MOBILITY AIR FORCE AIRCREW FLIGHT TRAINING REQUIREMENTS VALIDATION THROUGH THE USE OF LINE ORIENTED SAFETY AUDIT DATA

GRADUATE RESEARCH PAPER

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Abstract

This study fulfills the requirements levied by the AF Audit Agency on AMC/A3T as a result of a finding that highlighted Mobility Air Forces (MAF) aircrew flight training requirements are not necessarily quantifiably determined. Although AMC does have a process in which they adjust flight training requirements, it is predominantly a qualitative process. The primary process for adjusting training requirements relies on input from the line units and aircrew check ride trends. However, in the recent past, there have been very minimal check ride trends present, making this source of input into the process potentially nonviable. To bridge the gap and provide more viable data, this study will analyze data collected during Line Operations Safety Audits (LOSA) during real-world missions to assess whether or not current aircrew flying training requirements are at appropriate levels. Ensuring aircrew are trained at the appropriate level is critical in today's fiscally constrained environment. It is important that the MAF does not overtrain to ensure responsible spending, but it is just as important that aircrew are not undertrained to ensure proficiency and safety. A lack of proficiency could result in a catastrophic mishap, loss of life, and the loss of multi-million dollar aircraft.

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Jeffrey C. Davis

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MOBILITY AIR FORCE AIRCREW FLIGHT TRAINING REQUIREMENTS VALIDATION THROUGH THE USE OF LINE ORIENTED SAFETY AUDIT DATA

I. Introduction and Problem Statement

Introduction

The Air Force Audit Agency audited Air Mobility Command, Aircrew Training Division (AMC/A3T) in 2015. This audit highlighted that Semi-Annual Continuation Flying Requirements, sometimes referred as "Training Tables," are not necessarily analytically justified. AMC/A3T continuously looks at many sources to determine if the Mobility Air Forces (MAF) training program is sufficient. The sources AMC/A3T monitors include Safety Investigation Boards (SIB), Aviation Safety Action Program (ASAP), and Military Flight Operations Quality Assurance (MFOQA). In the event one of these monitored sources provides data justifying a change to the Training Tables, AMC/A3T will make appropriate changes. AMC/A3T primarily uses subjective data from unit level subject matter experts (SME) as well as downgrade trend data from check rides to validate the Training Tables. These Training Tables are published in an aircrew training Air Force Instruction (AFI) unique to each MAF Mission Design Series (MDS) for which AMC/A3T is responsible (M. Maloy, personal communication, April 19, 2017). Unit level SME input and check ride performance may appear to be good sources of data to validate a training program, but each of these sources has potential flaws.

Air Mobility Command (AMC) also gathers data on aircrew performance through its Line Oriented Safety Audit (LOSA) program for mitigating negative safety trends, but currently, LOSA data is not used to explicitly validate the Training Tables (K. Picha, personal communication, February 14, 2017). Due to the nature in which LOSA observations are conducted, it has the potential to be a more accurate source to validate aircrew required training. Current and potential future fiscal constraints make it imperative that AMC has an accurate method to validate the costly flying training requirements of its aircrew to ensure flying training is optimized to meet both fiscal and safety considerations.

The AFI 11-202, directs that lead Major Commands (MAJCOM) will establish aircrew ground and flying training requirements to meet the aircrew training program goal of ensuring all aircrew obtain and maintain qualification/certification and proficiency to efficiently and safely carry out their unit's mission (11-202, Vol 1, 2010). As the lead MAJCOM for the MAF, AMC has delegated this task to AMC/A3T (11-2C-130J Vol 1, 2012). Therefore, AMC/A3T is responsible for the development of all MAF aircrew training, and they publish required Aircrew Training Tables in an AFI that is unique to each MDS or each aircraft in the MAF.

Appendix A shows an excerpt of Table 4.4, Pilot Semi-Annual Continuation Flying Requirements from the 11-2C-130J Vol 1. This Appendix outlines the required number of Proficiency/Basic events for qualified Aircraft Commanders (AC) and qualified Mobility Pilot Development (MPD) pilots or Copilots (CP), based on Flight Training Level (FTL). There are four different FTL's in which the Volume 1 explains that the Squadron Commander, based on his or her judgment of that aircrew member's experience, assigns to each aircrew member on a semi-annual basis. FTL A is reserved for highly experienced crewmembers, FTL B is reserved for experienced mission ready crewmembers, FTL C is reserved for mission ready crewmembers, and FTL E is reserved for non-instructor crewmembers assigned to a staff position. As you can see in

Appendix A, the least experienced ACs and MPD line pilots (FTL C) are required to accomplish 12 takeoffs, 12 instrument approaches, 12 landings, and many other quantities of various events in a six month or semi-annual period (11-2C-13J Vol 1, 2012). Furthermore, the flying hours assigned to each unit provide all crew positions with the required amount of hours to accomplish all flying training requirements (11-2C-13J Vol 1, 2012). It is important to understand that the total number of training requirements drives the number of hours in the flying hour program, which has an associated cost. Therefore, one can argue how important it is that each flying training requirement is justified in today's fiscally constrained Air Force.

As previously mentioned, one of the two primary methods in which AMC/A3T validates its flying training requirements is through the use of subjective data from unit level SMEs. AMC/A3T is required to host SMEs from each MAF MDS wing throughout the AF to review all training programs for currency applicability, compliance, and effectiveness, as well as address any issues with AFI 11-2MDS Vol 1, on a biennial basis (11-202, Vol 1, 2010). AMC/A3T has named this meeting the Realistic Training Review Board (RTRB). During the RTRB the AMC/A3T staff collaborates with the SMEs on a myriad of issues. This collaboration at the RTRB provides the SMEs an opportunity to recommend changes to the Training Tables. After this evaluation, AMC/A3T staff will determine if it is necessary to adjust required training based on subjective inputs from the SMEs (M. Maloy, personal communication, April 19, 2017). The flaw with this tool is that data is subjective and if a problem exists it is usually unique to a single base or unit, making it difficult to change policy that will affect an entire MDS fleet's flying training requirements.

The other primary tool used by AMC/A3T to validate training requirements is downgrade trend data from check rides. Though Air Mobility Command, Aircrew Standardization, and Evaluation (AMC/A3V) is responsible for check ride trends, AMC/A3 staff reviews check ride trend data on a quarterly basis and AMC/A3T reviews this data at each RTRB. (M. Maloy, personal communication, April 19, 2017). Furthermore, the AFI 11-202 Volume 2, explains that each Operations Group Standardization and Evaluation office (OGV) is required to develop and maintain a trend program. As part of this trend program, each OGV is required to analyze check ride trends. Additionally, in the AMC supplement to AFI 11-202v2, AMC/A3V is required to analyze data from aircrew trends by MDS, crew position, and check ride documentation to determine if such trends are significant enough to publish an AMC Special Interest Item (SII). It is important to note that each MAF aircrew member is required to take a check ride annually and if an aircrew member is not proficient or receives a downgrade in a particular event, this data is used to develop trend data (11-202, Vol 1, 2010). If a negative trend is identified during the cyclical reviews or through AMC/A3V analysis justifying a published SII, AMC/A3T will then determine if adjusting the Training Tables is necessary (M. Maloy, personal communication, April 19, 2017). For example, if a certain number of pilots across the MAF were not proficient in takeoffs during their check rides, this could be identified during the quarterly review, the RTRB, or through AMC/A3V analysis. AMC/A3T would determine if an adjustment to the amount of required training was necessary to reverse the negative trend after its identification at the quarterly review or the RTRB. However, if the negative trend were identified solely by AMC/A3V, an SII would be published, and AMC/A3T would take notice and would then determine if an adjustment to the Training Table is required.

At first glance, this appears to be a scientific, quantitative way to determine if the required training is adequate. However, aircrew members under the spotlight of an evaluator during their check ride often perform at their very best. Therefore, check ride trends are not necessarily a reliable source of data (Grosz, 2014). This phenomenon may also explain why there are rarely any check ride trends published by AMC/A3V as SIIs. Appendix B provides a summary of all the check rides or evaluations given, and what downgrades or Q-minus' occurred from July of 2015 to June of 2016. If the numbers are totaled, 4,484 aircrew check rides occurred, and out of these 4,484 check rides, evaluators only saw fit to give 360 downgrades. Meaning on average a downgrade was given on only 8 percent of check rides over this period. Furthermore, with such a low percentage of total downgrades, it is difficult to establish trend data that correlates to aircrew-required training. Of the 360 downgrades given, only 20 of the downgrades are in direct association with events from an 11-2MDS Volume 1 Training Tables. This means less than 1 percent of check rides given across the fleet have a downgrade associated with a Training Table event. Such a low percentage makes it difficult to drive action in changing training requirements based on this data.

Subjective data from unit level SMEs and the lack of negative check ride trends make it difficult to validate current Flying Training Tables. LOSA data potentially could provide an accurate means to validate these training requirements either in conjunction with the current processes or as a separate method. LOSA is designed to collect and analyze aircrew members' performance in their natural operating environment in order to determine crew force strengths and weaknesses by placing specially trained observers aboard a sample of aircraft sorties to recognize, record and code errors. This observation and collection of data is different from an evaluation or check ride because all information linking the error to the aircrew involved is anonymous. Therefore, if an aircrew member makes a mistake or error during a LOSA observation, he or she will not receive retribution as a result of the observer recording the data. This promise of non-retribution along with LOSA's other critical characteristics help ensure aircrew perform as they would on any other sortie without an observer present (Klinect, 2005). Analyzing data that shows how MAF aircrew naturally perform on operational missions has the potential to validate the Aircrew Flying Training Tables more accurately.

Why is this important? Ensuring the process in which the amount of training required by pilots is adequate is critical, especially in a monetarily constrained Air Force. Making every dollar count is one of AF leadership's priorities (James, 2016). Finding the right balance of training is important because the MAF uses a tremendous amount of fuel to train aircrew. In the fiscal year 2015, the MAF spent upwards of $500 million on operational and maintenance flying hours (Widincamp, 2016). If aircrew receive too much training, it is a wasteful use of taxpayer's money. However, if aircrew do not receive enough training and destroy an aircraft, not only could people die as a result but the Air Force could also lose a multi-million dollar aircraft.

Problem Statement

Currently, AMC/A3T primarily relies on subjective data from unit level SMEs and check ride trend data to validate aircrew training requirements. This data may not necessarily be an accurate representation of aircrew proficiency. Therefore, the adequacy of current HQ AMC Aircrew Training Tables is in question, because the validation method AMC/A3T uses is dependent on subjective and potentially biased data. Based on current and potential future financial constraints, AMC should consider looking at additional means to validate required aircrew flying training to ensure it is in the right quantity to ensure fiscal responsibility, proficiency, and safety.

Research Question

The research question thus follows:

How can AMC develop more objective Training Tables to ensure fiscally-responsible aircrew proficiency and safety?

From this research question, two investigative questions were formed:

What can LOSA data tell us about the adequacy of current Flying Training Tables with respect to preparing pilots to operate on operational missions?

What can LOSA data tell us about the relationship between aircrew experience in terms of aircraft hours and mishap potential?

Research Objective and Focus

AMC has conducted LOSA events for every MAF MDS, but due to the time constraints to conduct this project, this research will only focus on the LOSA events conducted for the C-130J. Using the C-130J LOSA data as a sample, the researcher evaluates if LOSA data is a viable source to validate the aircrew Flying Training Tables. Furthermore, this research project will focus strictly on pilot LOSA data captured during operational C-130J missions. Though the C-130J LOSA events captured observations on additional crewmembers, the time limitations placed on the research did not allow for the analysis of multiple aircrew positions. The Literature Review will provide a full explanation of the LOSA program, and explain how the data collected during the LOSA process may be a more accurate representation of aircrew performance. If LOSA data is determined to be a reliable source for validation, this research will provide a template or methodology that AMC/A3T can apply to the Flying Training Tables across the entirety of MAF airframes and their associated crew positions.

The objective of the project is not to reduce training requirements, move more training into the simulator, determine the exact amount of training events AMC/A3T should require, or explain the relationship between aircrew experience and mishap potential. This research will attempt to use LOSA data to determine the adequacy of the C-130J flying training requirements in hopes that the result will provide AMC /A3T an approach to analyze required flying training requirements for all aircrew members across all MAF Airframes.

Methodology

This research project used data captured in the two C-130J LOSA events that occurred in 2011 and 2015. These data were used to analyze the assignment of FTLs, and the quantity of Proficiency/Basic events in the Aircrew Training Tables. To analyze the assignment of FTLs, the researcher assessed the number of errors made with respect to experience in terms of airframe hours to determine if a correlation existed. To analyze the quantity of Proficiency/Basic events in the Aircrew Flying Training Tables, the researcher compared the number of errors that occurred in an individual event from the 2011 LOSA to the 2015 LOSA to determine if the quantity of required training per each event in the C-130J Pilot Semi-Annual Continuation Flying Requirements table was adequate.

Assumptions/Limitations

This research requires some simplifying assumptions. First, the design of

AMC's LOSA database was not designed to categorize errors directly associated with events in the Training Tables. Therefore, the researcher had to review each error that occurred and make a determination if and how it related to events in the Flying Training Tables. Therefore, if the pilots made a briefing error or a checklist error that related to a particular event in the training table, it was counted as an error associated with that event, even if the pilots flew the event without error. This research assumes that briefings and checklist procedures related to the training table events are part of the event itself. The reasoning behind this necessary assumption is that even though an error in a briefing or checklist did not lead to an error in execution, these errors could lead to an error in the execution of the event under different circumstances. Secondly, a potential limitation exists with the accuracy of pilot airframe hours/experience used in the data analysis portion of this project. These data points were obtained by the LOSA observer asking the aircrew members during a LOSA observation, but to ensure aircrew remain anonymous the observer does not validate the information. Therefore, this research assumes that the aircrew experience recorded in the LOSA database is accurate. The third necessary assumption of this research is that both pilots are responsible for an error occurring during a LOSA observed flight. The reasoning behind this assumption is that two pilots operate MAF aircraft, and regardless of who is flying the other pilot is responsible for ensuring the aircraft is correctly operated. Therefore this research assumes that if an error is made it is an error by both pilots. Finally, one potential limitation of the research is the different terminology used in the Flying Training Requirements Tables and the LOSA data. The LOSA data uses the term Copilot (CP) to mean a pilots qualification that is synonymous with the term Mobility Pilot Development (MPD) pilot used in the Flying Training Tables. For the purposes of this project, the terms CP and MPD are interchangeable and refer to a pilot's qualification.

Implications

This research will potentially impact the AF by validating the C-130J Pilot Semi-Annual Continuation Flying Requirements through the use of LOSA data as a new methodology. Providing this process, it will potentially allow AMC/A3T to conduct the same validation for all aircrew members across all MDS Training Tables. This validation process could ultimately ensure that taxpayers' dollars are used wisely by optimizing training and are protected by providing aircrew enough training to be proficient, thereby reducing the potential for an aircraft mishap or loss.

II. Literature Review

Chapter Overview

This chapter evaluates the potential impact a constrained AF budget could have on AMC's flying hour program. It addresses the MAF's Class A mishap rate over the last decade and, through the use of an accident causation model, explains why this data cannot be solely relied upon. The chapter also explains the development of LOSA, its key characteristics, and how AMC implements these characteristics to ensure an accurate source of data to measure aircrew performance. Finally, this chapter discusses the Threat and Error Management (TEM) Framework.

Impact of a Constrained Budget on AMC's Flying Hour Program

The United States military requires a vast amount of energy to accomplish its mission. The largest consumer of energy in the world is the DoD (Hoy, 2008). The Air Force's usage of aviation fuel accounts for 48 percent of the energy consumed by the DoD, which is just over 50 percent of the total DoD energy costs (MAF Strategy, 2013). In the fiscal year 2007, DoD reported that the department consumed almost 4.8 billion gallons of mobility fuel and spent $9.5 billion. For every $10 increase in the price of a barrel of oil, the DoD's operating costs increase by an estimated $1.3 billion (GAO, 2008). Aircrew training is one of the primary reasons for the consumption of aviation fuel and is also directly tied to the Flying Hour Program of the Air Force.

The AFI 11-102 explains that the Air Force Flying Hour Program is a requirements-based, peacetime program which provides the necessary flying hours to train aircrews to safely operate aircraft to execute the core tasked mission. The Air

Force Single Flying Hour Model (AFSFHM) provides the methodology and processes for MAJCOMs to build their flying hour programs. The model determines the number of flying hours needed for all aircrew to achieve and maintain combat readiness. Furthermore, it must be defendable, auditable, easily understood, connected to readiness indicators, based on the train-to-task concept, and based on the requirements to train and experience aircrew to perform required Air Force Missions (AFI 11-102, 2011). AMC uses this guidance to develop its flying hour program (FHP). To meet short-term readiness, AMC budgets for enough hours to ensure all aircrew can accomplish the requirements in their specified 11 2MDS Vol 1 Semi-Annual Continuation Flying Requirements table. To meet future readiness, AMC budgets for additional hours to develop and season junior aircrew members. (Nielsen & Widincamp, 2016.) It is important to understand the two different portions that make up the AMC FHP to understand the potential impact of future budgeting constraints.

The rhetoric in the USAF Posture Statement of 2016 explains that budget cuts since 2013 have caused the AF to delay both aircraft modernization efforts and the completion of critical infrastructure maintenance. Necessary actions were taken by the AF, as a result of cuts, have increased long-term costs that will drive difficult decisions to continually balance modernization and readiness for years to come. Furthermore, failure to extend the Budget Control Act beyond the fiscal year 2018 will force the AF to only fund short term requirements (James, 2016). This means that, moving forward, the AMC FHP could potentially only provide the necessary hours to meet short-term readiness objectives as explained above and solidifies why it is important to justify the Semi-Annual Continuation Flying Requirements for each MDS in AMC.

If AMC cannot justify continuation flying requirements, and worst case conditions only provide funding for what is absolutely required, there are two potential outcomes. AMC could receive more flying hours than are required to adequately train aircrews, resulting in the funneling of money away from other necessary programs. To the contrary, AMC may not receive enough flying hours to adequately train aircrew, which could compromise both mission effectiveness and safety. If the latter were to occur, the worst case scenario could be a catastrophic accident with the loss of aircrew, passengers, and equipment. Though assigning a dollar figure to the life of a human being is difficult, it is easy to see how much the loss of an aircraft would cost. On the low end, a C-130J costs $48 million. On the high end, a C-17 costs $218 million (US Air Force, 2003 & 2015). For this reason, it is critical that analysis takes place with accurate data to determine how much training is required for the MAF to safely and efficiently provide rapid global mobility.

Accident Causation Model

Over the past decade, the MAF has maintained a Class A Mishap rate of .47 per 100,000 flying hours (Air Force Safety Center). This rate may lead one to believe that the MAF aircrew members rarely make an error and are extremely safe, and therefore the training MAF aircrews conduct on a recurring basis is adequate. On the other hand, especially in a fiscally constrained environment, one may potentially think that the training MAF aircrews perform on a regular basis is more than is required. However, making any one of these determinations based solely on the Class A Mishap rate is inaccurate. To understand why a mishap rate does not provide all the data, it is necessary to look at a graphical representation of the Accident Causation Model, commonly referred to as the "Swiss Cheese Model" shown in Figure 1.

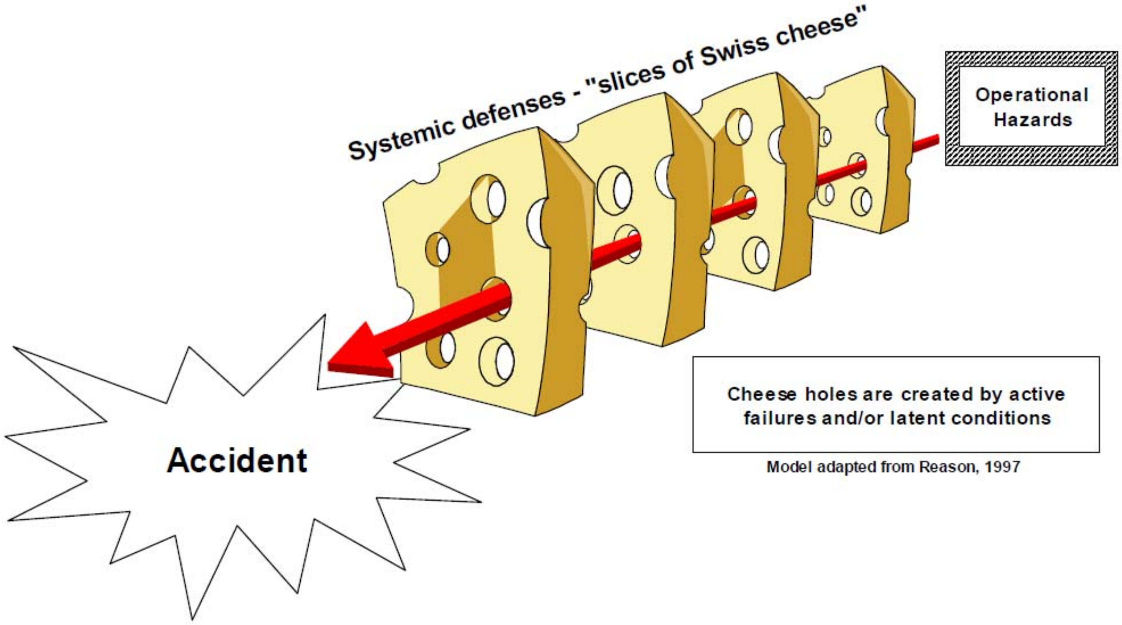

Figure 1: Accident Causation Model (Klinect, 2005)

As you can see in Figure 1 there are several layers of what appears to be Swiss cheese. Each layer represents an organizational level that contributes to the production of output in a complex system. For example, the layers in aviation could represent regulation and guidance, training, line managers, and maintenance processes (Anca, 2007). Each of these levels has built in systematic defenses. Some examples of such defenses could be notes, cautions, and warnings in an aircraft technical order, emergency training in a simulator, or quality assurance checks of an aircraft repair. Though many defenses are built into the system, there are always going to be some weaknesses. The holes in each layer represent these weaknesses. These weaknesses could be improper training techniques, inaccurate regulations, and guidance, or potentially an overstressed maintenance force. The arrow depicted in the model represents a hazard. As can be seen in Figure 1, an accident occurs only when a hazard is present, and the holes or weaknesses align properly allowing the hazard to pass through every level (Klinect, 2005). Usually, when a hazard occurs it will be caught by one of the levels' built-in defenses, and a mishap does not occur (Griffin, 2015). For this reason, the mishap rate does not provide the full picture to determine how well-trained aircrew are or how safe the system is. A scenario-based example can further explain this model.

Imagine during a flight an engine failure occurs due to a poor maintenance action that was not properly inspected before it was signed off. Fortunately, the aircrew has been trained well in handling an engine failure, and follow the proper procedures thereby recovering the aircraft without incident. This example shows that a hazard of an inadequate maintenance action was able to pass through a systematic defense in place. Though an inspection of work was designed into the system, it was not conducted properly for one reason or another. This failure would represent a hole or weakness. However, a mishap did not occur because the aircrew was well trained in handling such a scenario. Now imagine the same scenario happening but, due to budget constraints, flying hours were reduced and it was determined emergency scenario training did not need to take place because the mishap rate was very low. This reduction in emergency scenario training would create a hole or weakness in the system. Under these circumstances, the aircrew may not be well trained in dealing with an unexpected engine failure. This could potentially result in the aircrew accidentally shutting down the wrong engine, and a catastrophic mishap. In the second example, a change was made that created a weakness allowing the hazard to pass through each layer in the system and shows why relying just on a mishap rate does not provide the whole picture. Furthermore, to ensure long-term safety, it is important to identify and fix these holes or weaknesses proactively before a mishap occurs.

Line Operations Safety Audit (LOSA)

LOSA is a proactive safety program designed to collect and analyze true aircrew performance data through observation to determine crew force strengths and weaknesses (Diehl, 2005). LOSA is in use today in a significant number of airlines across the globe, as well as AMC (LOSA Collaborative). It is important to understand how LOSA developed through a partnering of industry and the human factors research field.

In 1994, Delta Airlines wanted to determine if the skills they were providing their pilots as part of their Crew Resource Management (CRM) Training program was transferring to normal line flights. Delta was conducting line check rides to make this determination. Concerned their pilots were presenting fake behaviors, thus providing inaccurate data, Delta partnered with the University of Texas Human Factors Research Project (UTHFRP). This partnership was established to develop a methodology to capture more accurate data of how pilots performed on everyday flights. Within three months observers from Delta and UTHFRP conducted over 450 observations with the promise to pilots that data would remain anonymous. These observations provided Delta with the CRM strengths and weaknesses of their pilot force as well as other data they could use to inform their training program. These results drove TWA, US Airways, and American Airlines to conduct CRM audits in partnership with UTHFRP (Klinect, 2003).

During this same timeframe, in the aviation human factors field, a movement to understand human error as it related to a complex system was taking place. As the UTHFRP conducted airline CRM audits and continued research as part of this movement, project resulted in the development of the TEM Model. UTHFRP developed the new methodology to incorporate TEM into their audit process and named it LOSA (Klinect, 2003).

In 1996 Continental Airlines partnered with UTHFRP to conduct the first audit to include TEM. This LOSA provided Continental areas for improvement across their entire organization. Continental strove to improve their system and accomplished another LOSA in 2002 to measure their success. The results of the 2002 Continental LOSA proved that LOSA was not only a methodology to provide a one-time look at strengths and weaknesses, but something that could measure the impact of changes made to the system or an organization (Klinect, 2003).

In 2004, the International Civil Aviation Organization labeled LOSA a best practice (Klinect, 2003). In 2006, the FAA endorsed the LOSA program and released an advisory circular providing US airline stakeholder's implementation guidance (FAA, 2006). More recently, AMC conducted LOSAs for all aircrew positions in several of its MDSs in 2011 and then conducted a second round to assess change in 2015 (K. Picha, personal communication, February 14, 2017). To date, AMC has captured over 2,000 observations across seven weapons systems and four different crew positions. These LOSA events have enabled AMC to correct checklist and technical order deficiencies, champion weapon system modifications, highlight crew strengths and weaknesses, and adjust policy. Although the program is relatively new to AMC, the commercial aviation sector has used it for decades and credits LOSA for helping the airline industry reach historically low safety mishap rates (Pavelschak, 2017).

Table 1: 10 LOSA Charateristics (Author, 2017)

10 LOSA Characteristics
1. Jumpseat observations during normal operations
2. Anonymous, confidential, and non-punitive
3. Voluntary crew participation
4. Trusted and trained observers
5. Joint management/union sponsorship
6. Systematic observation instrument
7. Secure data collection repository
8. Data verification roundtables
9. Data-derived targets for enhancement
10. Feedback of results to line pilots

The success LOSA has achieved in producing results is through ensuring implementation of its 10 characteristics in their entirety (Klinect, 2003). LOSA's 10 characteristics, when implemented correctly, ensure the results of the program overcome two potential concerns. Observation reactivity and low quality of data are two concerns that could potentially compromise the success of LOSA (Klinect, 2003). Observation reactivity is a condition whereby individuals act differently when they are monitored. More importantly, people being observed attempt to behave in the manner they feel the observer wants or expects them to act. Observation reactivity is present during aircrew line checks or check rides, because of the presence of the evaluator and the potential retribution involved (Klinect, 2005). To overcome observation reactivity, it is important to gain the trust of the observed aircrew, making it essential to implement characteristics 2, 3, 4, 5, 10 (See Table 1). To overcome the concern of low-quality data during a LOSA, it is essential to implement the characteristics 6, 7, 8, 9 (See Table 1) (Klinect, 2003). Below is a description of each of the 10 LOSA characteristics from an airline implementation point of view, as well as an explanation of how AMC implements each characteristic.

Jumpseat observations during normal operations

This characteristic, though not listed as one that ensures data validity or quality, provides the overall purpose of LOSA (Klinect, 2005). It highlights the importance that data collected is through observation and not evaluation. It emphasizes the difference between collecting data on strengths and weaknesses of the entire system and not conducting an evaluation of the crew. Furthermore, it explains that management and aircrew must understand this completely (Klinect, 2003). AMC's LOSA program has many partners involved but is ultimately managed by AMC Safety. The partners that assist AMC Safety in carrying out a LOSA event are AMC/A3, Air Force Reserve Command (AFRC), Air National Guard (ANG), 18 AF, 618 Air and Space Operations Center, Airlift/Mobility Wings, and the civilian contracted company the LOSA Collaborative (TLC). AMC Safety ensures that leadership and aircrew across all of AMC understand that these audits are observing the system as a whole and not conducting evaluations of the aircrew. All AMC observers attend TLC observer training, ensuring that they understand this principle or characteristic (K. Picha, personal communication, February 14, 2017).

Anonymous, confidential, and non-punitive

This characteristic highlights that trust is imperative to the success of the LOSA. If there is a lack of trust, and the crew feels their actions can result in retribution against them, there is a strong possibility the crew will not perform naturally, compromising data validity. This characteristic is also one of the safeguards built into LOSA. The observer does not collect any information that could identify the crew such as dates, times or flight number (Klinect, 2003). Through AMC Safety's management of the program, all data captured are considered safety privileged, furthering the safeguards of identification and non-retribution. Every AMC aircrew member is given safety privileged information training throughout their career. Their understanding of how LOSA information is classified builds trust with the aircrew. This trust increases the likelihood aircrew will perform naturally, ensuring the capture of valid data during the audit (K. Picha, personal communication, February 14, 2017).

Voluntary crew participation

The importance of this characteristic is to ensure the crew has the right of refusal and to honor a denial with no questions asked. This characteristic upholds the trust of the crew force and reinforces that LOSA is based on observing, not evaluating. AMC Safety coordinates with the A3 or Director of Operations for AMC, AFRC, ANG, Air Force Central Command, United States Southern Command, Pacific Air Forces and United States Air Forces Europe on a memorandum of understanding that explains what LOSA is, and its implementation strategy. This memorandum, signed by the A3s above, is provided to the aircrew before an observation and clearly states, that the program is voluntary and that the aircrew can deny at any time (See Appendix C). Furthermore, in the last five years of AMC conducted observations, LOSA has not highlighted nor caused any crew to receive retribution due to the safeguards AMC has in place (K. Picha, personal communication, February 14, 2017).

Trusted and trained observers

It is important that qualified individuals are selected to be observers. Though it is accepted to have a few instructors and evaluators, the predominance of the observers should be line crewmembers. Before observing, those selected attend training. The training consists of LOSA methodology, data recording and input, and actual observation. Furthermore, after the training observations are complete, the observers receive feedback or recalibration to ensure they understand the process and can be effective observers (Klinect, 2003). Each observer is selected by AMC Safety to meet the proper demographic requirements, and once selected TLC provides the necessary training to each selected observer (K. Picha, personal communication, February 14, 2017).

Joint Management / Union sponsorship

Management and crew union should complete a formal signed agreement stating that the LOSA is non-punitive, anonymous, confidential, and voluntary. This agreement gains trust in the crew force to ensure valid data (Klinect, 2003). AMC leadership serves as an equivalent to an airline company's management in this context, but AMC does not have an aircrew union. AMC Safety fulfills this role and, through the assurance of safety privilege protection, builds trust with the crew force. The previously mentioned memorandum of understanding found in Appendix C serves the purpose of the signed agreement (K. Picha, personal communication, February 14, 2017).

Systematic observation instrument

This characteristic emphasizes that it is necessary to have a standardized form with the necessary framework for observers to record and collect systematic factors that affect aircrew performance. This form not only makes data entry into the LOSA database easier but ensures a higher fidelity of accuracy because information is categorized and focused. (Klinect, 2003). In AMC, AMC Safety develops this standardized form which is reviewed/approved by AMC/A3. TLC provides this form to the observers for use during training and execution (K. Picha, personal communication, February 14, 2017).

Secure data collection repository

For purposes of confidentiality, it is necessary to have a trusted collection site or repository for data collected. To further gain the trust of the aircrew this characteristic recommends a third party maintains the data. Furthermore, this process ensures that data recorded during the observations can never link back to the aircrew (Klinect, 2003). AMC Safety maintains the repository and rights to all LOSA data and, as previously mentioned, safeguards or protects it with the classification of safety privileged information (K. Picha, personal communication, February 14, 2017).

Data verification roundtables

Roundtables ensure quality and valid data, and discard inaccurate data, which builds trust in both management and the crew force. Furthermore, this quality check or characteristic decreases the chance individuals will discount the integrity of unfavorable results. The roundtable panel consists of LOSA analysts and people from different parts of the airline (e.g., flight, operations, training, and safety). This board reviews all recorded threats and errors to identify inaccuracies. For example, an observer may perceive and log a procedural error for a pilot's failure to make a callout that is a technique, but there are no written procedures. Identifying inaccurate data and removing it ensures that the data that feeds the final report is accurate and valid in accordance with the organization's standard operating procedure (Klinect, 2003). Members from AMC/A3V and AMC/A3T work with analysts from TLC to verify and validate data recorded by the observers. (K. Picha, personal communication, February 14, 2017).

Data-derived targets for enhancement

After conducting data analysis, negative trends are presented. This process allows the organization to identify what they would like to improve. If the LOSA is a follow-up, then this characteristic allows for a comparison from previous LOSA results to determine if improvements occurred, and to what degree organizational changes (i.e., mitigation, training, and procedural changes) improved performance. Furthermore, this allows the organization to maintain, remove, or develop different changes if necessary to correct negative trends. This characteristic gives LOSA the ability to measure change in an organization (Klinect, 2003). AMC implements this characteristic by standing up a Safety Investigation Board with the convening authority of the AMC Commander. Allowing for the LOSA results to be further analyzed, resulting in recommendations for improvement. This process has proven instrumental in the correction of technical orders and checklists, adjustment of policy and guidance documents, identification of crew strengths and weaknesses, and recommendation of weapon system modifications (Pavelschak, 2017).

Feedback of results to line pilots

After the LOSA is complete, management and the pilots' association are obligated to communicate results to the crew force promptly. Delays will potentially give the crew force the impression that the audit produced nothing of value. It is important to not only provide the results but also to provide the improvement plan. These actions will lower resistance to LOSA thereby increasing the likelihood that observers will capture normal performance in follow-up audits. In the MAF, LOSA results and associated SIBs are available to Wing Safety offices to incorporate in their quarterly flight safety meetings (K. Picha, personal communication, February 14, 2017).

Not necessarily a characteristic but worth mentioning is the final report LOSA produces. This report serves as a reference document that captures the results of the audit and provides a comparison to previous LOSAs (if conducted) and other airline companies or fleets. The data and comparisons are represented in chart and graphical format, capturing prevalence and management of threats internal and external to the organization, prevalence of errors and flight crew management, crew strengths and weaknesses, and threat and error-linkages with undesired aircraft states (Klinect, 2003). In AMC's case, TLC provides the final report to the Safety Investigation Board. The Safety Investigation Board uses this final report as part of their overall analysis when determining recommendations for improvement (K. Picha, personal communication, February 14, 2017).

Threat and Error Management

The TEM Framework is the primary measure for LOSA that came into existence as a result of the UTHFRP participation during the initial CRM jump seat observations of Continental Airlines in 1994. Today, it continues to be refined collaboratively between airline managers, pilots, aviation SMEs and the UTHFRP (Klinect, 2005). Figure 2 shows a graphic of the TEM Framework.

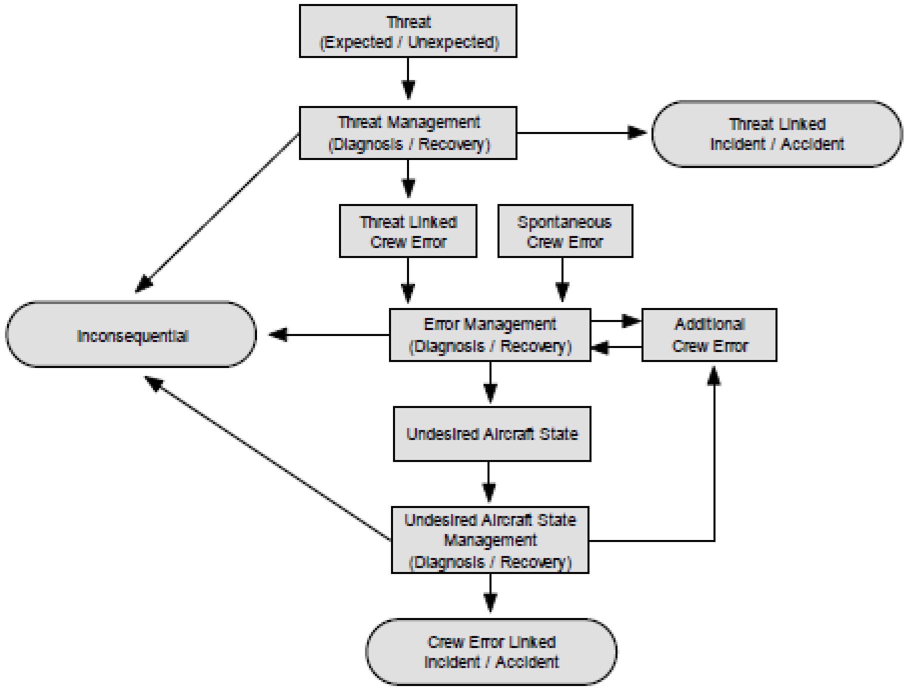

Figure 2: Threat and Error Management Framework (ICAO, 2002)

The TEM Framework assumes that threats and errors occur on every flight. In this model, a threat is an external factor the aircrew must manage, to maintain safety, which is outside their span of control. Some examples include errors by non-aircrew individuals (e.g., ATC, Maintenance, and Flight Dispatch), adverse weather, and aircraft malfunctions. Errors are aircrew actions or inactions that lead to a deviation in organizational expectations or intentions. Furthermore, the model explains that errors could potentially lead to a compromising of safety such as an altitude deviation, long landing, or an unstable approach. An error that leads to such a situation is categorized as an unintentional aircraft state (ICAO, 2002).

To understand how an undesired aircraft state could potentially happen, and to gain a full understanding of TEM it is best to walk through Figure 2. For example, if Air Traffic Control (ATC) makes an error by clearing an aircraft to an altitude below minimum vectoring altitude (MVA) (an altitude that provides an obstacle clearance of

1,000 ft. or 2,000 ft. in mountainous terrain), that would put the aircraft below the surrounding terrain it would be considered a threat. The aircrew must manage this threat (error by ATC/outside agency) to maintain safety. If the aircrew does not recognize this threat and descends the aircraft below the MVA and crashes into a mountain, it is considered a threat induced accident. However, if the aircrew recognizes the threat, queries the ATC controller, and is assigned an altitude at or above the MVA, this event becomes inconsequential. Let's assume that the process to get assigned a higher altitude by ATC took quite a bit of time and put the aircraft behind profile to arrive at the final approach fix altitude. This scenario can be considered another threat that the aircrew must manage. If the aircrew decides to make an aggressive descent and accelerates the aircraft to arrive at the final approach fix altitude faster than allowed by the aircraft manual, this would be considered a mismanaged threat that leads to an error. Now the aircrew must manage the error. If the crew recognizes the error, requests, and is cleared for a 360-degree turn to configure the aircraft for landing, the crew trapped the error, and the event becomes inconsequential. However, if the crew did not recognize that they were faster than prescribed in the aircraft manual at the final approach fix and continued the approach resulting in the aircraft being above glide slope, this would be considered a mismanaged error that leads to an undesired aircraft state. Now the crew must manage their undesired aircraft state. If the crew decides to aggressively maneuver the aircraft towards the glide slope resulting in an unstable approach causing the aircraft to land short of the threshold this would be considered a mismanaged undesired aircraft state that led to an error induced incident. However, if the crew recognized the aircraft was above glide slope requested and received new vectors for the approach this would be considered a well-managed undesired aircraft state, and the event would be inconsequential.

The examples above explored several paths an initial threat flowed through the model resulting in either an incident or an event that was inconsequential. Not provided or described in the above examples was a spontaneous crew error, an error that leads to an additional error, or an undesired aircraft state that leads to an additional error. If a scenario were to occur resulting in one of these three situations, how the aircrew manages these either positively or negatively determines the outcome, similar to the examples provided.

Summary

This research highlighted the potential impact a constrained budget would have on the AF and AMC's flying hour program. It addressed how the accident causation model provides justification as to why a low Class A mishap rate for the MAF over the last decade cannot be solely relied upon. Furthermore, this literature review gives an understanding of LOSA development, its key characteristics, and how AMC implements these characteristics to ensure an accurate source of data for aircrew performance. Finally, this chapter explained how LOSA relies upon the TEM Framework.

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III. Methodology

Chapter Overview

This research sought to evaluate the adequacy of the Pilot Semi-Annual Continuation Flying Requirements located in the 11-2C-130J Volume 1. To accomplish this evaluation, analysis of both the quantities of each Proficiency/Basic Event and the assignment of FTL's took place through the use of LOSA data. LOSA data were chosen because they represent observed and recorded aircrew performance during operational missions. AMC has conducted two LOSA events on the C-130J. These C-130J LOSA events took place in 2011 and 2015, with a total of 89 and 105 operational mission observations, respectively, around the globe. These two LOSA events represent a sample of aircrew performance during all C-130J operational missions flown in the given years, and ultimately provide an understanding of how C-130J aircrew perform on a regular basis. Through analysis of the LOSA data, the researcher attempts to make a determination about the adequacy of C-130J Pilot Semi-Annual Continuation Flying Requirements. Furthermore, this methodology provides a systematic approach to making a determination as to the adequacy of Semi-Annual Continuation Flying Requirements for all crew positions on all MAF aircraft.

Data Collection

As previously mentioned, all MAF LOSA observations are recorded in a database under the secure control of AMC Safety. Each database contains some aircrew demographic information and a record of what occurred during each observed flight. For this research the information analyzed from the database was Pilot airframe hours, Copilot

(Synonymous with MPD Pilot) airframe hours, total threats, total pilot errors, the narrative of each observed flight, and the explanation of each pilot error made. Within the database, all information was provided per observed flight, and though there is a capability to extract information, these tools did not fit the needs of this research. Therefore, the researcher analyzed each flight during the C-130J LOSA events to compile the appropriate data.

For each of the LOSA databases (2011 and 2015) an Excel spreadsheet was developed to track and compile the appropriate data. Each spreadsheet contained the following headings: LOSA Flight #, Total Threats, Total Errors, Aircraft Commander (AC) C-130J Hrs, Copilot (CP) C-130J Hrs, and a heading to represent each of the 51 Proficiency/Basic Events contained in the Pilot Semi-Annual Continuation Flying Requirements table from the 11-2C-130J Volume 1 (Takeoff, Landing, Instrument-Approach, etc.). The LOSA Flight number is the coding the LOSA Database uses to differentiate each flight, giving each observed flight a unique identifier. "Total Threats" represents the total number of threats observed on each flight. "Total Errors" represents the total number of errors observed on each flight. "AC C-130J Hrs" and "CP C-130J Hrs" represent the total number of C-130J hours the AC and CP have respectively, which was obtained verbally by the observer from the AC and the CP. After the construction of each spreadsheet, each flight from the LOSA database was analyzed to collect, record and track the proper information. The LOSA Flight Number, the Total Threats, the Total Errors, the AC C-130J hours, and the CP C-130J hours for each flight were transcribed from the LOSA database and recorded in the spreadsheet. After recording this basic data, further analysis was conducted on each observed flight to determine if errors associated with a Proficiency/Basic Event existed.

This further analysis was accomplished by reading the overall flight narrative as well as the explanation of each flight's pilot errors. If an error or multiple errors made during the flight directly correlated with a Proficiency/Basic Event, the appropriate tally was entered in the column corresponding to that event. For example, if during a flight the pilots made two separate errors on an instrument-approach, the number 2 was recorded under the Instrument-Approach column for that flight. The use of a single spreadsheet for each C-130J LOSA event (one spreadsheet for 2011, and one spreadsheet for 2015) was required because this technique provided the most efficient and accurate way to compile the appropriate data from a total of 194 observed flights. Compiling the appropriate data on one spreadsheet per LOSA event allowed for each investigative question to be answered.

Proficiency/Basic Event Quantity Validation

To answer the investigative question of, "*What can LOSA data tell us about the adequacy of current Flying Training Tables with respect to preparing pilots to operate on operational missions?*" the data containing errors associated with Proficiency/Basic Events was evaluated. A summation was conducted to determine the total number of errors related to each Proficiency/Basic Event for each year. After the total number of errors for each Proficiency/Basic Event was determined, a Proficiency/Basic Event error per flight rate was assigned to each event. A Proficiency/Basic Event error per flight rate was necessary due to the different amount of total flights observed in 2011 and 2015. This difference in total flights observed did not allow for a direct comparison to be made. Furthermore, by using the Proficiency/Basic Event error per flight rate, it will allow for comparisons to be made in future years, with other airframes and with other crew positions if future LOSA's do not contain the same number of flight observations.

The Proficiency/Basic Event error per flight rate was calculated by taking the summation of errors associated with each Proficiency/Basic Event and dividing it by the total number of flights observed for that given year (See Equation #1). Once the Proficiency/Basic Event error per flight rate was determined for each Proficiency/Basic Event, a comparison between 2011 and 2015 LOSA events was made. The data compiled in the 2011 LOSA acted as the baseline and allowed for a determination to be made if an improvement, regression, or zero change occurred when comparing the 2011 rate to the 2015 rate for each Proficiency/Basic Event. The determination of improvement, regression, or zero change allowed for a conclusion to be drawn as to whether or not the quantity provided in Pilot Semi-Annual Continuation Flying Requirements is too large, too small, or right-sized. For example, if the Proficiency/Basic Event error per flight rate for landings were greater in 2015 compared to 2011 it would show a regression in performance meaning the quantity of required events may be too low.

$$P/B\ Event\ Error\ Per\ Flight\ Rate = \frac{SUM\ of\ Errors\ for\ a\ P/B\ Event}{Total\ Number\ of\ Flights\ Observed}$$

Equation 1: Proficiency/Basic Event Error Per Flight Rate

Aircrew Mishap Potential Determination

The next investigative questions was, "*What can LOSA data tell us about the relationship between aircrew experience in terms of aircraft hours and mishap potential?*" The data containing AC C-130J hours, CP C-130J hours, Total Threats, and Total Errors were evaluated to address this question. First, all flight observations from the 2011 and 2015 LOSA events were combined. By combining all flights, it allowed for a larger sample size of AC’s and CP’s to make inference about the overall C-130J AC and CP populations. Once the data were combined, they were sorted from least to largest with respect to AC C-130J hours. This reflection then allowed for the data to be grouped in the following 500 hour experience groups: AC’s with less than 500; 500 to 1,000; 1,000 to 1,500; 1,500 to 2,000; 2,000 to 2,500; and greater than 2,500 hours. After grouping the data in this manner, each of the experience group’s total threats experienced, and total errors made were determined. Following the completion of this process for AC’s, the same process was conducted for CP’s with the exception of data grouping. The CP’s were grouped into the following 500 hour experience groups: CP’s with less than 500; 500 to 1,000; 1,000 to 1,500; and 1,500 to 2,000. AC's and CP's were broken down into 500 hour experience subgroups to determine the relationship of pilot experience and mishap potential. After determining the total threats experienced, and errors made for each group (separately for AC's and CP's), a mishap potential rate was assigned. The Mishap potential rate was calculated by dividing the total number of errors made by the total number of threats experienced (See Equation #2). This calculation was used for several reasons. First, the researcher recognized that every flight observed was not identical, and therefore a direct comparison was not appropriate. Second, it was necessary to take into account the number of threats experienced on each flight to provide a measure of how well the pilots managed the threats they faced to compare each experience group. Third, this calculation aligns with the theory behind the TEM model. As previously explained, the TEM model shows how well aircrew manage threats, determines how safe they operate, and by using this equation, it shows the mishap potential of the assigned experience groups to allow for a comparison. To interpret this rate, one must understand that a lower rate represents that aircrew managed threats better. If a group's mishap potential rate was

1, it shows that for every threat experienced the crew made an error. Consequently, if the rate was 0, it was a perfect flight and the crew did not make a mistake regardless of the number of threats experienced. It is important to note that if the mishap potential rate was greater than one, the aircrew made more errors than threats experienced, which means that they made errors not directly associated with threats or mismanaged threats, which resulted in compounding errors. Overall, computing this rate measured how well each group managed threats and allowed for a comparison to be made across each 500 hour experience group (separately for AC's and CP's) to determine the relationship between mishap potential and the number of airframe hours possessed by a C-130J pilot. The identification of this mishap potential/experience relationship can determine if the current guidance provided in the 11-2-C-130J Vol 1 with regards to FTL assignment is adequate.

$$\text{Mishap Potential} = \frac{\text{SUM of Errors Made}}{\text{SUM of Threats Experienced}}$$

Equation 2: Mishap Potential

Summary

This chapter provided the data collection process, as well as the methodologies for validating the Proficiency/Basic Event Quantities in the Flying Training Tables and determining the relationship between aircrew experience in terms of aircraft hours and mishap potential.

IV. Analysis and Results

Chapter Overview

The previous chapter explained data collection, organization, and the mathematical calculations used to make necessary comparisons to draw conclusions. This chapter will provide the results of those calculations and comparisons, and explain the importance of the outcome concerning the two investigative questions.

Results

Table 2 below shows the Proficiency/Basic Event Error per Flight Rate for each training event observed during the two separate LOSA events. In addition to the error rate for each event, the comparison of the two separate LOSAs, or change from 2011 to 2015, is shown. When comparing the two separate year's LOSA observations, the data show that fewer errors occurred per flight in the events of, Takeoff, Instrument Approaches, and Non-precision approaches, indicating a potential proficiency improvement. One may conclude that a reduction in training for these events is logical as a result of this improvement. However, it is important to look at the magnitude of improvement before making a recommendation. In the categories of Takeoff and Non-Precision Approaches improvements of 18 and 26 percent were shown respectively. The magnitude of improvements in these categories may justify a recommendation in reducing the required quantities in these training events. However, in the Instrument Approach category, an improvement of only three percent was shown, which perhaps doesn't justify a change to the required quantity of training. Similarly, in the categories of NDB/VOR and Landings, a regression was shown, but the magnitude of regression was minor, 4 percent and 5 percent respectively, justifying no change to required training event quantities. To the contrary, the data show a regression of 28 percent in the category of Precision Approaches. This magnitude of regression provides some justification to increase the quantity of Precision Approaches required per semi-annual period.

Table 2: Proficiency/Basic Event Error per Flight Rate (Author, 2017)

LOSA Event	# of Observations	Takeoff	Instrument Approach	Precision	Non-Precision	NDB/VOR	Landing	Circling
2012	89	0.36	0.76	0.25	0.48	0.00	0.13	0.01
2015	105	0.18	0.73	0.52	0.22	0.04	0.18	0.01
	Change	0.18	0.03	-0.28	0.26	-0.04	-0.05	0.00

What can LOSA data tell us about the adequacy of current Flying Training Tables with respect to preparing pilots to operate on operational missions? There is some evidence from the above analysis that in the categories of Instrument Approaches, NDB/VOR, Landing, and Circling no change is required, meaning that the current required quantities of training in these events do prepare pilots to conduct these events on operational missions. Furthermore, there is some evidence to reduce the required quantities of Takeoffs and Non-Precision Approaches required, meaning the current Flying Training Tables are potentially overtraining pilots in these areas. Lastly, the above analysis shows that in the category of Precision Approaches the current Flying Training Tables may not necessarily prepare pilots well enough to conduct this event on operational missions. Though there is justification showing that the Flying Training Tables are adequate in some events, and potentially inadequate in others, current LOSA data is not sufficient to make a determination as to the adequacy of the C-130J Training Tables as a whole. Due to insufficient LOSA data, this research cannot fully answer the investigative question.

As previously mentioned, the Pilot Semi-Annual Continuation Flying Requirements for the C-130J contains 51 Proficiency/Basic events that a LOSA could observe (11-2C-130J Vol 1, 2012). Past AMC LOSAs have not captured the full mission set for the C-130J and other MAF aircraft (K. Picha, personal communication, February 14, 2017). This is evident in that this research project was only able to analyze 7 Proficiency/Basic events from a total of 194 observed flights. As shown in the literature review, LOSA can overcome the downfall of the current flying training table validation process. That downfall being that check rides induce observation reactivity, which likely provides minimal or inaccurate data. Before a true answer to this investigative question can be made AMC's LOSA program will need to be expanded to cover the full mission set of every MAF aircraft.

Figures 3 and 4 provide data to answer, *"What can LOSA data tell us about the relationship between aircrew experience in terms of aircraft hours and mishap potential?"* Figures 3 and 4 below show a graphical representation of the calculated mishap potential compared to the amount of C-130J hours possessed by the observed ACs and CPs broken down into 500 hour experience groups.

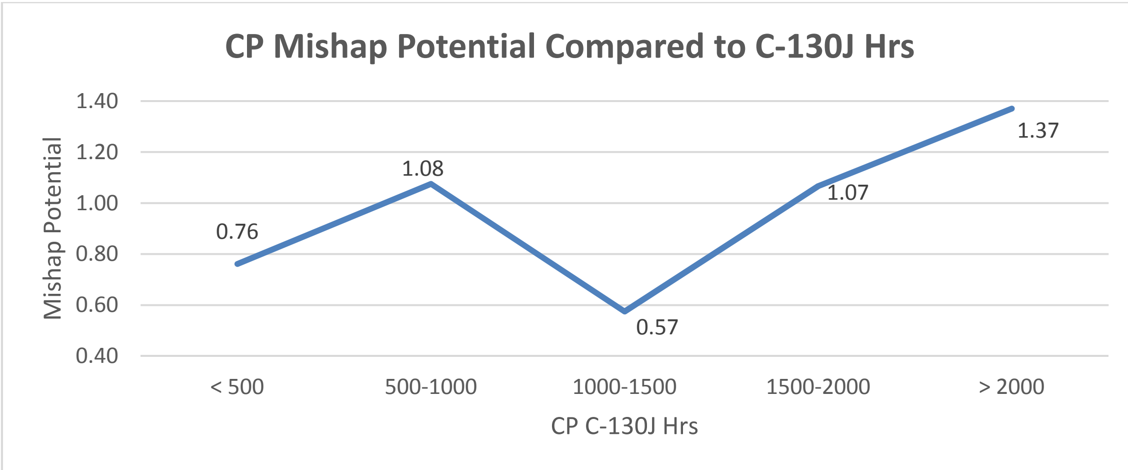

Figure 3: CP Mishap Potential Compared to C-130J Hrs (Author, 2017)

As Figure 3 above shows, CPs with less than 500 hours in the C-130J have a .76 mishap potential, or better stated for every 10 threats this experience group encounters they will make 7.6 errors. As CPs obtain between 500 and 1,000 hours, they have a mishap potential of 1.08, meaning that they slightly make more errors than the threats they encounter. The mishap potential drops to .57 as the CPs gain between 1,000 and 1,500 hours, meaning they make fewer errors than the number of threats they encounter. As CPs reach the experience categories of 1,500-2,000 hours and greater than 2,000 hours their mishap potential spikes to 1.7 and 1.37 respectively. Overall, the data show that as CPs gain experience their mishap potential tends to drop. Mishap potential continues to drop until they reach over 1,500 hours and after 1,500 hours the Mishap potential continues to climb as CPs gain over 2,000 hours of experience.

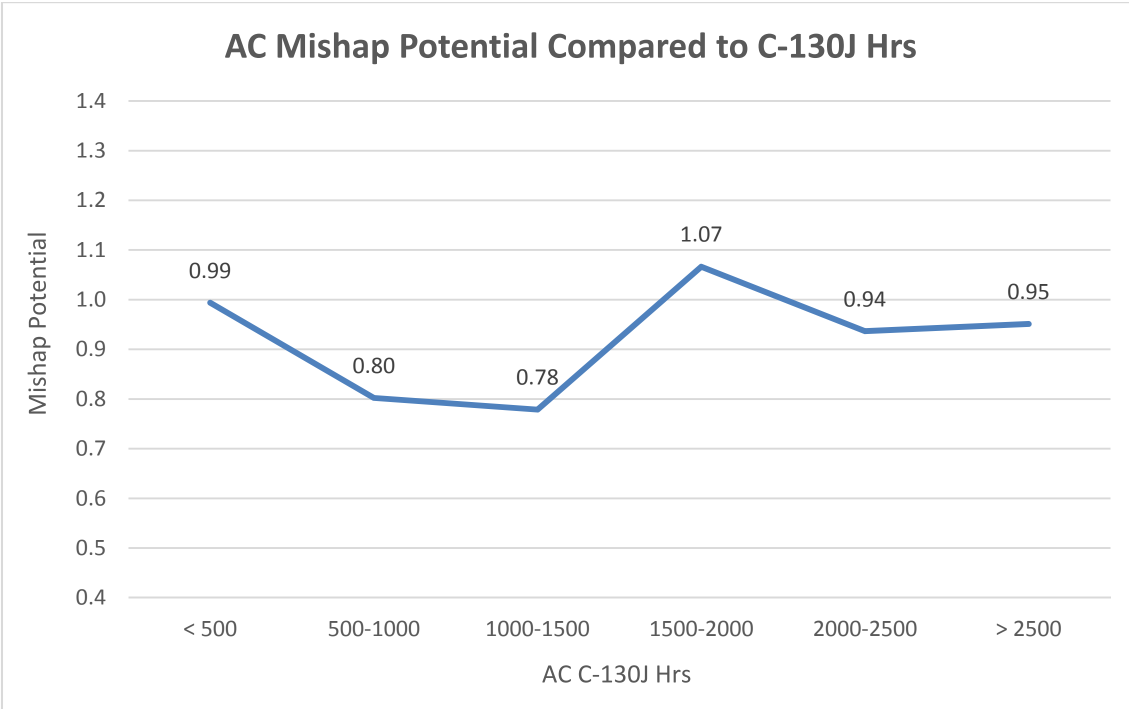

Figure 4: AC Mishap Potential Compared to C-130J Hrs (Author, 2017)

ACs mishap potential with respect to C-130J hours obtained follows a slightly different path compared to CPs. Figure 4 above shows that ACs with less than 500 C-130J hours have a mishap potential of .99 and as they gain over 500 hours and reach the categories of 500-1,000 hours, and 1,000-1,500 hours their mishap potential drops to .80 and .78 respectively. As ACs gain between 1,500 and 2,000 hours their mishap potential spikes to 1.07. The mishap potential drops to .94 as ACs reach the category of 2,000-2,500 hours and then remains relatively constant at .95 as ACs gain over 2,500 hours. Overall, the data show that as ACs gain experience their mishap potential tends to drop until they reach over 1,500 hours. After 1,500 hours ACs mishap potential climbs until they gain over 2,000 hours where the mishap potential drops again and eventually levels out.

The analysis above shows that the mishap potential for both CPs and ACs fluctuates as they gain experience in terms of hours. The important take away from this discovery is that the relationship between mishap potential and pilot airframe hours is not linear. As previously mentioned, the 11-2 C130J Vol 1 directs the Squadron Commander to assign aircrew members an FTL based on that aircrew member's experience. This direction given in the 11-2C-130J Vol 1, has the underlying assumption that as an aircrew member becomes more experienced, he or she requires less training. Evidence that this assumption exists is shown in the Pilot Semi-Annual Continuation Flying Requirements table. The FTL A column for both ACs and CPs in the table mentioned above has the least amount of training requirements per Proficiency/Basic event when compared to the other FTL columns. If the underlying assumption of this guidance were correct the graphical depiction of mishap potential compared to airframe hours for both CPs and ACs would have shown a linear downward slope as these pilots gained experience with respect to hours. For both CPs and ACs the data show that there is a group of hours where the pilots have their lowest mishap potential (1,000-1,500 hours for CPs and 500-1500 for ACs). After these windows as the pilots gain more hours their mishap potential spikes demonstrating that the underlying assumption in the 11-2-C-130J Vol 1 does not necessarily provide valid guidance.

Summary

This research sought to determine if the Pilot Semi-Annual Continuation Flying Requirements located in the 11-2C-130J Volume 1 were adequate. To accomplish this objective, two portions of the Pilot Semi-Annual Continuation Flying Requirements were analyzed. The quantities required for each Proficiency/Basic event were analyzed by comparing the total number of errors observed directly associated with each

Proficiency/Basic event across two separate LOSA periods. The assignment of FTLs was analyzed by combining all observations from the two separate LOSA periods to determine the relationship between mishap potential and pilot experience in terms of hours. The result of this analysis is that currently a solid determination cannot be made as to the adequacy of required Proficiency/Basic event quantities and that the relationship between mishap potential and pilot experience is not linear. A recommendation as to how LOSA can be expanded to provide an answer to the training event quantity question and how the understanding of the relationship between mishap potential and pilot experience applies to the assignment of FTLs will be discussed in the next chapter.

V. Conclusions and Recommendations

Chapter Overview

This section will provide the conclusion and significance of the research accomplished in this project, some recommendations for action, as well as suggestions for further research.

Conclusions of Research

This research project developed a method to evaluate the adequacy of the current Flying Training Tables for MAF aircrews. The purpose of this evaluation stems from past, current, and potential future fiscal constraints on the USAF. It is conceivable that in the future the USAF may only receive funding to accomplish what is minimally necessary. In the MAF this would mean aircrew members would only receive the training outlined in their respective flying training table. The accuracy of these tables is crucial in a fiscally challenging situation. Too much training is an irresponsible use of tax payer's dollars and too little training could result in a very costly safety mishap. That said, this research project was unable to fully validate the current Training Tables of the C-130J. Research shows that data obtained from LOSA is a better source compared to the data used in the current training table validation process, but current LOSA data from AMC's observations does not capture the full mission set of the C-130J. This shortfall in data does not allow for LOSA data to validate all of the Proficiency/Basic events in the Flying Training Tables. Though this project fell short in validating Proficiency/Basic event quantities, it did discover that the underlying assumption used to assign quantities of Proficiency/Basic events is not entirely accurate. This discovery shows that there may be some validity to adjusting the quantities of training requirements based on pilot experience in terms of hours versus on the commander's judgment of pilot experience. Recommendations to expand the LOSA data, and to incorporate the experience to mishap potential of pilots will be provided as a means of validating and ensuring adequate Training Tables in the future.

Significance of Research

Though this research project did not fully fulfill its purpose of validating the current Flying Training Tables, it provides a methodology to do so in the future. This project used data that is currently being captured by AMC as part of their proactive safety program and links it directly to the Flying Training Tables. This methodology, and more importantly, this idea has the potential to improve the adequacy of the MAF training programs. This improvement can ensure that, if a fiscally challenging situation in the future drives AMC to only accomplish what is necessary, they can make a sound decision to effectively balance tax payer's dollars with safety and proficiency when dealing with aircrew flying training.

Recommendations for Action

In AMC's next round of LOSA, the command should strongly consider improving and expanding the data in which LOSA observations capture and should reevaluate the assignment of FTL's. If these recommendations are adopted AMC will potentially have better fidelity on the adequacy of the MAF Flying Training Tables and will ensure that the aircrew members are accomplishing the right amount of training based on their experience level. The following outlines these recommendations in further detail.

The first two recommendations from this research strive to improve and expand the type of LOSA data captured during AMC observations. This project was unable to conclusively answer its first investigative question of "*What can LOSA data tell us about the adequacy of current Flying Training Tables with respect to preparing pilots to operate on operational missions?*" The LOSA events conducted by AMC only captured a small amount of flying Proficiency/Basic events. To conclusively answer the first investigative question and ultimately determine if the quantity of each flying Proficiency/Basic event is appropriate to prepare aircrew for operational missions; it is necessary for AMC's LOSAs to capture the maximum number of Proficiency/Basic events possible. After this step is in place, the data collected will provide a baseline. Then, a subsequent LOSA data can be measured against this baseline to determine if an improvement, regression, or no change has occurred. Going through this process will allow AMC to determine if the quantities they prescribe in the Flying Training Tables are adequate.

The second recommendation to improve LOSA data strives to ease the collection and organization of data dealing with errors directly associated with Proficiency/Basic events. As mentioned in the methodology the data collection portion of this project was accomplished by the researcher analyzing every error on every LOSA observed flight. This was very time consuming and would be almost impossible for an individual on the A-Staff to accomplish successfully while at the same time balancing their other responsibilities. AMC should consider adding something to the LOSA observer's data collection sheet. This addition should have a list of every possible Proficiency/Basic event that can be observed, allowing for the observer to assign the error to the exact Proficiency/Basic event in which the error is associated. By accomplishing this tweak, collection and organization of the necessary data will be more efficient, allowing for an individual on the A-staff to simply analyze the data. Another option is to conduct this analysis as part of the SIB process. If the analysis occurs during the SIB, making sure the data are easy to work with is crucial. If the data are not easy to work with, those individuals on the safety board will not be as efficient and could potentially not be able to capture other areas for improvement from the LOSA data. By incorporating these recommendations, data will be captured on every basic/proficiency event in an organized fashion. This process could provide a means to validate if the current quantity of each Proficiency/Basic event in the Flying Training Tables is appropriate to prepare aircrew for operational missions.

In addition to expanding and improving data collected during LOSA observations, AMC should also consider incorporating what was discovered in this research project. As shown in Figures 3 and 4, the relationship between pilot C-130J hours and mishap potential is not linear. As previously stated, this means that as a pilot in the C-130J gains more experience in terms of hours, they do not necessarily make fewer errors. This discovery shows that the assumption embedded in the assignment of FTLs in the 11-2C-130J Volume 1 is not necessarily accurate. Therefore, it is recommended that the mishap potential with respect to airframe hour experience relationship be considered when assigning FTL's in the C-130J, instead of a pure judgment of experience. In addition to recommending this change for the C-130J, the discovery in this research makes it plausible there is a similar phenomenon in other MAF airframes. Therefore, it is recommended that AMC uses the process outlined in this project to analyze other airframe's LOSA data to determine if the same relationship exists. If this is the case, then it is further recommended AMC make the same Volume 1 philosophy adjustments to those airframes. These recommendations, if complied with, have the potential to ensure that as a pilot gains more hours, their required quantities of training can be adjusted appropriately to balance proficiency and safety, resulting in the appropriate use of tax-payers dollars.

Recommendations for Future Research

This research focused solely on data captured during LOSA observations to determine if current Flying Training Tables were adequate in preparing aircrew for operational missions. LOSA is one of three AMC proactive safety programs which collects data on aircrew performance. The other proactive safety programs used by AMC are ASAP and MFOQA. ASAP collects data through self-reporting of errors in hopes to share lessons learned across the aircrew force to prevent mishaps. MFOQA collects data from aircraft onboard sensors that is analyzed to identify negative operating safety trends. Both of these programs collect data through de-identified means similar to LOSA, which explained in this research provides more viable data compared to data collected during check rides. Though AMC currently uses these programs to identify negative safety trends, these data are not tied directly to the Training Tables. For this reason, further research can be conducted using the data from either or both ASAP and MFOQA in a similar fashion to this project. Performing this recommended research will help further the understanding of what occurs naturally during flying operations and to determine if current Training Tables are adequate.

In addition to looking into other sources of data to validate the MAF aircrew training program another area for further research is to determine why the relationship between pilot experience and mishap potential is not linear. This project focused solely on aircrew training, but there may be something outside the training program that could have an effect on pilot performance. As an officer gains more experience in an aircraft they usually are given jobs that require more time and effort on things outside the focus of flying. Performing research to determine the impacts of increased officer responsibilities (not related to flying) on pilot performance could potentially help the AF balance the workload of its pilot force, making training more focused and effective.

Summary

Budget cuts since 2013 have driven the AF to continuously balance modernization with readiness, and future fiscal challenges could force the AF to fund only what is absolutely necessary in the short term. This current and future fiscal challenge the AF faces makes it more important than ever to use tax payers dollars responsibly. The AF Audit Agency highlighted that AMC's Semi-Annual Continuation Flying Requirements are not analytically justified, showing that it is uncertain how adequate the Flying Training Tables, in their current state, are to prepare aircrew to operate. AMC captured LOSA data, if expanded, has the potential to more accurately validate the quantities of Proficiency/Basic events prescribed in the Semi-Annual Continuation Flying Requirements. Furthermore, AMC captured LOSA data shows that pilot experience does not necessarily equate to a smaller mishap potential. Expanding AMC's LOSA data to capture the full mission set of every MAF aircraft and incorporating the analysis of each MAF aircraft associated aircrew experience to mishap potential ratio could pay dividends in the future if the worst case fiscal challenge is faced. Accomplishing these things provide AMC the possible means to ensure MAF Aircrew are not over or under trained via a validated set of training requirements in the future to ensure fiscally responsible, safe, and proficient exercise of rapid global mobility.

Appendix A: Excerpt from AFI 11-2C-130JV1

Code	Event	Aircraft Commander					MPD Pilot				Creditable in WST			
	Proficiency /Basic Events	A	B	C	E	CUR	A	B	C	CUR	%	Maintain	Regain	Notes
B014	Cat I Navigation Sortie										100	Yes	Yes	2, 4, 6, 9
G240	CRM Simulator										100	Yes	Yes	2, 14
G250	Pilot Simulator Refresher										100	Yes	Yes	2, 14
M010	Proficiency Sortie	1	1	1			1	2	2		100	Yes	Yes	1, 4
NV47	NVG Takeoff	2	4	6			2	2	2		100	Yes	Yes	4
NV48	NVG Landing	2	4	6		Q	2	2	2	Q	100	Yes	Yes	4
NV80	NVG Instrument Approach	1	1	2			1	1	2		100	Yes	Yes	4
P020	Takeoff	8	10	12	6	M	8	10	12	M	100	Yes	Yes	1, 4
P028	Right Seat Takeoff						2	3	3	Q	100	Yes	Yes	4, 13
P029	Left Seat Takeoff						2	3	3	Q	100	Yes	Yes	4, 13
P070	Instrument Approach	6	8	12	6	M	6	8	12	M	100	Yes	Yes	1, 4
P071	Head-Down Approach	2	2	3	1		3	3	4		100	Yes	Yes	4
P080	Coupled Approach	1	1	1	1		1	1	1		100	Yes	Yes	4

Appendix B: Q-Minus Summary

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AMC AF IMT 3862 TOP-3 Q-MINUS SUMMARY BY MDS, QUARTER (ACTIVE DUTY)

ROLLING 4-QUARTER HISTORY; ALL EVAL TYPES, ALL CREW POSITIONS; SOURCE: GTIMS

- 3862 Area Highlighted When 3 or More Consecutive Per Quarter or MDS
  - Directives & Pubs
  - Use of Checklists

MDS	2Q/CY16	1Q/CY16	4Q/CY15	3Q/CY15
C-17	Total Evals: 603 1. Use of Checklists: 16 2. Directives & Pubs: 12 3. Airmanship/SA: 11	Total Evals: 695 1. Directives & Pubs: 18 2. Use of Checklists: 13 3. Airmanship/SA: 11	Total Evals: 651 1. Directives & Pubs: 15 2. Use of Checklists: 10 3. Tie Down/Restraint: 9	Total Evals: 681 1. Airmanship/SA: 9 2. Use of Checklists: 9 3. Crew Coord/CRM: 9
C-130J	Total Evals: 146 1. Other EPs: 7 2. Crew Coord/CRM: 7 3. Use of Checklists: 6	Total Evals: 125 1. Directives & Pubs: 8 2. Use of Checklists: 8 3. Enplane/Deplane: 4	Total Evals: 101 1. Directives & Pubs: 4 2. Preflight Inspection: 2 3. Weight & Balance: 2	Total Evals: 90 1. Directives & Pubs: 4 2. En Route Formation: 4 3. Airdrop Accuracy: 3
C-5M	Total Evals: 127 1. Directives & Pubs: 5 2. Msn Prep/Planning: 3 3. Aircraft Limitation: 3	Total Evals: 115 1. Directives & Pubs: 2 2. Landings: 2 3. Use of Checklists: 2:	Total Evals: 134 1. Directives & Pubs: 4 2. Landings (full Flap): 2 3. Msn Prep/Plan/Perf; 2	Total Evals: 130 1. Directives & Pubs: 4 2. Load Plan/Inspection: 3 3. Special Interest Items: 3
KC-10	Total Evals: 163 1. Directives & Pubs: 5 2. Syst Ops Knowledge: 5 3. Cargo Load/Unload: 3	Total Evals: 194 1. Use of Checklist: 7 2. Directives & Pubs: 5 3. Syst Ops Knowledge: 4	Total Evals: 211 1. Directives & Pubs: 7 2. Airmanship/SA: 2 3.Preflight: 2	Total Evals: 174 1. Syst Ops Knowl/Limits: 6 2. Performance: 5 3. Eng Out GA/EFTOC: 3
KC-135	Total Evals: 307 1. Directives & Pubs: 12 2. Airmanship/SA: 5 3. Circling Aprch: 3	Total Evals: 305 1. Directives & Pubs: 7 2. Use of Checklist: 5 3. Landing (30-40 Flap): 3	Total Evals: 274 1. Use of Checklist: 4 2. Comm Procedures: 4 3. Directives & Pubs: 3	Total Evals: 263 1. Directives & Pubs: 6 2. Comm Procedures: 4 3. Mission (Tanker AAR): 3

UNCLASSIFIED

As of 1 Jul 2016; OPR AMC/A3V

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Appendix C: LOSA MOU

DEPARTMENT OF THE AIR FORCE
HEADQUARTERS AIR MOBILITY COMMAND

COMMAND MEMORANDUM OF UNDERSTANDING FOR LINE OPERATIONS SAFETY AUDIT (LOSA)

MEMORANDUM OF UNDERSTANDING
AMONG
THE DIRECTOR OF OPERATIONS, AIR MOBILITY COMMAND,
THE DIRECTOR OF OPERATIONS, AIR FORCE RESERVE COMMAND,
THE DIRECTOR OF OPERATIONS, PACIFIC AIR FORCES,
THE DIRECTOR OF OPERATIONS, AIR NATIONAL GUARD,
THE DIRECTOR OF OPERATIONS, US AIR FORCES IN EUROPE,
THE DIRECTOR OF OPERATIONS, US AIR FORCES SOUTHERN,
THE DIRECTOR OF OPERATIONS, US AIR FORCES CENTRAL
FOR COMMAND RESPONSIBILITIES AND SCOPE OF
AMC'S LINE OPERATIONS SAFETY AUDIT (LOSA) PROGRAM

1. **Subject.** This Memorandum of Understanding outlines an agreement between AMC and AFRC, PACAF, ANG, USAFE, USAFSOUTH and USAFCENT for the sustainment of AMC's Line Operations Safety Audit (LOSA) program. Analysis and lessons learned will be shared with affected MAJCOM leadership and mobility aircrew. Recommendations will be incorporated into operational procedures as required. Data may be shared with sister services and aviation industry partners in the future.

2. **Purpose.** LOSA is a time-proven civilian aviation initiative embraced by governmental regulators, corporate leadership and labor unions alike. The purpose of AMC's LOSA program is to increase the overall safety of daily MAF operations and optimize the system to work more safely and efficiently. At AMC, LOSAs will work in concert with the Aviation Safety Action Program (ASAP) and Military Flight Operations Quality Assurance (MFOQA) programs to produce a proactive safety culture. Aircrew participation and confidence in the safety process is absolutely essential for program success. Therefore, LOSA observations will be conducted in a strictly anonymous and non-punitive manner - there will not be any crewmember/leadership reprisals based on the observations.. Aircrews face numerous impediments to safe and efficient mission accomplishment - these problems are characterized as "threats" to the operation. LOSA will contribute to this proactive approach to safety by seeking to discover the threats aircrews face, document common errors, and capture best practices employed by crews to mitigate and trap those threats and errors. With this information, AMC can make changes to training, procedures, hardware and other programs to make the MAF system safer and more efficient for everyone.

   Scope. AMC's LOSA program will take place worldwide, on all AMC-owned or gained aircraft including air-land, air-refuel and air-drop missions in and outside of any AOR. The LOSA program utilizes trained observers to document "natural crew performance" on a non-interference and non-jeopardy basis. These proactive audits will record threats, errors, hazardous situations and high-risk activities not identified by other methods prior to an actual mishap. The LOSA program thoroughly trains and monitors the AMC crewmembers who act as

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observers during the typical 6 to 8 week observation period for each MDS. These observation periods will be coordinated well in advance. The de-identified observation reports will be submitted to an independent contractor who will conduct an analysis of the data and provide an out-brief to MAF leadership. AMC anticipates that the LOSA program will be an on-going safety tool and will re-coordinate this MOU as necessary.

3. **Understandings, Agreements and Responsibilities.** During LOSA observation periods, observers will be granted complete access to observe flight deck and cabin operations on all AMC aircraft in Mission Essential Personnel (MEP) status. The observers, as coordinated by AMC/A3V, will be granted MEP status on all 618 AOC TACC-controlled flights and will have MEP letters coordinated with other MAJCOMs/Component Commands (AFCENT, AFSOUTH) for their controlled missions. Observers will never displace primary crewmembers and will coordinate their observations in advance with the aircraft commander, and when possible, the local MAF command and control element. These observations are non-punitive and no jeopardy; no personal identifiable aircrew information will be recorded. The observations are strictly on a volunteer basis and the Aircraft Commander, or operational leadership (i.e. WG/CC, OG/CC or Sq/CC) may deny or terminate a planned observation at any time, for any reason. The intent is to capture "natural crew performance" and if extenuating or ORM circumstances inhibit a quality observation, it will be rescheduled on another mission.

4. **Effective Date, Periodic Review, Modification and Termination.** This agreement is effective on the date of the last signature and will remain in effect until rescinded, reviewed or suspended. This agreement may be cancelled at any time by mutual agreement with at least 30 days advance written notice. Modifications will be processed through AMC/A3.

5. **For LOSA Observations Occurring in USAFCENT AOR Only.** Observers will meet with the EOG/CC for an in-brief before commencing LOSA observation flights in USAFCENT AOR. Observers must have all appropriate theater-specific and MEP training and requirements completed including current AF Form 1042, High Risk of Isolation training and DD Form 1833.

//SIGNED//
FREDERICK H. MARTIN, Brig Gen, USAF
AMC Director of Operations

//SIGNED// 1 MAY 2011
JAN-MARC JOUAS, Maj Gen, USAF
PACAF Director of Operations

//SIGNED// 11 MAY 2011
WALLACE W. FARRIS, Jr, Maj Gen, USAF
AFRC Director of Operations

//SIGNED// 20 APR 2011
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USAFSOUTH/12AF Director of Operations

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DONALD A. MCGREGOR, Col, USAF
ANG Director of Operations

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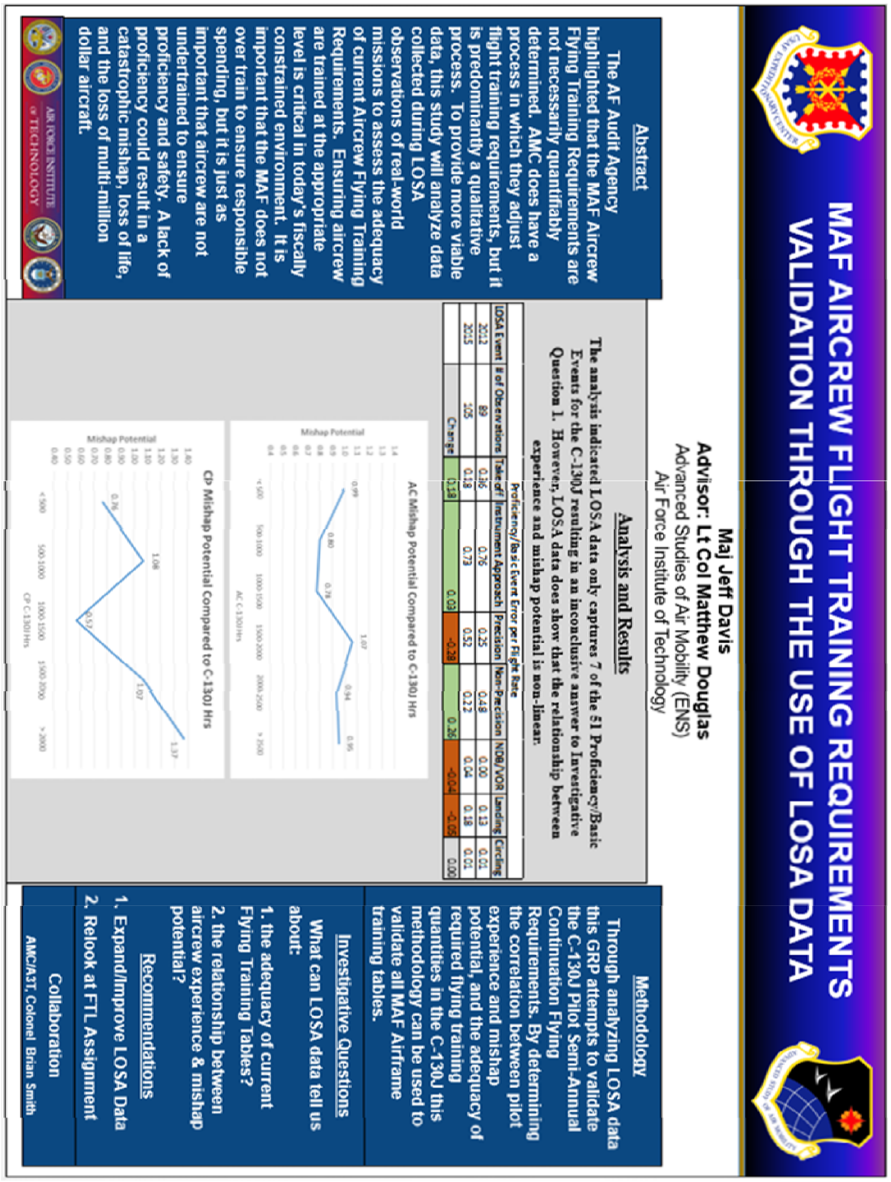
JACK B. EGGINTON, Maj Gen, USAF
USAFE Director of Operations

//SIGNED// 29 APR 2011
SAM J. SHANEYFELT, Col, USAF
USAFCENT Director of Operations

Date Approved: 11 MAY 2011

Appendix D: Quad Chart



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14. ABSTRACT
The AF Audit Agency highlighted that Mobility Air Forces aircrew flight training requirements are not necessarily quantifiably determined. Although AMC does have a process in which they adjust flight training requirements, it is predominantly qualitative. The primary process for adjusting training requirements relies on input from the line units and aircrew check ride trends. However, in the recent past, there have been very minimal check ride trends present, making this source of input into the process potentially nonviable. To provide more viable data, this study will analyze data collected during Line Operations Safety Audits (LOSA) during real-world missions to assess whether or not current aircrew flying training requirements are at appropriate levels. Ensuring aircrew are trained at the appropriate level is critical in today's fiscally constrained environment. It is important that the MAF does not overtrain to ensure responsible spending, but it is just as important that aircrew are not undertrained to ensure proficiency and safety. A lack of proficiency could result in a catastrophic mishap, loss of life, and the loss of multi-million dollar aircraft.

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