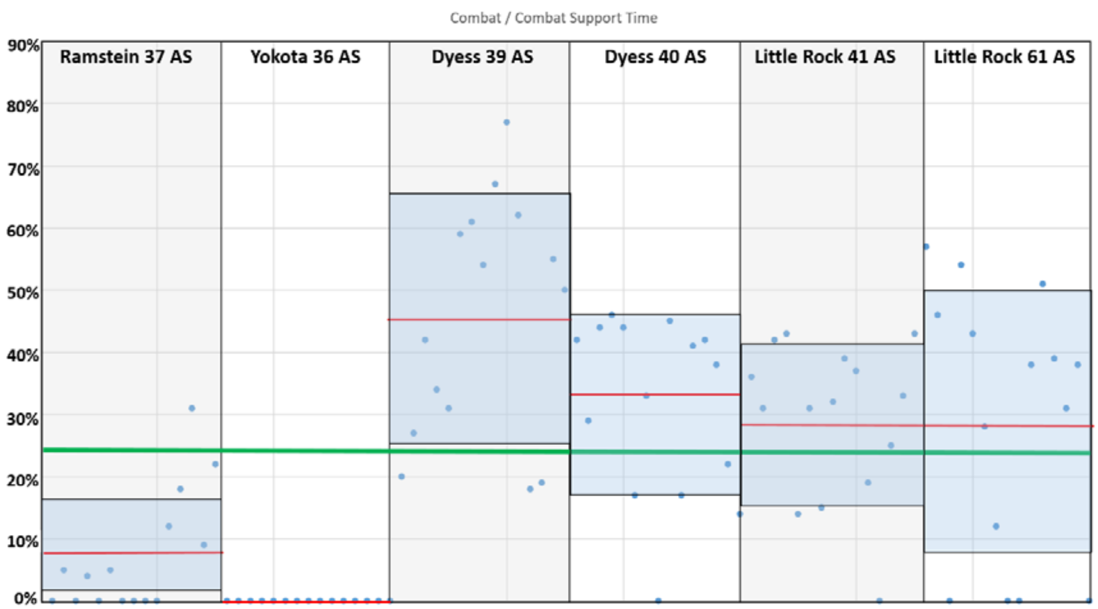


Figure 14: Combat / Combat Support Flight Time as a Percentage of Total C-130J Hours

Research Questions Answered

1. Are there significant statistical variances between the C-130J squadrons in regards to how their respective flight pilots are obtaining flight hours in each category?

The majority of this chapter highlighted that there are differences between location and squadrons, based on both the mean and variance. Only 1 of the 11 categories examined did not have a significant difference. The goal of this research is to highlight where these variances are and provide data-backed tools to assist squadron commanders in decision making when it comes to their flight pilots' development.

The next three tables provide consolidated results of this research. First, Table 13 consolidates the results of the variances produced from running the Levene Test. Table 14 then provides the consolidated results of the Kruskall-Wallis H Test. And finally, Table 15 combines all results to provide insight into which squadrons vary the most.

In Table 13, grey cells indicate the variances resulted in failing to reject the null hypothesis (not a significant difference between the squadrons). Green cells indicate a variance that was causal in the rejection of the null hypothesis based on its low variance. Yellow cells indicate a variance that was causal in the rejection of the null hypothesis based on its high variance. Furthermore the red variances indicate a low variance based on an extremely low mean.

Table 13: Consolidated Levene Test Results

	Primary	Secondary	Other	Nite	INS	NVG	Training	Tasked	Simulator	JA/ATT	CMB/Spt
RMS37	33.27	31.21	7.89	7.35	59.41	1.89	54.11	60.84	17.5	11.27	93.64
YOK36	32.31	18.89	50.12	2.12	25.21	2.74	104.35	88.84	10.64	2.4	0
DYS39	64.31	39.14	24.27	56.69	32.35	45.07	44.81	153.21	68.21	11.86	366.78
DYS40	30.7	24.29	27.55	30.67	48.41	29.69	70.38	138.55	8.26	11.6	205.4
LRF41	27.78	40.14	8.64	15.7	16.78	20.81	58.38	121.83	77.27	19.38	155.95
LRF61	33.64	25.12	41.78	19.14	39.21	22.03	111.92	453.1	163.6	22.24	449.84

Within Table 14, the grey cells indicate the sample mean resulted in failing to reject the null hypothesis (not a significant difference between the squadrons). Orange cells indicate that within that category, the squadron had a significantly higher mean that was larger than the other squadrons, while yellow cells indicate a significantly smaller mean.

Table 14: Consolidated Kruskall-Wallis H Test Results

	Primary	Secondary	Other	Nite	INS	NVG	Training	Tasked	Simulator	JA/ATT	CMB/Spt
RMS37	70.87	22.27	6.8	12.93	29.47	6.2	28.4	56.53	8.07	6.87	7.07
YOK36	58.8	20.2	21.13	12.13	26.73	5.8	55.93	36.53	7.07	0.4	0
DYS39	58.8	24	17.13	31.4	29.73	22.07	17.33	69.73	8.73	4	45.07
DYS40	54.13	30	16.13	27.67	25.87	18.6	21.67	65.13	8.6	4.8	31.6
LRF41	54.93	32	13.07	26.47	28.07	18.33	26.33	48.4	19.53	5.67	29.33
LRF61	52.73	31.53	15.93	24	25.27	14.2	28.27	49.67	14.8	7.33	29.13

Finally, Table 15 consolidates all test results. Within the table, each cell contains a 0, 1, or 2. 0 indicates neither test resulted in a rejected null hypothesis, 1 indicates one of either test hypotheses were rejected, and 2 indicates both tests resulted in a rejection. The far-right side Totals column is the sum for each squadron, and the lower Totals row is the sum for each flight hour category. Table 15 provides evidence there are differences between the squadrons and are most significant between the overseas locations (Ramstein and Yokota) versus the stateside locations.

Table 15: Consolidated Research Results

	Primary	Secondary	Other	Nite	INS	NVG	Training	Tasked	Simulator	JA/ATT	CMB/Spt	TOTALS
RMS37	1	1	2	2	0	2	0	1	0	0	2	11
YOK36	0	1	1	2	0	2	1	1	0	2	2	12
DYS39	0	1	0	1	0	0	1	1	0	0	0	4
DYS40	0	1	0	0	0	0	0	1	1	0	0	3
LRF41	0	1	1	0	0	0	0	1	2	0	0	5
LRF61	0	1	0	0	0	1	0	2	2	0	1	7
TOTALS	1	6	4	5	0	5	2	7	5	2	5	

2. What is the correct distribution of flight hours a C-130J flight pilot should obtain to provide commanders full confidence the individual has received a sufficient amount of quality flight hours?

Through the analysis of 90 flight records, averages were set for each category of flight hour. After an average was established as a percentage of total C-130J flight hours, the percentage was multiplied by 700 hours. 700 flight hours were chosen as this is the minimum amount of flight hours a flight pilot requires before upgrade to aircraft commander. After calculating the raw number of hours, rounding was applied based on standard deviations resulting in the recommended hours. Both the raw data hours and rounded hours are provided in Table 16.

Table 16: Recommended Flight Hour Distributions

	Primary	Secondary	Other	Nite	INS	NVG	Training	Tasked	Simulator	JA/ATT	CMB/Spt
C-130J FP AVERAGE	58%	27%	15%	22%	28%	14%	30%	54%	11%	5%	24%
STANDARD DEVIATION	8%	7%	7%	9%	6%	8%	15%	17%	9%	4%	21%
Raw Hours (% x 700)	408.6533	186.7301	105.0833	157.1431	192.7251	99.25314	207.5889	379.5556	77.93333	33.91111	165.9
Rounded Recommended	**400**	**200**	**100**	**150**	**175**	**100**	**250**	**350**	**75**	**25**	**100**

3. Can the Six Sigma DMAIC methodology be applied to C-130J flight pilot development, and if so, what results will emerge?

Through answering the first two research questions, a significant portion of the DMAIC method has already been completed. The problem has been **D**efined, a means to **M**easure the problem has been established, and **A**nalysis has been completed. The two remaining steps will be the recommendation put forth to Air Mobility Command. To **I**mprove the current process, an easily accessible method to this information would be required; in this case the Automated Aircrew Management System is recommended.

Finally, **C**ontrol would come through squadron, group, and MAJCOM training review boards. This topic is further discussed in the section Recommendations for Action**.**

Summary

This chapter provided the results of statistically analyzing the flight records of 90 flight pilots dispersed amongst six C-130J squadrons. The analysis highlighted significant variances between the squadrons and also cases of significant variance within the squadron. The final chapter of this research will provide a recommended way forward to reduce these cases of variances.

V. Conclusions and Recommendations

Chapter Overview

The results of this research are a new consideration of how to monitor C-130J flight pilot development more effectively. It is the first known attempt to quantifiably compare the squadrons and how unique location requirements can impact the flight hours of their respective pilots. The results indicate that there are significant variations between the squadrons and within the squadrons, hence there is room for process improvement. The proposed variance reduction methods developed in this research could potentially be utilized by all Department of Defense aviation communities, or any community that utilizes hours as a measure of experience. This chapter highlights the significance of this research project and provides suggestions and recommendations of how it could be implemented into aviation communities.

Conclusions of Research

This research provides the C-130J community with three critical findings regarding flight pilot development. First, it highlighted that variances are occurring concerning how flight pilots are obtaining their flight hours. Second, based on statistical results, the research generated minimum recommended flight hours in each of the 11 categories. Finally, the research proposes a widely accepted process improvement methodology that could be implemented within the C-130J community.

Recommendations for Action

The recommendation from this research is to implement a program within the Automated Aircrew Management System that is capable of monitoring variance in pilot development. Figure 15 presents the recommended DMAIC method as it could be applied to the flight development process. This section discusses each step of DMAIC and how it could be applied to C-130J flight pilot development.

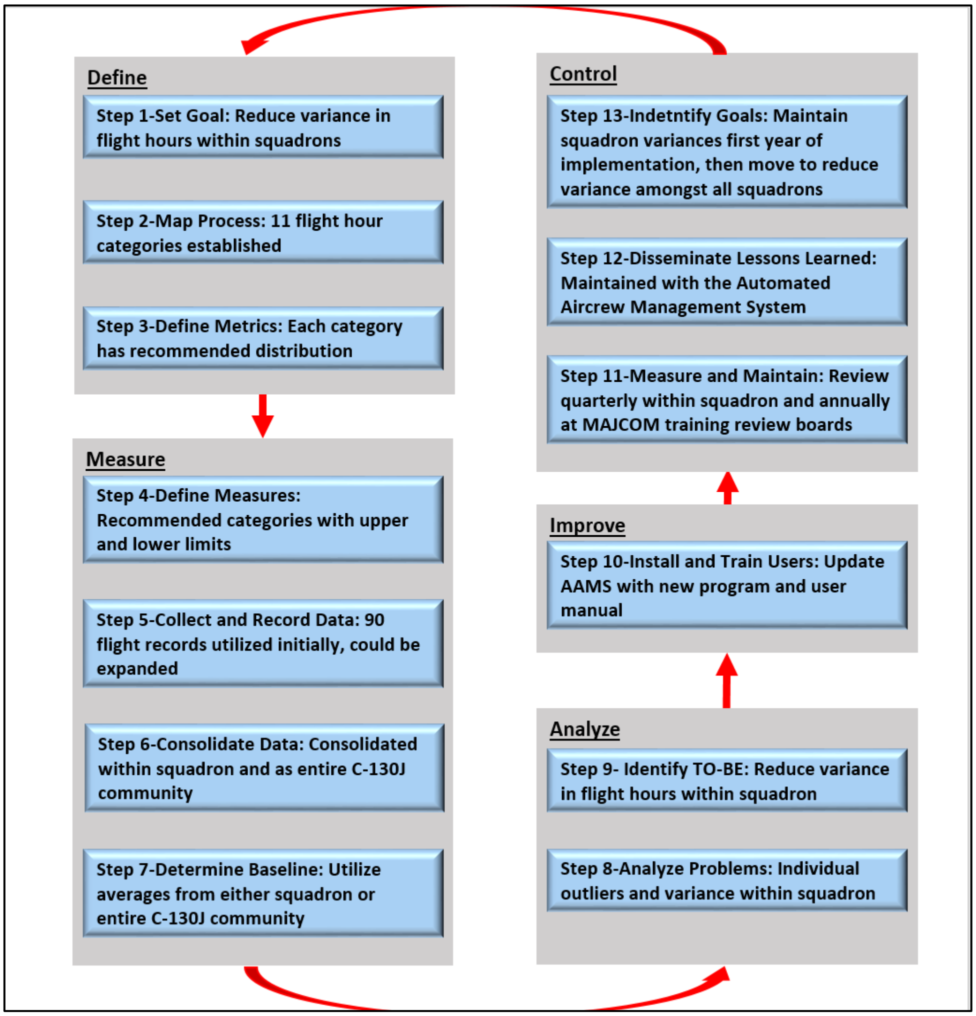


Figure 15: DMAIC Method Applied to C-130J Pilot Production

Define: The results of this research project highlighted significant variances regarding C-130J flight pilot development. The results indicate these variances occur both within the squadron and between the squadrons. To scope this recommendation, it is recommended that the initial focus is to reduce variances within the individual squadrons. As discussed in Chapter 2, variance reduction improves processes. Thus, the definition as it relates to this subject is: Reduce flight hour variances amongst C-130J flight pilots within their respective squadrons.

Measure: Again, this research project has completed this step through the data collection and analysis of 90 flight pilots' aviation records. If this recommendation is accepted, further discussion will be required from the C-130J community to determine if the recommended "baselines" should be adjusted. The baselines could be adjusted by individual squadrons based on the findings of this research. For example, overseas locations are likely unable to meet the same amount of NVG or night time as the stateside locations.

Analyze: Through subject matter expert inputs and employing post hoc analysis, reasons for the variances are provided in Chapter 4. With an understanding of why the variances are occurring would be the first step in reducing the variances. In some cases, the restrictions imposed by the host nation will not change. For this reason, individual squadrons should have the capability to adjust their control limits for each category. Setting control limits will improve variance reduction and is the basis for the next step.

Improvement: To reduce variance in flight pilot hours, it is recommended to set upper and lower control limits within each flight hour category. Additionally, it is recommended that individual squadrons control these limits. The vision of these recommendations is for a squadron training officer to obtain this information from the Automated Aircrew Management System. For each category, a baseline has been established; next squadrons would set their upper and lower control limits. Then by applying these filters to their respective flight pilot population, individual outliers could be identified and then scheduled more effectively. The envisioned generated product would likely be similar to Figure 16. In this example, the squadron determined the control limit, then set upper and lower limits. All pilots that fall outside these limits are identified and scheduled more efficiently to reduce the variance within the squadron.

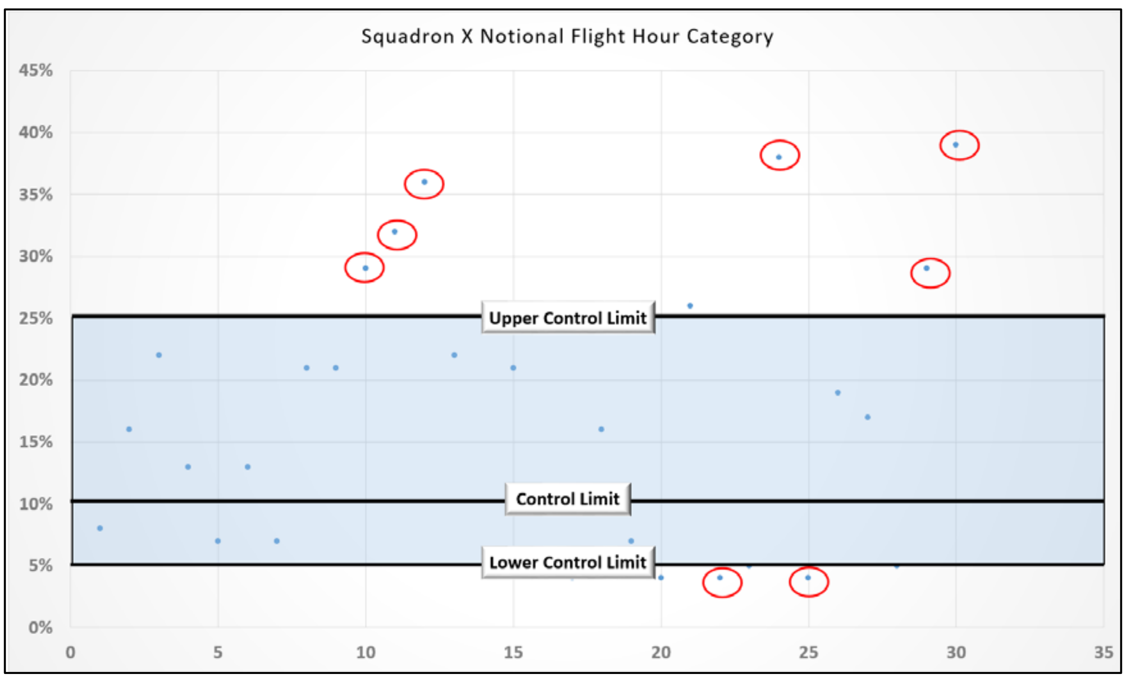


Figure 16: Envisioned AAMS Report on Notional Scenario

Control: As the final step of the DMAIC method, documentation would be stored within the Automated Aircrew Management System. The data would enable analysis from the squadron level up to Air Mobility Command. At the squadron level, the main goal will be to reduce variance. At the group and wing level, the variance between the squadrons could be utilized to more effectively schedule exercises and seek assistance from Air Mobility Command regarding the Flying Hour Program, as an example. Air Mobility Command could utilize the data produced to closely monitor the impacts of a multitude of scenarios. For example, flight hour distribution, impacts of updating currency requirements and could even be used to consider the assignment process or aircraft allocation.

Recommendations for Future Research

This project focused specifically on C-130J flight pilots, but this information could be generated for all crew positions. The variance reduction methods discussed in this research could easily be adopted by any military aviation community, whether it be Army, Navy, Marines, Coast Guard, or Air Force. These methods could also be utilized within the civilian aviation sectors or any career field that utilizes hours as a measure of experience. Appendix B: How to Guide on Obtaining the Data, provides the full process that was utilized to collect and analyze the data in this project which can be utilized to develop this method for any community.

The variances uncovered in this research were substantial in some instances; for example, 31% of the total time as other time or 38% of the total time as simulator time. It would be worthy of determining if these extreme cases are an indicator of poor performance. Future research could identify individuals who had significant variances in their flight hours compared to the averages and examine their aviation performance. This type of research would require prior permissions from the chain of command and likely the individuals as it would require interviews and an in-depth analysis of evaluation and training reports. However, it would be essential to determine if a high variance is correlated to low performance.

A final recommendation stemming from this research is to determine if the recommended hours distribution is agreed upon by the C-130J community. Table 16 presents this distribution of hours found through conducting this research. If the community agrees on this distribution amongst the 11 categories or adjusts them through subject matter experts, they could be used as an additional tool. The distribution of hours should not be a mandatory number to meet, but rather a guide to assist squadron commanders, and could be published in the Mobility Pilot Development Workbooks.

Summary

This research provides the C-130J community with three critical findings regarding flight pilot development. First, it highlighted that variances are occurring with how flight pilots are obtaining their flight hours. Second, based on statistical results, the research generated minimum recommended flight hours in each of the 11 categories. Finally, the research proposes a widely accepted process improvement methodology that could be implemented within the C-130J community. Addtionally, these results can be implemented within any field that utilizes hours as a measure of experience.

Appendix A: Complete Sample

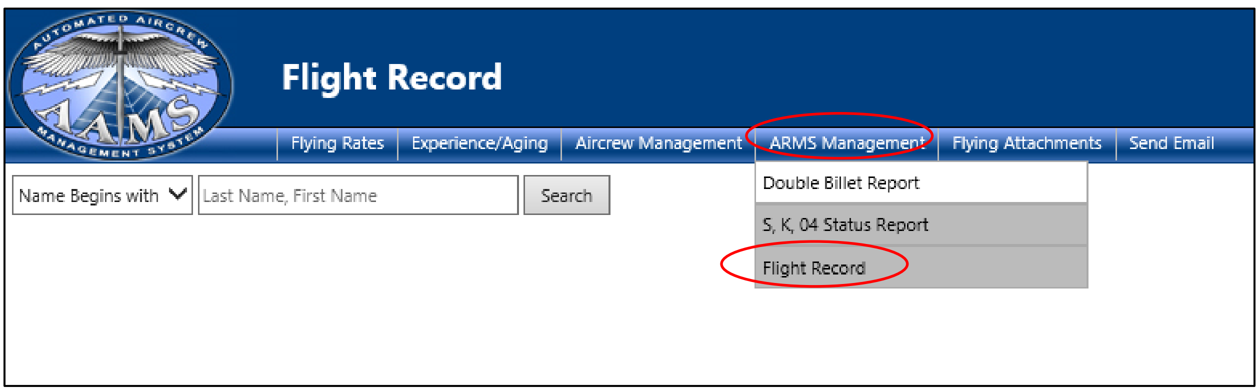
	Primary	Secondary	Other	Nite	INS	NVG	Training	Operational	Simulator	JA/ATT	CMB/Spt
RMS 1	71%	19%	9%	12%	31%	8%	30%	54%	7%	9%	0%
RMS 2	74%	14%	11%	11%	38%	6%	25%	51%	9%	15%	5%
RMS 3	70%	20%	10%	13%	27%	6%	35%	56%	6%	3%	0%
RMS 4	59%	31%	10%	18%	24%	8%	42%	49%	5%	4%	4%
RMS 5	73%	24%	4%	13%	34%	5%	16%	65%	13%	6%	0%
RMS 6	73%	24%	3%	12%	42%	4%	23%	59%	6%	12%	5%
RMS 7	68%	25%	7%	19%	41%	6%	25%	62%	9%	4%	0%
RMS 8	60%	34%	6%	12%	29%	6%	38%	41%	15%	6%	0%
RMS 9	78%	14%	8%	11%	29%	5%	31%	56%	8%	5%	0%
RMS 10	75%	21%	4%	13%	21%	6%	30%	49%	17%	4%	0%
RMS 11	77%	20%	3%	13%	27%	9%	31%	50%	10%	8%	12%
RMS 12	64%	27%	9%	11%	38%	7%	21%	69%	4%	6%	18%
RMS 13	75%	17%	9%	14%	21%	7%	35%	58%	3%	4%	31%
RMS 14	73%	22%	4%	14%	18%	5%	26%	61%	5%	8%	9%
RMS 15	73%	22%	5%	8%	22%	5%	18%	68%	4%	9%	22%
YOK 1	64%	21%	15%	12%	29%	5%	61%	32%	7%	0%	0%
YOK 2	70%	21%	9%	12%	30%	7%	48%	41%	8%	0%	0%
YOK 3	56%	23%	21%	12%	29%	3%	60%	30%	9%	0%	0%
YOK 4	57%	28%	15%	13%	26%	5%	39%	46%	15%	0%	0%
YOK 5	52%	23%	24%	10%	22%	4%	49%	39%	3%	6%	0%
YOK 6	57%	16%	27%	12%	25%	7%	57%	35%	8%	0%	0%
YOK 7	56%	21%	23%	11%	25%	7%	57%	39%	5%	0%	0%
YOK 8	68%	23%	9%	13%	30%	7%	39%	54%	5%	0%	0%
YOK 9	52%	20%	28%	12%	23%	3%	61%	35%	4%	0%	0%
YOK 10	55%	22%	24%	15%	16%	8%	69%	24%	7%	0%	0%
YOK 11	55%	18%	27%	10%	26%	6%	72%	19%	8%	0%	0%
YOK 12	59%	11%	31%	11%	22%	7%	57%	37%	5%	0%	0%
YOK 13	54%	19%	28%	15%	28%	5%	70%	23%	7%	0%	0%
YOK 14	62%	24%	14%	12%	36%	5%	48%	48%	3%	0%	0%
YOK 15	65%	13%	22%	12%	34%	8%	52%	36%	12%	0%	0%
DYS39 1	52%	31%	17%	29%	30%	18%	25%	63%	8%	4%	20%
DYS39 2	51%	27%	22%	20%	20%	13%	22%	58%	7%	13%	27%
DYS39 3	64%	22%	14%	36%	35%	30%	13%	75%	7%	5%	42%
DYS39 4	58%	20%	22%	22%	36%	15%	23%	63%	7%	6%	34%
DYS39 5	56%	25%	19%	27%	30%	19%	21%	65%	7%	7%	31%
DYS39 6	66%	21%	13%	31%	35%	17%	17%	75%	4%	4%	59%
DYS39 7	74%	13%	13%	38%	41%	26%	13%	80%	4%	3%	61%
DYS39 8	62%	15%	23%	35%	29%	24%	9%	82%	5%	3%	54%
DYS39 9	67%	22%	11%	41%	26%	31%	12%	86%	2%	0%	67%
DYS39 10	51%	34%	15%	33%	20%	22%	14%	82%	4%	0%	77%
DYS39 11	57%	30%	13%	48%	30%	35%	9%	84%	2%	5%	62%
DYS39 12	50%	25%	24%	28%	30%	20%	31%	42%	23%	4%	18%
DYS39 13	45%	32%	23%	22%	28%	12%	17%	64%	13%	6%	19%
DYS39 14	64%	17%	19%	30%	31%	24%	24%	70%	6%	0%	55%
DYS39 15	65%	26%	9%	31%	25%	25%	10%	57%	32%	0%	50%

DYS40 1	56%	25%	19%	25%	27%	16%	19%	74%	4%	3%	42%
DYS40 2	56%	31%	13%	28%	38%	16%	13%	79%	6%	2%	29%
DYS40 3	47%	34%	18%	32%	18%	21%	22%	71%	5%	3%	44%
DYS40 4	46%	31%	23%	28%	17%	21%	21%	67%	8%	4%	46%
DYS40 5	53%	32%	17%	28%	24%	20%	18%	73%	6%	3%	44%
DYS40 6	45%	32%	23%	20%	15%	10%	25%	61%	10%	4%	17%
DYS40 7	59%	25%	17%	30%	20%	24%	31%	57%	7%	5%	33%
DYS40 8	65%	32%	3%	19%	35%	14%	46%	29%	13%	13%	0%
DYS40 9	57%	28%	15%	40%	28%	26%	11%	69%	14%	5%	45%
DYS40 10	59%	19%	22%	21%	30%	11%	22%	66%	9%	3%	17%
DYS40 11	57%	29%	15%	27%	25%	24%	19%	67%	8%	8%	41%
DYS40 12	51%	36%	14%	33%	23%	25%	17%	69%	10%	4%	42%
DYS40 13	51%	31%	18%	30%	32%	24%	15%	73%	8%	4%	38%
DYS40 14	52%	39%	9%	31%	22%	14%	21%	56%	12%	11%	22%
DYS40 15	58%	26%	16%	23%	34%	13%	25%	66%	9%	0%	14%
LRF41 1	44%	44%	11%	23%	27%	21%	21%	64%	8%	7%	36%
LRF41 2	59%	29%	13%	27%	34%	19%	25%	50%	16%	9%	31%
LRF41 3	52%	39%	9%	31%	23%	22%	18%	58%	22%	2%	42%
LRF41 4	57%	26%	18%	30%	31%	24%	36%	51%	13%	0%	43%
LRF41 5	61%	26%	13%	25%	32%	12%	30%	49%	7%	13%	14%
LRF41 6	57%	26%	17%	30%	31%	24%	38%	48%	13%	1%	31%
LRF41 7	61%	26%	13%	26%	31%	13%	32%	48%	7%	13%	15%
LRF41 8	61%	26%	13%	28%	24%	16%	23%	53%	21%	3%	32%
LRF41 9	53%	38%	9%	31%	25%	22%	22%	55%	21%	2%	39%
LRF41 10	60%	26%	14%	27%	29%	18%	17%	53%	29%	1%	37%
LRF41 11	50%	32%	18%	25%	19%	17%	31%	32%	32%	5%	19%
LRF41 12	57%	32%	11%	15%	31%	8%	29%	25%	36%	10%	0%
LRF41 13	51%	34%	15%	25%	25%	18%	38%	30%	22%	10%	25%
LRF41 14	53%	34%	12%	27%	30%	20%	19%	51%	25%	5%	33%
LRF41 15	48%	42%	10%	27%	29%	21%	16%	59%	21%	4%	43%
LRF61 1	55%	21%	24%	23%	38%	16%	15%	78%	5%	4%	57%
LRF61 2	53%	28%	19%	26%	16%	21%	26%	66%	4%	4%	46%
LRF61 3	60%	34%	7%	12%	32%	6%	38%	36%	16%	9%	0%
LRF61 4	46%	30%	24%	32%	24%	22%	21%	68%	7%	4%	54%
LRF61 5	44%	32%	24%	27%	28%	13%	25%	62%	4%	10%	43%
LRF61 6	47%	34%	19%	26%	19%	18%	28%	38%	26%	7%	28%
LRF61 7	47%	36%	17%	25%	26%	12%	38%	50%	4%	9%	12%
LRF61 8	64%	25%	11%	22%	35%	8%	51%	25%	5%	19%	0%
LRF61 9	55%	38%	7%	22%	27%	12%	36%	13%	38%	13%	0%
LRF61 10	48%	31%	22%	27%	20%	16%	21%	73%	4%	1%	38%
LRF61 11	58%	31%	11%	26%	22%	14%	19%	59%	19%	4%	51%
LRF61 12	56%	30%	14%	21%	29%	9%	22%	57%	17%	4%	39%
LRF61 13	52%	27%	21%	25%	20%	16%	31%	58%	5%	6%	31%
LRF61 14	49%	39%	12%	25%	22%	19%	13%	54%	29%	4%	38%
LRF61 15	57%	37%	7%	21%	21%	11%	40%	8%	39%	12%	0%

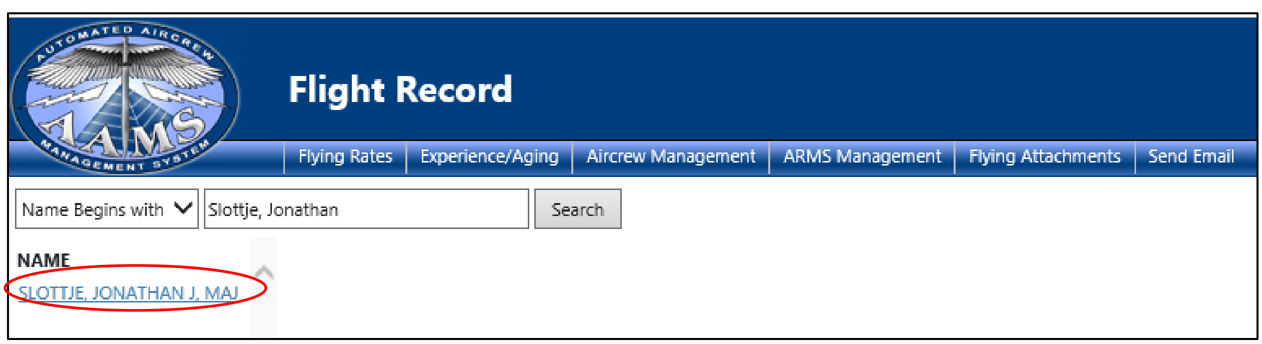
Appendix B: How to Guide on Obtaining the Data

This section delivers the process used to collect the data presented in this research. This provides for additional research opportunities and would also enable the AAMS programmers an understanding of what steps would be required to make these reports available.

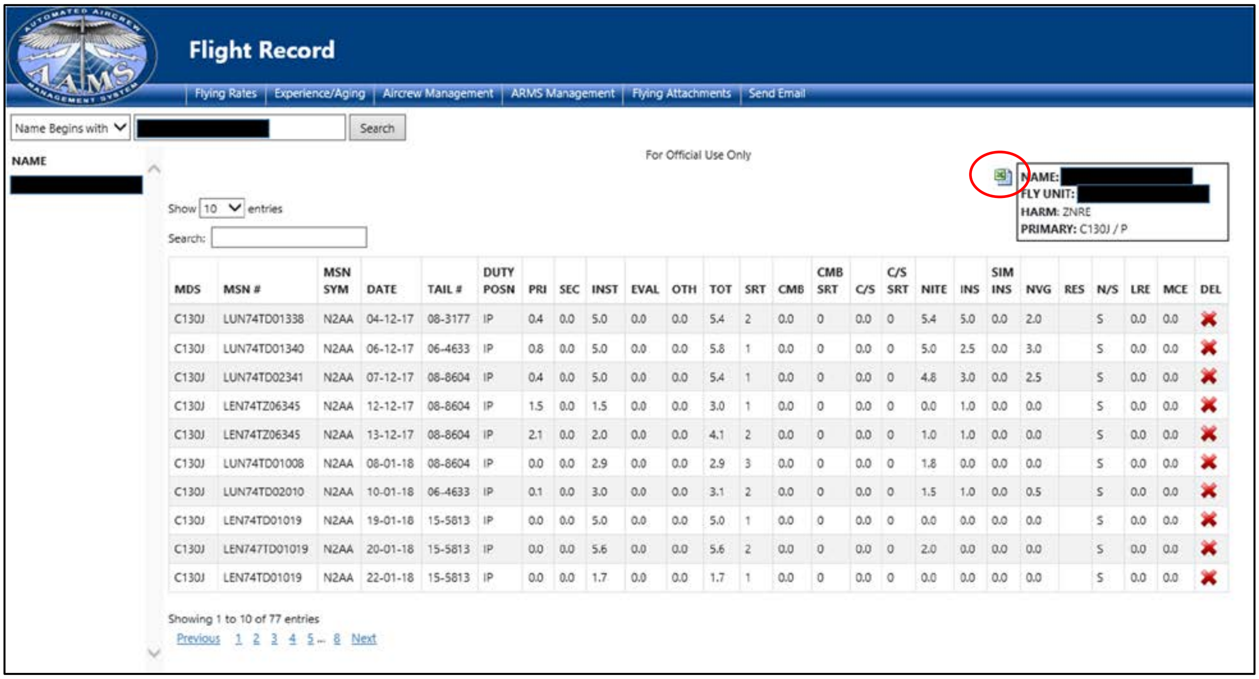
After obtaining AAMS access and the appropriate rights within the system, any active flyer's flight record can be obtained. This is done through the "ARMS MANAGEMENT" tab and selecting "Flight Record."



After arriving at the "Flight Record" page, enter the Last, First name of the individual pilot and hit search.



If the member is found within the system, their name will be displayed. By clicking on the member’s name, a screen will generate with a table and an option to export the data to Microsoft Excel. Click on the Excel Icon.



MDS	MSN #	MSN SYM	DATE	TAIL #	DUTY POSN	PRI	SEC	INST	EVAL	OTH	TOT	SRT	CMB	CMB SRT	C/S	C/S SRT	NITE	INS	SIM INS	NVG	RES	N/S	LRE	MCE	DEL
C130J	LUN74TD01338	N2AA	04-12-17	08-3177	IP	0.4	0.0	5.0	0.0	0.0	5.4	2	0.0	0	0.0	0	5.4	5.0	0.0	2.0		S	0.0	0.0	✖
C130J	LUN74TD01340	N2AA	06-12-17	06-4633	IP	0.8	0.0	5.0	0.0	0.0	5.8	1	0.0	0	0.0	0	5.0	2.5	0.0	3.0		S	0.0	0.0	✖
C130J	LUN74TD02341	N2AA	07-12-17	08-8604	IP	0.4	0.0	5.0	0.0	0.0	5.4	1	0.0	0	0.0	0	4.8	3.0	0.0	2.5		S	0.0	0.0	✖
C130J	LEN74TZ06345	N2AA	12-12-17	08-8604	IP	1.5	0.0	1.5	0.0	0.0	3.0	1	0.0	0	0.0	0	0.0	1.0	0.0	0.0		S	0.0	0.0	✖
C130J	LEN74TZ06345	N2AA	13-12-17	08-8604	IP	2.1	0.0	2.0	0.0	0.0	4.1	2	0.0	0	0.0	0	1.0	1.0	0.0	0.0		S	0.0	0.0	✖
C130J	LUN74TD01008	N2AA	08-01-18	08-8604	IP	0.0	0.0	2.9	0.0	0.0	2.9	3	0.0	0	0.0	0	1.8	0.0	0.0	0.0		S	0.0	0.0	✖
C130J	LUN74TD02010	N2AA	10-01-18	06-4633	IP	0.1	0.0	3.0	0.0	0.0	3.1	2	0.0	0	0.0	0	1.5	1.0	0.0	0.5		S	0.0	0.0	✖
C130J	LEN74TD01019	N2AA	19-01-18	15-5813	IP	0.0	0.0	5.0	0.0	0.0	5.0	1	0.0	0	0.0	0	0.0	0.0	0.0	0.0		S	0.0	0.0	✖
C130J	LEN747TD01019	N2AA	20-01-18	15-5813	IP	0.0	0.0	5.6	0.0	0.0	5.6	2	0.0	0	0.0	0	2.0	0.0	0.0	0.0		S	0.0	0.0	✖
C130J	LEN74TD01019	N2AA	22-01-18	15-5813	IP	0.0	0.0	1.7	0.0	0.0	1.7	1	0.0	0	0.0	0	0.0	0.0	0.0	0.0		S	0.0	0.0	✖

Showing 1 to 10 of 77 entries

Previous 1 2 3 4 5 … 8 Next

An Excel file will be generated like the one below.

Flight Records

ARMS Updated: 1/16/2020

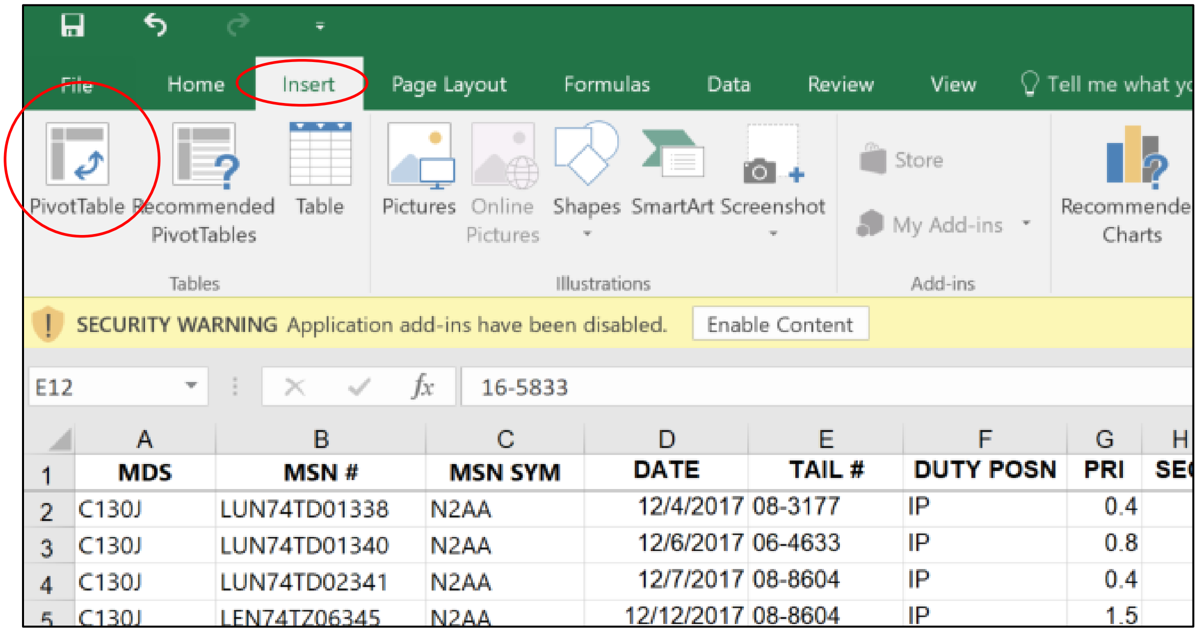
RANK: NAME: FLY UNIT: PRIMARY: C130J / P

	MDS	MSN #	MSN SYM	DATE	TAIL #	DUTY POSN	PRI	SEC	INST	EVAL	OTH	TOT	SRT	CMB	CMB SRT	C/S	C/S SRT	NITE	INS	SIM INS	NVG	RES	N/S	LRE	MCE
5	C130J	LUN74TD01338	N2AA	12/4/2017	08-3177	IP	0.4	0	5	0	0	5.4	2	0	0	0	0	5.4	5	0	2		S	0	0
6	C130J	LUN74TD01340	N2AA	12/6/2017	06-4633	IP	0.8	0	5	0	0	5.8	1	0	0	0	0	5	2.5	0	3		S	0	0
7	C130J	LUN74TD02341	N2AA	12/7/2017	08-8604	IP	0.4	0	5	0	0	5.4	1	0	0	0	0	4.8	3	0	2.5		S	0	0
8	C130J	LEN74TZ06345	N2AA	12/12/2017	08-8604	IP	1.5	0	1.5	0	0	3	1	0	0	0	0	0	1	0	0		S	0	0
9	C130J	LEN74TZ06345	N2AA	12/13/2017	08-8604	IP	2.1	0	2	0	0	4.1	2	0	0	0	0	1	1	0	0		S	0	0
10	C130J	LUN74TD01008	N2AA	1/8/2018	08-8604	IP	0	0	2.9	0	0	2.9	3	0	0	0	0	1.8	0	0	0		S	0	0
11	C130J	LUN74TD02010	N2AA	1/10/2018	06-4633	IP	0.1	0	3	0	0	3.1	2	0	0	0	0	1.5	1	0	0.5		S	0	0
12	C130J	LEN74TD01019	N2AA	1/19/2018	15-5813	IP	0	0	5	0	0	5	1	0	0	0	0	0	0	0	0		S	0	0
13	C130J	LEN747TD01019	N2AA	1/20/2018	15-5813	IP	0	0	5.6	0	0	5.6	2	0	0	0	0	2	0	0	0		S	0	0
14	C130J	LEN74TD01019	N2AA	1/22/2018	15-5813	IP	0	0	1.7	0	0	1.7	1	0	0	0	0	0	0	0	0		S	0	0
15	C130J	LUN74TD02024	N2AA	1/24/2018	16-5833	IP	0	0	1.4	0	0	1.4	2	0	0	0	0	0	0.3	0	0		S	0	0
16	C130J	LJM423101035	M6C	2/4/2018	08-3177	IP	0	0	11.4	0	0	11.4	2	0	0	0	0	0	1.5	0	0		S	0	0
17	C130J	LVM423101035	M6CA	2/6/2018	08-3177	IP	0	0	7.6	0	0	7.6	1	0	0	0	0	0	2	0	0		S	0	0
18	C130J	LJM424701042	M6CA	2/11/2018	15-5817	IP	0	0	12.2	0	0	12.2	2	0	0	0	0	0	4	0	0		S	0	0
19	C130J	LJM424701042	M6CA	2/12/2018	15-5817	IP	0	0	7.1	0	0	7.1	1	0	0	0	0	0	2	0	0		S	0	0
20	C130J	LJM424701042	M6CA	2/13/2018	15-5817	IP	0	0	1.8	0	0	1.8	1	0	0	0	0	0.5	0.5	0	0		S	0	0
21	C130J	LJM424701042	M6CA	2/14/2018	15-5817	IP	0	0	1.6	0	0	1.6	1	0	0	0	0	0	0	0	0		S	0	0
22	C130J	LUN74TD01071	N2AA	3/12/2018	16-5833	IP	0	0	3.6	0	0	3.6	1	0	0	0	0	1	1	0	0.7		S	0	0
23	C130J	LUN74TD01071	N2AA	3/14/2018	16-5833	IP	0	0	1.6	0	0	1.6	1	0	0	0	0	0	0	0	0		S	0	0
24	C130J	LUN74TD04120	N2AA	4/30/2018	14-5843	MP	3	0.4	0	0	0	3.4	4	0	0	0	0	2	1	0	2		S	0	0
25	C130J	LUN74TD06121	N2AA	5/1/2018	16-5843	IP	0	0	4.1	0	0	4.1	3	0	0	0	0	2	2	0	0.3		S	0	0
26	C130J	LJZA967CD223	C3FA	8/11/2018	06-4633	MP	2.4	0	0	0	0	2.4	1	0	0	0	0	0	1	0.3	0		S	0	0
27	C130J	LMZA967CD223	C3FA	8/12/2018	06-4633	MP	2.2	0.2	0	0	0	2.4	1	0	0	0	0	0	0	0	0		S	0	0
28	C130J	LVZA967CD223	C3FA	8/13/2018	06-4633	MP	3.2	0	0	0	0	3.2	1	0	0	0	0	1.3	0.8	0.3	0		S	0	0
29	C130J	LUN74TD06240	N2AA	8/28/2018	15-5841	IP	0	0	3.8	0	0	3.8	3	0	0	0	0	2.1	3	0	0.5		S	0	0
30	SMC130J	SIM	Q1Y1	9/1/2018	WST-0001	IP	2	0	2	0	0	4	1	0	0	0	0	0	1	0	0		Q	0	0
31	SMC130J	SIM	Q1Y1	9/2/2018	WST-0001	IP	2	0	2	0	0	4	1	0	0	0	0	0	0	1	0		Q	0	0
32	SMC130J	SIM	Q1Y1	9/4/2018	WST-0001	IP	2	0	2	0	0	4	1	0	0	0	0	0	0	0	0		Q	0	0
33	C130J	LUN74TD06254	N2AA	9/11/2018	15-5813	IP	0	0	3.6	0	0	3.6	2	0	0	0	0	2	1	0	1		S	0	0
34	C130J	LUN74TD01261	N2AA	9/18/2018	06-8610	IP	0.3	0	3.5	0	0	3.8	2	0	0	0	0	2	2	0	0.5		S	0	0
35	C130J	LUN74TD05263	N2AA	9/20/2018	14-5807	IP	0	0	3.6	0	0	3.6	2	0	0	0	0	2.7	3.1	0	0		S	0	0

The next step is to create a Pivot Table, to accomplish this within Excel, the user must first delete the first three lines of data, leaving the column headers as the first line.

1	MDS	MSN #	MSN SYM	DATE	TAIL #	DUTY POSN	PRI	SEC	INST	EVAL	OTH	TOT	SRT	CMB	CMB SRT	C/S	C/S SRT	NITE	INS	SIM INS	NVG	RES	N/S	LRE	MCE
2	C130J	LUN74TD01338	N2AA	12/4/2017	08-3177	IP	0.4	0	5	0	0	5.4	2	0	0	0	0	5.4	5	0	2		S	0	0
3	C130J	LUN74TD01340	N2AA	12/6/2017	06-4633	IP	0.8	0	5	0	0	5.8	1	0	0	0	0	5	2.5	0	3		S	0	0
4	C130J	LUN74TD02341	N2AA	12/7/2017	08-8604	IP	0.4	0	5	0	0	5.4	1	0	0	0	0	4.8	3	0	2.5		S	0	0
5	C130J	LEN74TZ06345	N2AA	12/12/2017	08-8604	IP	1.5	0	1.5	0	0	3	1	0	0	0	0	0	1	0	0		S	0	0
6	C130J	LEN74TZ06345	N2AA	12/13/2017	08-8604	IP	2.1	0	2	0	0	4.1	2	0	0	0	0	1	1	0	0		S	0	0
7	C130J	LUN74TD01008	N2AA	1/8/2018	08-8604	IP	0	0	2.9	0	0	2.9	3	0	0	0	0	1.8	0	0	0		S	0	0
8	C130J	LUN74TD02010	N2AA	1/10/2018	06-4633	IP	0.1	0	3	0	0	3.1	2	0	0	0	0	1.5	1	0	0.5		S	0	0
9	C130J	LEN74TD01019	N2AA	1/19/2018	15-5813	IP	0	0	5	0	0	5	1	0	0	0	0	0	0	0	0		S	0	0
10	C130J	LEN747TD01019	N2AA	1/20/2018	15-5813	IP	0	0	5.6	0	0	5.6	2	0	0	0	0	2	0	0	0		S	0	0

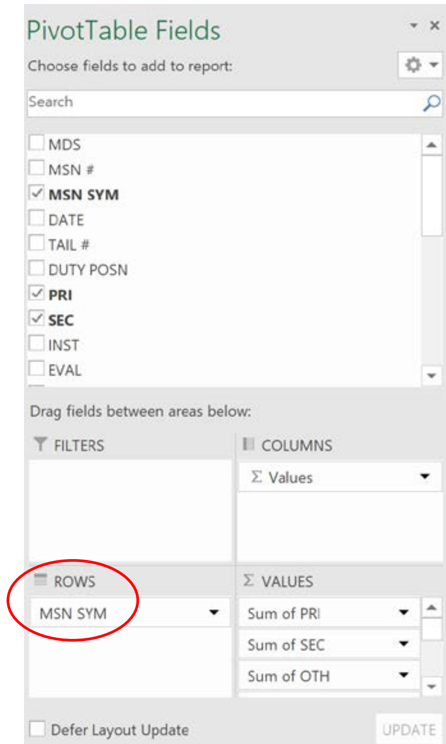
Once this step is complete, click anywhere within the data file, click the “Insert” tab, then “PivotTable.”



The Pivot Table will look similar to this:

	A	B	C	D	E	F	G	H	I
1	Drop Report Filter Fields Here								
2									
3		Data							
4	MSN SYM	Sum of PRI	Sum of SEC	Sum of OTH	Sum of NITE	Sum of INS	Sum of NVG	Sum of CMB	Sum of CMB SRT
5	N10A	0	0	4.1	0	0	0	0	0
6	N1AA	1.9	1.9	0	0	1	0	0	0
7	N1DA	2.9	2.8	2.4	2.4	1	1	0	0
8	N2AA	64.2	41.6	2.6	19	21.5	15	0	0
9	T5HE	7.2	0	0	5.9	7.2	0	0	0
10	C2CA	4.2	4.3	0	1.7	3	0	0	0
11	C2PA	9.6	1.8	30.5	9.5	3.9	3	8.5	4
12	M10A	26	12.4	0	7.8	7.5	0	0	0
13	M30A	12	0	0	4.9	0.5	0	0	0
14	M40A	25.9	25.8	0	8.5	15	0	0	0
15	M6CA	47.1	7.3	2.6	3.4	32.1	0	0	0
16	O30A	1.9	1.9	0	0	0.5	0	0	0
17	P7BA	232.6	26.5	42.1	144.7	140.1	100.2	239.6	188
18	P7BG	35.3	3.6	11.3	13.9	8.1	2	2.2	2
19	M8AA	10.4	10.6	0	0.9	8	0.3	0	0
20	M8BA	5	5.2	1.5	3.6	0.9	0	0	0
21	Q2	13.9	14	0.1	8	11	7.8	0	0
22	Grand Total	500.1	159.7	97.2	234.2	261.3	129.3	250.3	194

Selections on the right side of the screen allow the user to generate the different categories. It is essential to ensure that MSN SYM is selected in the ROWS section.



The fields that can be selected are those available in the actual Flight Record. For the other categories, such as Training or Tasked, some basic Excel formulas will be required. First, sum up each row or MSN SYM under Primary, Secondary, and Other columns.

MINUTE | fx =SUM(B5:D5)

	A	B	C	D	E	F	G	H	I	J
1										
2										
3		Data								
4	MSN SYM	Sum of PRI	Sum of SEC	Sum of OTH	Sum of NITE	Sum of INS	Sum of NVG	Sum of CMB	Sum of CMB SRT	
5	N10A	0	0	4.1	0	0	0	0	0	=SUM(B5:
6	N1AA	1.9	1.9	0	0	1	0	0	0	3.8
7	N1DA	2.9	2.8	2.4	2.4	1	1	0	0	8.1
8	N2AA	64.2	41.6	2.6	19	21.5	15	0	0	108.4
9	T5HE	7.2	0	0	5.9	7.2	0	0	0	7.2
10	C2CA	4.2	4.3	0	1.7	3	0	0	0	8.5
11	C2PA	9.6	1.8	30.5	9.5	3.9	3	8.5	4	41.9
12	M10A	26	12.4	0	7.8	7.5	0	0	0	38.4
13	M30A	12	0	0	4.9	0.5	0	0	0	12
14	M40A	25.9	25.8	0	8.5	15	0	0	0	51.7
15	M6CA	47.1	7.3	2.6	3.4	32.1	0	0	0	57
16	O30A	1.9	1.9	0	0	0.5	0	0	0	3.8
17	P7BA	232.6	26.5	42.1	144.7	140.1	100.2	239.6	188	301.2
18	P7BG	35.3	3.6	11.3	13.9	8.1	2	2.2	2	50.2
19	M8AA	10.4	10.6	0	0.9	8	0.3	0	0	21
20	M8BA	5	5.2	1.5	3.6	0.9	0	0	0	11.7
21	Q2	13.9	14	0.1	8	11	7.8	0	0	28
22	Grand Total	500.1	159.7	97.2	234.2	261.3	129.3	250.3	194	

Next, determine which MSN SYMs will be categorized. In this research, the MSN SYMs were categorized as seen below.

MSN Symbol	Hour Category
M8	JAATT
N2	Training
N1	Training
T1-3	Training
A1-9	Operational
C2-9	Operational
L1-8	Operational
M1-7	Operational
P7-9	Operational
O3	Operational
Q1-3	Simulator

To total these categories is the most tedious step that was taken in this project. By manually sorting the MSN SYMs, the categories can be grouped in descending order for simplicity.

	Data									
MSN SYM	Sum of PRI	Sum of SEC	Sum of OTH	Sum of NITE	Sum of INS	Sum of NVG	Sum of CMB	Sum of C/S	Totals	
C2DA	35	16.2	0	0	10.2	0	0	0	51.2	Tasked
C2MA	6.5	0.1	0	0.4	4	0	0	0	6.6	Tasked
C2PA	66.8	13.5	0.3	18.6	21.3	11.2	4.6	49.4	80.6	Tasked
C7DA	46.9	2.4	0	7.3	16	6.4	0	0	49.3	Tasked
M30A	22	0.3	0	1	19	0	0	0	22.3	Tasked
M6CA	22.8	1.8	0	1.5	11	0	0	0	24.6	Tasked
M8AA	21.1	16.2	0.1	5.1	12.3	1	0	0	37.4	JA/ATT
N10A	20.4	1.9	0	0	5.5	0	0	0	22.3	Training
N1DA	63.2	24.7	10.6	20.3	6.6	14.9	0	0	98.5	Training
N2AA	18.7	7.2	0	2	6	1	0	0	25.9	Training
Q1	0.5	0	0	0	0.5	0	0	0	0.5	Simulator
Q2	35.1	9	3.9	6.7	14.7	5.7	0	0	48	Simulator
Grand Total	359	93.3	14.9	62.9	127.1	40.2	4.6	49.4		

Again, basic Excel formulas will be required for the next step. Sum up each category in a separate cell.

	Data									
MSN SYM	Sum of PRI	Sum of SEC	Sum of OTH	Sum of NITE	Sum of INS	Sum of NVG	Sum of CMB	Sum of C/S	Totals	
C2DA	35	16.2	0	0	10.2	0	0	0	51.2	Tasked
C2MA	6.5	0.1	0	0.4	4	0	0	0	6.6	Tasked
C2PA	66.8	13.5	0.3	18.6	21.3	11.2	4.6	49.4	80.6	Tasked
C7DA	46.9	2.4	0	7.3	16	6.4	0	0	49.3	Tasked
M30A	22	0.3	0	1	19	0	0	0	22.3	Tasked
M6CA	22.8	1.8	0	1.5	11	0	0	0	24.6	Tasked
M8AA	21.1	16.2	0.1	5.1	12.3	1	0	0	37.4	JA/ATT
N10A	20.4	1.9	0	0	5.5	0	0	0	22.3	Training
N1DA	63.2	24.7	10.6	20.3	6.6	14.9	0	0	98.5	Training
N2AA	18.7	7.2	0	2	6	1	0	0	25.9	Training
Q1	0.5	0	0	0	0.5	0	0	0	0.5	Simulator
Q2	35.1	9	3.9	6.7	14.7	5.7	0	0	48	Simulator
Grand Total	359	93.3	14.9	62.9	127.1	40.2	4.6	49.4		
% Of Total Hours	77%	20%	3%	13%	27%	9%	1%	11%		
Total Hours	467.2									
Total Training Hrs	=SUM(J35:	% Of Total Hrs	31%							
Total Tasked Hrs	234.6	% Of Total Hrs	50%							
Total Sim Hrs	48.5	% Of Total Hrs	10%							
Total CMB/SPT Hrs	54	% Of Total Hrs	12%							
Total JA/ATT Hrs	37.4	% Of Total Hrs	8%							

After calculating total hours, percentages of total hours can be found for each category. As these are percentages of total hours, they can be utilized at any stage of flight pilot development to ensure the correct mixture of hours is being obtained.

Appendix C: Quad Chart

C-130J Flight Pilot Development: An Empirical Mixed Method Analysis on Aircraft Commander Upgrade

Maj Jonathan J. Slottje
Advisor: Lt Col Jason R. Anderson, Ph.D.
Advanced Study of Air Mobility (ENS)
Air Force Institute of Technology

Introduction

This research aims to improve the C-130J pilot development process through variance reduction by employing the Six Sigma DMAIC methodology. The results provide the community with three critical findings; 1. Highlighted that variances are occurring in upgrade training 2. Based on statistical results, the research generated minimum flight hours in 11 categories, and 3. Proposes a process improvement methodology that could be implemented within the C-130J community and more importantly, in any upgrade training where people advance into higher echelons of a business.

Research Goals

This research will determine the answers to three research questions:

1. Are there significant statistical variances between the C-130J squadrons in regards to how their respective flight pilots are obtaining their flight hours?

2. What is the correct distribution of flight hours a C-130J flight pilot should obtain to reduce variance and provide commanders full confidence the individual has received a sufficient amount of quality flight hours?

3. Can the Six Sigma DMAIC methodology be applied to C-130J flight pilot development, and if so, what results will emerge?

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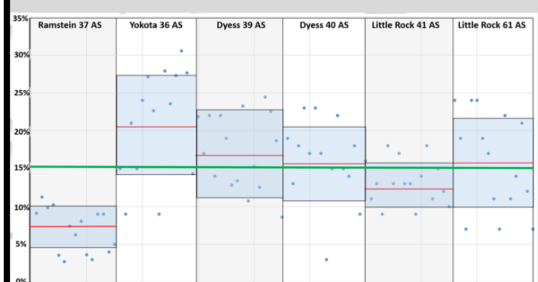
Results

- Six Sigma DMAIC methodology is utilized as a framework to both identify and provide causal factors for variances in C-130J flight pilot development.
- 11 flight hour categories were established and variance between the squadrons was found in 10 of the 11 through statistical analysis (example below).



As a percentage of total C-130J flight time, this figure displays the amount of Other Time logged by 90 flight pilots. Green line indicates average of sample (n=90). Red line is squadron average (n=15). Width of blue box indicates standard deviation within squadron.

- Additionally, the research developed a recommended distribution of flight hours that can be used as a tool to reduce variance and schedule more efficiently. The percentages can be used at any stage of pilot development to vector check the pilot's seasoning to ensure they are obtaining the right mix of experience. The total hours provide commanders additional situational awareness on a pilot's experience when nearing aircraft commander certification.

	Primary	Secondary	Other	Night	Instrument	NVG	Training	Tasked	Simulator	JA/ATT	Combat
Percent of Total Hours	60%	25%	15%	20%	30%	15%	30%	45%	10%	5%	15%
Recommended +/-	+/- 10%	+/- 5%	+5/-10%	+10/-5%	+/- 5%	+10/-5%	+/- 5%	+/- 10%	+/- 5%	+5/-2 %	+/- 15%
Recommended Distribution of 700 Hours	400	200	100	150	175	100	250	350	75	25	100

Methodology

A mixed methodology was employed through three distinct phases of research to answer the research questions. Phase I involved data collection and quantitative analysis of 90 C-130J flight pilots' aviation records. Phase II involved statistically testing the data retrieved from the flight records.. The final step in Phase II was the qualitative input of subject matter experts on the results in hopes of determining what the causal factors were. Phase III was the study and proposed implementation of Six Sigma's DMAIC methodology into the C-130J upgrade process.

Implications

This research proposes a method to more efficiently develop pilots through reducing variances within and amongst the squadrons. The results could potentially be used by all Department of Defense aviation communities.

Recommendations

1. Publish recommended distribution of flight hours.

2. Update the Automated Aircrew Management System to generate variance reduction reports.

3. Fully employ Six Sigma DMAIC methodology into MAF pilot development processes.

Collaboration

AMC DA3, (36, 37, 39, 40, 41, 61) Airlift Sqs.

Bibliography

AMC/A3TA. Air Force Manual 11-2C-130J, Volume 1. *Flying Operations. C-130J Aircrew Training.* 10 February 2020.

AMC/A3VX. Air Force Manual 11-2C-130J, Volume 3. *Flying Operations. C-130J Operations Procedures.* 17 July 2019.

AP/2. DoD Flight Information Publication (Enroute). *Supplement Europe-Africa-Middle East.* National Geospatial-Intelligence Agency, United States Government. 27 February 2020.

AP/3. DoD Flight Information Publication. *Pacific-Australasia-Antarctica.* National Geospatial-Intelligence Agency, United States Government. 10 October 2019.

Automated Aircrew Management System (AAMS). *User's Manual.* Version 3.17. 9 October 2019.

Chakrabortty, Ripon K., Biswas, Tarun K., & Ahmed, Iraj. (2013). REDUCING PROCESS VARIABILITY BY USING DMAIC MODEL: A CASE STUDY IN BANGLADESH. *International Journal for Quality Research, 7*(1).

Conn, Richard. "Developing software engineers at the C-130J software factory." *IEEE software* 19.5 (2002): 25-29.

De Mast, Jeroen. and Joran Lokkerbol. (2012). An analysis of the Six Sigma DMAIC method from the perspective of problem solving. *International Journal of Production Economics, 139*(2), 604-614.

Department of Transportation. Federal Aviation Administration. "Pilot Certification and Qualification Requirements for Air Carrier Operations." Federal Register/Vol. 77, No. 40/Wednesday, February 29, 2012.

Electronic Code of Federal Regulations. "Part 61, Subpart G – Airline Transport Pilots" U.S. Government Publishing Office. https://www.ecfr.gov/cgi-bin/text-idx?SID=762dc9e1dc3ebb7f4ea478978a57ae7c&mc=true&node=se14.2.61_1159&rgn=div8. (accessed 17 January 2020).

Gastwirth, Joseph L., Yulia R. Gel, and Weiwen Miao. "The impact of Levene's test of equality of variances on statistical theory and practice." *Statistical Science* (2009): 343-360.

Glen, Stephanie. *Levene Test for Equality of Variances.* Statistics How To. March 4, 2014. https://www.statisticshowto.datasciencecentral.com/levene-test/. (accessed 11 March, 2020).

HQ AMC/A3D. Air Mobility Command Instruction 10-2101. *Operations, Joint Airborne/Air Transportability Training.* 15 June 2018.

HQ USAF/A3O-T. Air Force Instruction 11-401. *Aviation Management.* 10 December 2010. (Incorporates Air Force Guidance Memorandum AFGM2019-01. 31 January 2019).

Klefsjö, Bengt, Hakan Wiklund, & Rick L. Edgeman. (2001). “Six Sigma seen as a methodology for total quality management.” *Measuring business excellence*. Vol. 5 No. 1, pp. 31-35.

Lynch, Donald P., Suzanne Bertolino, & Elaine Cloutier. (2003). How to scope DMAIC projects. *Quality progress*, *36*(1), 37-41.

Matson, Eric and Laurance Prusak. “The Performance Variability Dilemma.” *MIT Sloan Management Review*, 45.1. (2003): 39.

Mackay, Jock R. and Stefan H. Steiner. *Strategies for Variability Reduction.* Department of Statistics and Actuarial Sciences. University of Waterloo. 1997.

Morton, Peter, Adams, Barbara; Byrnes, Kenneth; Morrison, Gary; Hibler, Terry; Greubel, Darrin; Haugaard, LaMar; Buyer, John; Dee, Michael; Winter, Jeffrey; and Panhans, Jeff. "Panel 2: ATP/CTP Experience Report & New Ideas In Flight Education." (2016). National Training Aircraft Symposium (NTAS). 11.

Morrissey, Thomas. "Analysis of Pilot Performance Using Precision Visual Flight Rules." Master’s Thesis, University of Tennessee. (2004).

NIST/SEMATECH. e-Handbook of Statistical Methods. http://www.itl.nist.gov/div898/handbook. (accessed 10 March 2020).

Nolan, Thomas W., and Lloyd P. Provost. Understanding Variation. *Quality progress.* 23.5 (1990): 70-78.

Pan, Zhedan, Hoyeon Ryu, & Jongmoon Baik. (2007, August). A case study: CRM adoption success factor analysis and Six Sigma DMAIC application. In *5th ACIS International Conference on Software Engineering Research, Management & Applications (SERA 2007)* (pp. 828-838). IEEE.

Panagopoulos, Ilias, Chris J. Atkin, & Ivan Sikora. (2016). Lean Six-Sigma in Aviation Safety: An implementation guide for measuring aviation system's safety performance. *Journal of Safety Studies*, *2*(2).

Poiger, Martin. *Improving performance of supply chain process by reducing variability*. Diss. WU Vienna University of Economics and Business. 2010.

Smith, Guy M., Derek Herchko, Elizabeth Bjerke, Mary Niemczyk, Robert Nullmeyer, Julie Paasch, & David A. NewMyer. "The 2012 pilot source study (phase III): Response to the pilot certification and qualification requirements for air carrier operations." *Journal of Aviation Technology and Engineering* 2.2 (2013): 2.

Tang, Loon C., Thong N. Goh, Shao W. Lam, & Cai W. Zhang. (2007). Fortification of Six Sigma: expanding the DMAIC toolset. *Quality and Reliability Engineering International*, *23*(1), 3-18.

Thompson, Nathan. *Avoiding a Pilot Retention Death Spiral: The Pilot Shortage and DOD's Challenge to Maintain an Effective Fighting Force*. Joint Forces Staff College/NDU NORFOLK United States, 2018.

Tonini, Antonio. C., Mauro de Mesquita Spinola, & Fernando Jose Barbin Laurindo. (2006, July). Six Sigma and software development process: DMAIC improvements. In *2006 Technology Management for the Global Future-PICMET 2006 Conference* (Vol. 6, pp. 2815-2823). IEEE

U.S. Congress, Office of Technology Assessment. "Safe Skies for Tomorrow: Aviation Safety in a Competitive Environment. OTA-SET-381". Washington D.C: U.S. Government Printing Office, July 1988.

Werfelman, Linda. "Counting the Hours." Flight Safety Foundation. 2010. https://flightsafety.org/asw-article/counting-the-hours/. Retrieved 10 January 2020.

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14. ABSTRACT
This research aims to improve the C-130J pilot development process by reducing variance. After quantitatively identifying variances, qualitative data was collected to identify the causal factors. This study recommends employing the Six Sigma DMAIC methodology to the current processes. The results provide the community with three critical findings; 1. Highlighted that variances are occurring in upgrade training 2. Based on statistical results, the research generated minimum flight hours in the 11 categories, and 3. Proposes a process improvement methodology that could be implemented within the C-130J community and more importantly, in any upgrade training where people advance into higher echelons of a business.

15. SUBJECT TERMS
Variance reduction, Six Sigma, DMAIC, C-130J, upgrade

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