CREW RESOURCE MANAGEMENT DEVELOPMENT TRAINING FOR THE NON-INTEGRATED FLIGHT CREW OF THE CIVIL AIR PATROL

By

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NOMENCLATURE

A/C	Aircraft Commander
AFB	Air Force Base
AFRCC	Air Force Rescue Coordination Center
AGL	Above Ground Level
AOO	Air Operations Officer
AOPA	Aircraft Owners and Pilots Association
ATC	Air Traffic Control
CAP	Civil Air Patrol
CAPM	Civil Air Patrol Manual
CAPR	Civil Air Patrol Regulation
CD	Civil Defense
CN	Counter Narcotics
COL.	Colonel-U.S. Military Desgnitation
CRM	Cockpit/Crew Resource Management
DF	Direction Finding Equipment
DOT	Department of Transportation
ELT	Emergency Locater Transmitter
FAA	Federal Aviation Administration
IFR	Instrument Flight Rules
IMC	Instrument Meterological Condiditons

MC	Mission Coordinator
NTSB	National Transportation Saftey Board
OKANG	Oklahoma Air National Guard
NASA	National Aeronautics and Space Administration
SAR	Search and Rescue
SAR/EX	Search and Rescue Exercise
TQM	Total Quality Management
USAF	United States Air Force
USAFAUX	United States Air Force Auxiliary
VFR	Visual Flight Rules

Chapter I

Introduction

Statement of the Problem

Safety of flight has always been paramount for those who fly as well as those on the ground. The complexity of Civil Air Patrol's mission leaves large breaches where potential accidents could occur. By having a non-integrated aircrew the chances for mishaps is greatly increased. With this in mind, determination of a way to train aircrews to better manage the flight environment is a necessity. The aircrews must then be able to take that training they will receive and create a safer, more efficient flight.

A reliable sampling must be made of flight and support participants, to determine valid concerns and possible enhancements. Taking this data and turning it into an effective training tool, whereby aircrews will become more aware of theirs and others actions and able to increase the safety of flight and mission effectiveness.

Background

A significant way to decrease the chance of accidents and improve mission effectiveness for civilian and military flights has been through the use of Cockpit Resource

Management (CRM). The term Cockpit or Crew Resource Management was coined sometime in the mid 1970's when the National Aeronautics and Space Administration (NASA), Ames Research Center conducted studies on crew management tools. This concept has grown and is incorporated in many of the worlds flight operations as an effective management tool. However, The Civil Air Patrol (CAP) at this time has not implemented such a tool.

The Civil Air Patrol is a United States Air Force (USAF) Auxiliary (USAFAUX) that is tasked to perform air and ground search and rescue (SAR) missions. CAP is made up of volunteers that are trained to perform a wide array of activities. While search and rescue missions are the primary mission functions, the Civil Air Patrol also performs numerous other missions such as: disaster relief for local and state emergencies, Military Support of Civil Defense (MSCD), Joint Key Assets Protection (JKAP), disaster relief missions for state and local, Counter Narcotics, Customs searches, and low-level training route surveys/area orientation, just to name a few. Compounding to the already challenging flying of the mission parameters, is the element that flight altitudes are between 500 feet and 1,000 feet Above Ground Level (AGL). While low altitude flying challenging, the idea of having an in-flight emergency

leaves no time for hesitation. While CAP also conducts ground operations as well, this document will consider the aspect of flight operations only. Air Force Rescue Coordination Center (AFRCC), Langley Air Force Base (AFB) Virginia, directs each Wing to perform designated rescue missions. Wings are representative of the physical boundaries of each state, ie. the Oklahoma Wing lies with the boundaries of the state of Oklahoma. When a Wing is alerted to a mission they in turn alert appropriate rescue teams located closest to the probable crash site, or Emergency Locator Transmitter (ELT).

Civil Air Patrol operates a varied selection of single engine high wing aircraft to perform missions. The high wing allows for easy visibility of the ground and good aircraft stability. Most Wings operate modified Cessna 172's, 182's, 206's and T-41's. These aircraft are modified with larger horsepower engines and increased communication equipment. Some aircraft with in the Oklahoma Wing are equipped with video camera relay and airborne communication repeater. While still basic the added equipment increases the required knowledge base and increases work load. Internal crew configuration still remains the same. Two individual seats up front, behind the aircraft controls, for the Aircraft Commander and observer. One bench seat is positioned behind

the pilot and observer for the scanner.

Most missions carry a crew compliment of three officers, however, there are occasions where a crew will only consist of two members. These flight positions include: (1) mission pilot, (2) mission observer, and (3) mission scanner. For flights of two crew members there are just one pilot and one observer. In either crew configuration, non-integration is a given. Non-integration reflects the point that all three crew members perform separate duties independent of each other. Where as today's civilian an military's cockpits have a pilot, and copilot to assist in flying duties. By having another crewmember assist the other, crew "integration" occurs. To articulate on non-integration, the three flight positions must be examined.

The mission pilot acts as the Aircraft Commander (A/C) and is directly responsible for the safety of the aircraft, crew, and fly the mission as briefed (CAPM 50-15, 1983, p. 42). The pilot is also charge with all flight, navigation, and communication operations. The A/C is positioned in the left front seat for a commanding view of flight instrumentation. The foremost duty of the pilot is to fly the aircraft. The Aircraft Commander has the power to delegate duties to other crewmembers. During an emergency situation the single pilot could very easily become task

saturated. This is where Crew Resource Management (CRM) plays a vital role, the training of other aircrew members to be of assistance when needed.

Sitting up front with the pilot, in the right seat, is the mission observer. The title of observer is misleading to an extent. Duties of the observer are: (1) look for search objective, (2) compile information concerning flight, (3) plot observed radiation level on Civil Defense (CD) missions, (4) and maintain flight log listing all observations (p. 43). It is frequent that the observer is a qualified CAP and civilian pilot, performing observer duties. This fact is very important, in that the observer would have valuable piloting experience in the event of an emergency. Observers are a valuable asset in their own duties, but could even improve the overall safety of flight.

The third crewmember on flights is the mission scanner. This individual sits in the back seat of the aircraft behind the pilot. The scanner is so located to provide a person that can scan at the ground from the left side of the aircraft. Although the pilot is located on the left side of the aircraft, their job, as stated, is to fly the aircraft not look for search targets. A scanners job is quite simple, (1) look for search objective and (2) report all observations (p. 43). Being located in the back seat does

not afford opportunities to physically help in aircraft control manipulation, but are a vital asset of observation and experience.

What is trying to be accomplished is integration of the three crew members so they work together through effective communication. CAP aircrews exist in a non-integrated crew environment because they perform separate tasks with little interaction. This is where the "concept" of Crew/Cockpit Resource Management (CRM) comes into creation. The whole purpose of CRM is for aircrews to recognize their limitations and how they can over come these by using available resources and better aircraft management. "One of the most striking developments in aviation safety during the past decade has been the overwhelming endorsement and widespread implementation of training programs aimed at increasing the effectiveness of crew coordination and flightdeck management." (Wiener, Kanki, and Helmreich, 1993) Although the civilian and military aviation communities are throughly engaged in CRM training, CAP has not taken as definite course. It is at this time that CAP has begun to look at the possibility of a CRM training program.

Unlike using the term Crew Resource Management, Cockpit Resource Management teaches crews to use all available resources. While in flight there are many resources provided

by various sources. In times of emergency many of these sources are neglected as seen in many accident reports and NASA's Accident Reporting Program. Help from the Federal Aviation Administration's (FAA) numerous facilities and other individuals are just a radio call away. Not limiting ones self to the radio, there are also numerous printed guides available. CRM tries to guide aircrews in the manipulation and use of all the different and available resources.

Purpose of the Study

First determination must be made as to where the Civil Air Patrol currently is, develop and institute a CRM training program to ameliorate flight safety and mission effectiveness. There are however, several factors that must be taken into account before development and implementation of training. (1) All members are volunteers and have other work schedules and commitments. (2) Not all aircrew members have been exposed the CRM concept yet and my have anti-implementory ideas. (3) Crews are spread across the state and will either have to travel to attend classes, or individuals will have to take the classes to them. (4) CAP has a limited budget that is currently being scrutinized for possible budget cuts by Congress and the Air Force. All these factors will have an adverse affect on how training

curriculum is developed and indoctrinated.

Importance of the Study

By training aircrews in the fields of good crew communication and coordination, safer and more effective missions should result. Any steps that can be taken to make one flight safer and more effective could literally mean whether or not someone lives or dies. CRM training will try and install good concepts that will always be used by all aircrews and raise the consciousness of keeping themselves safe while trying to perform their mission. Training will also expose crews to the vast resources of help and experience both inside and outside the cockpit.

Scope and Limitations

While there are numerous uses for the concept of CRM this study will stay within the flight environment of CAP missions. However, to act upon the flight environment one must also look at pre and post flight preparations of the activity. Preflight briefings play a critical role in how the crew expects the mission to be performed. It is at this time when procedures and concerns should discussed by all crew members until there are no questions. At the conclusion of the mission the postflight brief should be accomplished, and in it discuss discrepancy areas that will increase awareness for the next flight. Due to the vital nature of

the pre and postflight briefings, this must also be targeted as crucial areas for improvement.

A crucial limiting factor with this study is the element that all members volunteers. It therefore becomes very difficult to work around schedules and transportation when trying to work with everyone within the state of Oklahoma. Being volunteers and very different backgrounds training has to begin broad enough to accommodate all aircrew positions, unlike a several of CRM programs that specifically focus on pilot training. It was discussed earlier, but there are monetary constraints that the Air Force has placed upon the organization that must be adhered to. While one may develop an elaborate training curriculum that would undoubtedly accomplish CRM training, it could well be out of the allotted budget.

While the Federal Aviation Administration is still focused on second generation CRM, discussion hereon will be focused on third generation CRM. Second generation observes a problem and uses an accident example to demonstrate a point then moves on. Now, in the third generation, a problem is addressed, possibly an accident quoted, but then discussed. A prolonged examination of why the problem arose and preventative measures. By such an in-depth examination, aircrew members begin to make self determinations about the

events and how they would have handled a similar situation. This is the level of training the Civil Air Patrol needs to be at. The ability to recognize, observe, communicate, delegate, and coordinate.

Chapter II

Literature Review

Civil Air Patrol Literature

The specific nature of Civil Air Patrol does not provide for previously written material about Cockpit Resource Management. There has been, however, many published titles on the subject of CRM as it has progressed since the mid 1970's. While there are no direct titles associated with CAP, other sources have provided valuable guidance in many areas of the study.

Although being a large organization, the Civil Air Patrol is not widely known. Even in the aviation community few actually know the endeavors of the CAP. For this reason there has been little written in either civilian or military communities. Since the start of this study there have been official letters written by Oklahoma Wing Commander Colonel Walter Schamel addressing the topic of CRM and implementation.

Literature in the United States Air Force

There have been many studies performed by and for the U.S. Air Force regarding Crew and Cockpit Resource Management. These studies have ranged from very broad, wide scale spectrum, to narrow channelized studies. From all the information collected and implemented in the Air Force community, little has bled over into the CAP. Civilian companies, such as CAE-Link Corporation, produce training manuals and send qualified

instructors to military units to instruct CRM classes. The Oklahoma Air National Guard (OKANG) used CAE-Link Corporation to teach their inductory CRM class to aircrews. With the plethora of information available to the civilian and military markets, it becomes amazing that training was not accomplished for the CAP earlier.

With the great supply of personnel the Air Force has, numerous studies and tests were performed to develop training devices for the different types of aircrew the they support. Early records showed the start of ergonomics and the discovery of man/machine integration in the late years of World War II. Most improvements were made to equipment as technology erupted, decreasing the cause of most accidents from mechanical malfunction to human error. Realizing that humans were making majority of the errors, research then turned to "fixing" the new human error problems. After the implementation of CRM accident rates did drop but still exist.

Being the "Parent" organization for CAP, the Air Force has not disseminated their information of Cockpit Resource Management. Why this information was not passed down or requested is unknown. Communications with Air Force flight crews have revealed that their materials used for CRM training were beneficial. As with anything, there were isolated individuals that thought the materials were poor and the process and idea were "A waste of time and resources". For the majority, CRM training materials have proven to be beneficial and rewarding. Using these already published and tested materials is a way for CAP implementation of CRM. These sources that the Air Force are using, Must be slightly edited before being used by CAP. There are enough differences between the two organization that regulation interpretation and mission orientation

would cause small problems for the Civil Air Patrol.

The Civilian Community

While the Air Force has government funding, the civilian community, pedicular the Air Carriers, have made astounding progress on their own. Considered by many to have "started behind", civil air carriers have great training programs, and have extended their training programs to other air carriers. The airlines have taken CRM to the point where thousands of dollars are spent on each crew member to undergo classes and simulator training.

Many books have been written by those that have researched the crew training problems extensively and developed elaborate training curriculums. Although being around since the mid 1970's and a hot topic among the flying community, there are not great numbers of works that have been published for the population. As more universities develop aviation programs, and thus create a greater demand for related reading literature, it is found that a majority of books in print are for the classroom. Very few recreation books on the topic have been published. One must find books on the subject in places that specialize in educational texts. Most of the recently published books examined, present material in a third generation CRM context. While the FAA and even some Air Force literature approaches CRM from a second generation stand point.

Any reference used in current training models need to be third generation. Why this push for third generation? Not only the fact that they are the most recent, but they are a different concept in training. As mentioned earlier, but to reiterate, third generation delivers the message of prevention through understanding and demonstration. While

second generation materials had the correct concept in what needed to be fixed, it was more directive. Second generation texts gave the impression of "you will be safe" then provided an example of a problem area to be corrected and an example of a accident to reinforce the point. At the time it was a valid learning tool. While some of ideas were learned there were still accidents. The crews were not working through problems to determine their reaction and thusly didn't know how to handle the situation they were to be avoiding. Third generation takes the process one step further. Determine and demonstrate the problem is still critical. Now provide a learning tool by allowing crews to work through problems. For a class room situation the old "what if" question sparks the thought process. It is apparent that allowing crews to interact during stressful situations with each other in a safe environment, that they will retain the mental process of resolution in a actual environment. Books and training guides such as Wiener, Kanki, and Helmreich's Cockpit Resource Management, Trollip and Jensen's Human Factors for General Aviation, and CAE-link's Air National Guard Crew Resource Management Workbook are great references for third generation training. Although the "rest of the world" have moved into third generation the Federal Aviation Administration still publishes their works in second generation. They provide training, evaluation, and reference material, while still operating in second generation.

Aviation Week & Space Technology, Flying, and APOA Pilot, frequently print articles pertaining to research done or helpful ideas on CRM. Most of the ideas presented are valid and constructive to those with extensive and little CRM training. These articles provide channelized attention into one area or give direction to a set of research that has

been completed. These periodicals should only be used for supplementation or enhancement of an exiting course or knowledge base. For those with no training said and similar publications could be of detriment to perceptions. If one is not familiar with the minute workings of the CRM program, articles could provide confusion, and lead to the reverse of what was attempted by the author. On the other hand, said article could lead to overall enhancement or spark thought in the recipient. Each individual in unique and must realize self limitations before attempting a procedure or idea suggested in the article. For those with CRM training that the idea be first self examined and discussed before attempting in the flight environment.

Summary

For such a small amount of publication on CRM, there have already been a lot of changes. Relatively few sources have been reduced even farther by the rapidly changing field of aviation, and new advancements in training. Trying to publish material on the rapidly changing concept of CRM would appear to be a fruitle task, however, several have accomplished that task. It would appear that with this shift to third generation CRM, there has come a plane of stability on which to teach upon. Since the change there has been a rush to get new materials published. While authors and publisher stride to meet this demand, it falls on the consumer to beware of what they obtain. Materials currently available could have shortcomings, like second generation, or incompleteness. When one uses the available materials validity must first be determined.

Close examination of material content is essential for integration. A training program proposed to a crew that flies Air Force F-15's will not be totally acceptable to a

C-130 multi-member flight crew. Overall concepts and generalizations will transfer almost throughout most training courses, however, specific training requirements must be met. This also holds true for current printed text. Some of what is printed will be applicable to all, while others will be restricted to one scope. Even then, examination and thought of the materiels is required of comprehension. A crew that has been well trained in CRM two years ago, could have a very confusing time understanding materials printed today. As discovered, the Air Force has publications that could be used by the CAP if slight changes were made. The civilian markets have great training material, but exact payment. Under the already limited budget of the Civil Air Patrol, payment for training is not that high of an option.

Training requires recent material that is applicable and easily understandable. Recency provides third generation cutting edge information. Articles and materials must be applicable to the training. Demonstration of bad examples can even confuse the subject and distract from issues at hand. The ability to understand the article and the message it is trying to convey is paramount. The aviation industry is filled with acronyms, slang terms, and complex subject matter. Publishing becomes troubled while trying to produce an article that covers the issue, but in such a way that the layman could understand. With CRM, the aviation industry is already working with concepts instead of occurrences.

Chapter III

Methodology

Chapter Overview

This chapter will provide information on how the research was conducted. Discussion of methods, subjects, test instruments, research design, and data analysis will presented. This study is a pilot study to determine CRM training design for the Oklahoma Wing Civil Air Patrol. There has been no study of the introduction and effects of Cockpit Resource Management on the CAP's aircrew members. This section on methodology will examine how research was collected on samples, and what the results mean. Collection of data took place between August of 1994 and August of 1995 with the men and women of Oklahoma Wing Civil Air Patrol.

Research Methodology

Research was collected through the use of interviews and observation. Participating aircrew members would first be observed performing their duties and tasks under normal operations then questioned about their procedures at the conclusion of the flight. Later, discussions about CRM implementation with same aircrews would take place. These discussions involved ways that the crew could have communicated better within and outside the cockpit environment. Follow up observations would then occur to determine CRM improvement. This research is a pre-experimental design (one shot case

study).

CAP aircrews would be selected randomly by type of mission flown. Those missions flown, fell into one of four categories (1) Emergency Locater Transmitter (ELT), (2) Route searches, (3) Grid searches, and (4) High Bird communications. CAP has many other different types of searches such as; parallel track, creeping line, sector, expanding square, and contour searches. (CAPR 55-1, p. 66-67)The previously listed three searches constitute the majority of search patters that are replicated during a mission. While the other types of missions are valued search patters all aircrew members are required to be trained in ELT, Route, and Grid searches. By using the previously listed four areas, all aircrew member will be kept in the sample population. Search and Rescue, being the primary mission of CAP, was chosen over all the other varied missions that are also performed for several reasons. There are more Search and Rescue actual missions flown, and thusly more Search and Rescue training. Other flying, such as Civil Defense (CD) and Counter Narcotics (CN) require additional crew training and qualification over the typical search and rescue crew members. By requiring additional training, many CAP members are not qualified in CD or CN missions, limiting the subject pool. However, those aircrew members that are qualified in CD and CN missions are qualified Search and Rescue pilots and therefore be available for this study and CRM training.

Emergency Locater Transmitter missions or "Electronic" searches is vastly different from Route, Grid and High Bird. ELT searches use direction finding equipment (DF) to track signal emissions from activated ELTs, while the others use visual contact

with the ground to look for the mission target. Most commonly, ELTs are aircraft mounted, but may also be found on maritime equipment or personal ELTs. In either form, all types are tracked alike. Being the most frequent types of searches, these missions are frequent and very often occur at night. ELTs are activated by impact, or G-force. Because perception becomes impaired at night more hard landings are experienced. With these hard landings ELTs are commonly activated. Many instances may be cited where ELT's were tracked in aircraft, vehicles, and trains that were moving to other destinations. Numerous objects such as; hangers, buildings, power lines, and radio antennas, have caused the ELT radio signal to be bounced in many different directions. The aircrew must be able to track these signals and distinguish between the actual and reflected signals. This at times, force the aircrews to make low altitude maneuvers in deciphering the true signal addend to an increased danger factor.

The Observer is tasked in adjusting the DF equipment so the Aircraft Commander can track to the signal origin. The DF equipment only track in a straight line to and from the signal. Unfortunately, the equipment does not differentiate from to and from. DF "homes" toward the signal. The A/C must perform tight 360 degree turns to create a wing null effect, or signal blockage, on the signal to determine to and from direction to the target. The Scanners function is to look out the window at the ground for possible targets. Electronic searches can be conducted under Instrument Flying Rules (IFR) instead of Visual Flight Rules (VFR) like the other searches are restricted to. With the compoundedness of fatigue, from early morning searches, and Instrument Meteorological Conditions (IMC) aircrews on ELT searches easily become task saturated. Flying while

under IMC conditions requires immense coordination with Air Traffic Control (ATC) to allow search patters that are non-standard to normal routing. Expanding this is the possible loss of radio communications and aircraft malfunctions. With these points only taken into count, it obvious to see that electronic searches can become very involved and inherently dangerous.

Selected ELT crews were observed during mission briefing by the Mission Commander (MC) and Air Operations Officer (AOO). During this time aircrews were assigned missions and areas to search of probable location. After their briefing from the MC and AOO, individual aircrews undergo briefings by the Aircraft Commander. After the conclusion of the preflight briefings the crew exit to the aircraft and fly the mission. Observation of the aircrew members was made from the onset of the mission brief, throughout flight, and to post-flight briefing. During the first two flights observations only were made. The second two flights occurred after CRM training was accomplished. During all stages of the second flight, CRM was encouraged and comments were made to the crew for better effectiveness. The final flight was observation only.

High Bird communications flights were included in this study because of its unique nature. High Bird refers to an aircraft that is launched to climb up to eight to ten thousand feet and circle over an area to relay communications. This mission tasking is critical to the function of search operations. When aircraft depart on low level (or low altitude) missions they are unable to contact mission base due to the reduced broadcast range of their radios. The High Bird aircraft at high altitude intercepts the radio calls and relays messages to and from aircraft and mission base. While this duty sounds simple

enough there are several different radios that must be monitored all at once, compounding possible confusion. These missions do not carry a mission Scanner on board to reduce weight and increase climb performance and airborne endurance. Leaving a A/C and Observer to fly and handle all the radio traffic.

Several factors were taken into consideration when this tasking was chosen. The first was hypoxia and secondly task saturation. While hypoxia rarely occurs at eight to ten thousand feet, it has happened unexplainably several times to different aircrews. The goal here was to increase crew coordination and observation, to better spot the onset of hypoxia, and work through remedies. The other factor, task saturation, has happened to many crews when there are numerous aircraft trying to communicate with mission base, while the pilot is involved with ATC communications.

One observation flight was followed by ground instruction in coordination and human factors. A second observation flight was performed, after ground instruction, to determine improvements in Cockpit Resource Management. The special session of human factors taught the effects of hypoxia on aircrew members. This hypoxia class was taught to make the crew better aware of the onset and corrective measures of hypoxia.

Route and Grid searches constitute the majority of all visual searches. A Route search mission will fly the last known or projected route an aircraft took. Grid searches are designed to minutely search large squares of land when a route or last position is not known. These types of missions are flown at 1,000 to 500 feet AGL to allow good visibility of the ground. Not only must the pilot (A/C) be conscious of low altitude hazards but must also fly very exact search patterns. With the inherently dangerous

aspect of visual searches CRM is a vital necessity.

Three preliminary observation flights, with three separate aircrews, were made on both Route and Grid searches for a total of six different aircrews observed. After the observation flights, the crews were instructed on the fundamentals of good Cockpit Resource Management, in relation to the types of missions the CAP flies. After instruction the crews made another flight where suggestions were made by a CRM observer, in flight, as how to better facilitate coordination. Finally a last observation flight was made to record the progress the aircrew members had made since their first flight.

All the aircrew members in the study under went a ground training class in between observation flights. Ground training was broken down into four general categories which were then covered in detail. These four categories were: (1) Interpersonal Coordination and Communication, (2) Problem-Solving and Conflict Resolution, (3) Workload Management, and (4) Technical Performance. These four basic topics were broken down further into many subcategories. The subcategories were: (1) Command Authority and Delegation of Tasks or Duties, (2) Professional Crewmember Participation and Task Performance, (3) Assertive Feed-Back Techniques, (4) Effective Communication, (5) Workload Performance Factors, (6) Workload Classifications (7) Flight Priorities for Safety, (8) Use of Aircrew Resources (both internal and external), (9) Situational Awareness, (10) Basic Flying Skills, (11) Spatial Orientation, (12) Physical, Physiological, and Psychological factors, (13) Decision Making, (14) Cause Factors, (15) Evaluation Tools, (16) Flight Inspection/Crew Evaluation, (17) Judgment, (18) Common

Sense, (19) The Mental Processes of a Safe Flight, (20) The Five Hazardous Attitudes, (21) Stress, (22) Time and Performance, (23) The Five Risk Elements of; Operation, Aircraft, Pilot and Crew, Environment, and Situation, (24) Self Factors of; Illness, Medication, Stress, Alcohol, Fatigue, and Eating, and (25) Aeronautical Decision Making. All of these topics were presented in an instructional/discussion format by Oklahoma Wing Civil Air Patrol Commander, Col. Walter Schamel. Col. Schamel is also a instructor with the Federal Aviation Administration in Oklahoma City, who teaches a similar CRM class to FAA instructors and evaluators.

After in-depth instruction/discussion of CRM, crews were given a set of possible senecios for them to "act out". Working through the problem senecios gave the crewmembers an opportunity to practice what they had just learned in a non-hazardous environment. During this time crews were able to be critiqued by other crews watching and in turn critique other, thusly increasing their knowledge of CRM. While most authorities on CRM recommend the use of situations while flying in ground based simulators. Due to budget constraints, the use of simulators was not an option. The scenario enactments were conducted in a informal classroom situation.

The second flights were conducted as an instructional/critique flight. During preflight briefings by A/C's, relevant comments were added to help improve the CRM improvement process during the flight. During flight, relevant comments were made by the CRM instructor as to effective communication and crew coordination. An in-depth crew debriefing was made to find all members reactions and comments on all aspects of the flight and pre/post flight preparation.

Selection of Subjects

The selection of subjects was taken from the mission capable flying officers of the Civil Air Patrol, Oklahoma Wing. Crews were selected at random by (1) their crew position, and (2) their willingness to participate. Selectees were asked privately in person if they would like to participate in Cockpit Resource Management training. Those that participated were not documented to keep their participation secret.

One of each crew position, Aircraft Commander, Observer, and Scanner, were selected to be one crew. Those selected were fully mission qualified in their official position in which they were acting in. While all crewmembers were qualified in their position, several were also qualified in other positions and several were in training/upgrade for others. For the purpose of this study participants flew in their respectively qualified positions for the entire study.

Acceptance or denial to participate was of the individuals choice. There was no benefits given for participation. Likewise, there was no recourse taken against those who did not participate. The only "benefit" would be their increased understanding of Cockpit Resource Management. Participants were made aware that of these facts, and that the results would be published, but with no name documentation in the publication. Participants were made aware that no physical or mental harm would be incurred, and at any time they may with draw from the study with no repercussions. During the course of the study, no participants with drew.

Qualified personnel that were acting in a flight capacity were asked to participate only based upon their qualification. Selection of individuals was made at random from a

list of qualified aircrew members, provided by a qualified Mission Coordinator (MC). Although the MC provided the list they remained unknowledgeable about the lists intent or selection. Once the list was broken down by crewmember position, individuals were selected by random draw. Once the member was chosen they were asked, in confidence, about their willingness to participate. Those who were selected were then assigned to a flight crew for the duration of the entire study. For the couple of aircrew members who decided not to participate, a replacement name was draw.

Research Instruments

Since Cockpit Resource Management is a tool for more effective management there is no real design to test immediate validity of training. There has not been a totally inventive way in which to create a base line and measure progress. However, the Department of Transportation (DOT), National Transportation Safety Board (NTSB) and the FAA have documented CRM as an effective tool through many years of tracking accident rates. However, attributing CRM improvements and declines to aircraft accidents is very difficult when there have been so many recent changes to technology in so many areas affecting the Aviation Industry.

As Helmreich and Foushee quote NTSB accident reports (See figure one) the primary cause of accidents since 1959 has been due to flightcrew, or human error. (Wiener, Kanki, and Helmreich, p. 5) Although this figure only reports hull losses and not minor accidents, the trend can be interpolated. By examining accident reports (See figure two) as reported by Trollip and Jensen a decrease in the accident rate has shown a decline over the years. The representation is given for general aviation aircraft, the

commercial sector follows the same trend of decreasing accidents. The NTSB attributes decline in human error to better management. The statics accumulated by the Federal Government have taken years to gather. Since there have been no official CRM training to CAP aircrews no starting line has been draw. Even if a starting point could be named not near enough time has progressed to determine accident rates and to what the accident is attributed.

For those few flight crews who participated in the study their reactions were positive that CRM was a worth while investment and improved safety and mission effectiveness. Study observations show the crews did communicate more frequently, with a larger dissipation of tasks and duties. At the start of the study a record was kept as to the frequency of: (1) crew communication, (2) delegation of tasks, (3) discussion of a possible event, (4) use of a resource to alleviate a problem, (5) loss of situational awareness. Keeping of the numbers had to be abounded due to the extreme difference each mission provided. There was no way to adequately duplicate the same flight over and over to detect differences between aircrews.

The commercial air carriers and military aircrews are required to attend CRM training. For the immense expense involved to send aircrews through CRM training, the companies and Air Force consider the training a worth while investment and must therefore be interpellated as a benefit to operations.

Research Design

Research design was pre-experimental. Because there were no valid testing procedures available this became a one shot case study of CRM implementation training.

Having no prior studies in this specific areas this was a pilot study in its self. There were insufficient means available to duplicate repeated flight conditions for different crews to make adequate analysis of effectiveness.

Personnel observations had to be made for the lack of a discriminating test. Allowing for an entirely subjective recording of the data. Having been trained and undergone several advanced courses, progress in flights was my determination. Remaining unbiased and neutral for the purpose of pre and post observation flights so that a difference could be determined.

Three flights with each selected aircrew were flown to make evaluations. The first flight was a baseline observation flight. In these flights crews were just watched to determine the amount of coordination and task dissemination that was performed by all members. After the first observation flight, CRM ground training was introduced. Prior to classroom training, crews were debriefed immediately following their flight and asked to describe various aspects and asked questions in regards to their use and function of CRM. On another day, a group classroom training session was held. The topics that were taught and discussed were listed in research methodology. Along with the CRM classroom training there were crew situational training that took place in a classroom setting as well. After initial ground training, flight crews were monitored during a second flight. During this flight constructive and relevant comments were made to the aircrews to help enhance their application of CRM. After the completion of the second flight, crews were again debriefed on their views of the flight. Finally a third observation flight was held to determine the increase or decrease of CRM usage after training.

After each flight, aircrews went through post flight questioning, and were asked to describe aspects of the flight and how they could be improved or changed. Crews were asked special questions regarding unique events that occurred during flight, that impacted CRM. Some brief examples of questions asked are; (1) Do you feel this was a safe and productive flight? (2) What do your duties entail? (3) Are you being over worked/under worked? (4) Could there have been more crew interaction/involvement? (5) What do you know about the other aircrew members background and experience? (6) How could you have helped the other crewmembers in any way? (7) Was there adequate preflight discussion as to the manner in how duties would be performed? (8) How could you have improved the flight? (9) Could you provide some examples of when you used or participated in CRM during the flight? (10) As a non-pilot crewmember, would you speak out if you noticed a possible dangerous situation? (11) Are you mission oriented, crew oriented, or equal concern about both? These questions and more were designed to obtain the crews views on the mission and their part in coordination and CRM interaction.

Data Analysis

The compilation of data shows that the implementation of Cockpit Resource Management training did have a positive impact upon the aircrew members of the Civil Air Patrol who received the training. At the onset of the study there was very little coordination among aircrew members other than standard mission interaction. At the conclusion there was a conscious effort by all members to interject ideas to create a safer and more effective flight.

Of the thirty aircrew members observed, three had admitted to receiving prior CRM training outside CAP. These members tried to foster good coordination among crewmembers throughout the entire study. These three members were on three different crews and had experience as a pilot in the civilian industry. While these individuals practiced good CRM techniques at the onset, overall crew CRM was increased, and can be attributed to the training of the rest of the aircrew. For those crews that had no prior exposure to CRM there was a large increase in the conscious effort to interact with the other crewmembers.

On the contrary to the three individuals that had previously been trained in CRM, there were two individuals that had heard of CRM. However, their ideas were a very negative concept of what CRM was about. These two members had also received Total Quality Management (TQM) training from the companies they worked for and did not like the outcome of TQM training. As they stated, they had heard about CRM as a management style and associated it with their negative concepts of TQM. These individuals still agreed to under go CRM training and keep a open attitude until the end of the study. After the initial ground training in CRM both individuals stated that their initial ideas about CRM were wrong and that now see how effective CRM was in obtaining its goal of increasing flight safety and mission effectiveness. Both were very glad that they had participated, if not for the knowledge of increasing flight safety, but to educate them on the true function of CRM. These two individuals displayed a very positive attitude toward learning a concept they thought they did not want to learn. Hopefully all individuals with the same misconception will have the same positive

attitude toward learning CRM.

This summation is deduced by the increased number of CRM observations from the fist to third flights. While the second flight was not an observation flight, but more of a training flight there was still a great increase in the number of times crewmembers made comments about the flight to increase safety or mission effectiveness. Examining the numbers from the first and third flights there is a significant increase in the times CRM practices were observed. This increase shows that CRM training was understood and is being used by aircrew members to effectively enhance flight safety and mission effectiveness.

Post study personnel interviews with the aircrew members revealed that they all thought that CRM was a valid tool in increasing their awareness and manipulation of flights to create safer and more mission effective flights. The consciences amongst these subjects is to start a Wing wide training program for all aircrew members.

Chapter IV

Findings

Data Collection

The number of times a Cockpit Resource Management "concept" was used from the second observation flight, or third total flight, was significantly higher than the first observation flight. The greater number of ending observations leads to the conclusion that aircrew members were using the CRM training they had received. However, due to the lack of an immediate formal testing format, one could argue the validity of the observations taken. The only observations logged and counted in ending research were those were a CRM tool was positively used. Regardless of the outcome, positive or negative, if a crewmember personally used or introduced ideas to the other crewmembers a tally of one was given. These total number of interactions were counted and the first set of observations compared with the last set of observations. Producing the conclusion that there was more usage on the second observation flight than the first. Along with personal comments from the aircrew members in regards to their flights. Therefore it was deduced that CRM training program had been a benefit to those that under went CRM training.

Evaluation of Data

One may contest the method of subjective collection, however there is no contesting the results. Not only do the numbers support that CRM was a positive

influence, but the comments from those that underwent training confirm the collected data. All subjects had the same general answer to the question of, "Was the Cockpit Resource Management training you received beneficial to the improvement of flight safety and mission enhancement?". All answers received were a resounding "yes". Therefore the conclusion must be drawn that the data collected is valid.

All thirty crewmembers, ten flight crews, displayed an increase in the usage of CRM techniques from the first to second observation flights. Even with the variance taken into account for the crewmembers that had previously received CRM training there was still an increase in overall crew coordination. Reflecting the increased CRM education of the other two aircrew members involved on the respective flights.

Program Requirements

The ground training session was presented with overhead transparencies in a lecture/discussion situation. The general response by participating aircrew members was that class was to long. The three hours and forty-five minute class session could be broken up into shorter classes, however getting those that live in distant locations to several meetings would be difficult as well. The situation discussions were also presented in a classroom situation and should really be performed in a controlled flight environment, such as a ground based flight simulator to add realism and simulated in-flight situations. However, due to budget constraints, the use of a flight simulator at this time is not feasible.

Another constraint that faces the program is the use of a "qualified" instructor. Not just anyone can get up and teach the class. Col. Schamel was used because he

teaches CRM to FAA instructors and examiners. The instructor needs to be well versed in the topic and able to communicate the desired outcomes in such a manner that all will understand, regardless of experience and ability. For multiple instructors, one set curriculum must be developed and followed. One class should receive the same material as the other classes receive to keep training uniform and alleviate missed areas among groups. As the times change teachers and future class curriculum need to also receive the latest updates to present relative and eventful information to those receiving. Also, those receiving training need to attend recurrency training to keep aircrews up to date and provide refreshing for what they had already learned.

Summary

The findings of this study showed a positive improvement in flight safety and mission effectiveness when Civil Air Patrol flight crews were trained in Cockpit Resource Management. The observation data collected shows an increase in crew coordination and conscious effort in creating a safer more mission effective flight. Also, the comments made by the crews at the conclusion of the study stated that the training received was a positive influence on how they would conduct the flight.

Again it must be noted that there are insufficient immediate testing medium available to collect hard data documentation of flightcrew training progress. Observations taken were taken subjectively and done so only when the aircrew members exhibited and communicated aspects of CRM. The totals were taken from the first and last flights observation flights and compared to create data trends for the effectivness of CRM . These subjective comparisons then showed the improvement over the first flight

before the introduction of CRM training.

Chapter V

Summary, Conclusions, and Recommendations

Summary

Showing how the study group improved so well, would indicate a need for a wide spread implementation of Cockpit Resource Management training throughout the Oklahoma Wing. However, training should be carried out at the National level for all aircrews involved with Civil Air Patrol. This study has shown the positive effect CRM had on the study group and warrants implementation to the entire Wing.

In a rapidly changing industry all avenues that can be taken tho increase flight safety must be taken. As the civilian industry and Air Force will attest to CRM training is a viable tool used in the reduction of aviation accidents. The current training program that was used in the pilot study has shown that, even with limited resources an effective training tool can be quite effective.

Conclusions

The current training program used in the pilot study was developed by the Federal Aviation Administration and then modified to third generation CRM and CAP regulations, to meet the specific needs of the CAP. While an elaborate version could be created the existing model is very effective. However, more improvement could be placed on the situation training to allow for more realistic and controlled flight

simulation training.

The pilot study shows a successful retention and practice of CRM by the exposed flightcrews. This in its self warrants implementation to the remaining aircrew members of CAP. The use of the study training guide has proven to be very effective in its training goal. For use on future aircrews, however, the training curriculum needs to be updated to keep up to date with changing Air Force and CAP regulations and advancements in the rapidly changing industry.

Recommendations

It is recommended that someone develop a reliable testing measure to determine more immediate results for those who under go CRM training. The test should also be objective in nature to show test discrimination among recipients. Not only should immediate results be determined, but long term tracking of accident results should be kept to show the overall benefit of CRM training.

All members of the CAP nation wide be trained in CRM. A well developed training plan be implemented to allow a nation wide education of individuals involved in the flight process. Training should also include those individuals whom support flying and are not a member of a flight crew. This would allow for knowledgeable support for the non-flying members, but also allow helpful insight from the support personnel.

One time training situations should be avoided if possible, but create an on going program that will include "refresher" training. I would recommend a refresher training of some type every six months. This would also afford the opportunity to record results of training retention. Refresher training would be a constant reminder for the good practice

of CRM, but will afford the opportunities to introduce new material when it comes available. Such sessions should also include opportunities for other pilots to share experiences to help educate the other members by their experience.

A staff of trained professionals in the organization be available to take classes to remote areas of the Wing to ensure all members receive training. There would be significant time and cost involved in training the trainers to the point they would make good instructors. Another limiting factor would be finding the persons needed that would be willing to take the time and become qualified and train other aircrews in remote locations of the Wing.

At this point it appears to be highly unreasonable, but a flight simulator should be made available to better train aircrew members. This would allow crews to interact under simulated dangerous situations in a controlled safe environment. This in its self would also create its own set of problems. Making the simulator available to everyone and their schedules would require a great amount of personnel power. The other problem would be getting members from far locations to the simulator. Making the simulator mobile would be too many problems.

SELECTED BIBLIOGRAPHY

National Headquarters Civil Air Patrol. (1983). Civil Air Patrol Manual 50-15, Emergency Services . Maxwell AFB, Al.

National Headquarters Civil Air Patrol. (1992). Civil Air Patrol Regulation 55-01, CAP Operational Mission Procedures . Maxwell AFB, Al.

Trollip, S., & Jensen, R. (1991). Human Factors for General Aviation . Englewood, CO: Jeppesen Sanderson.

EIENER, E., Kanki, B., & Helmreich, R. (1993). Cockpit Resource Management. San Deigo, CA: Academic Press, Inc.

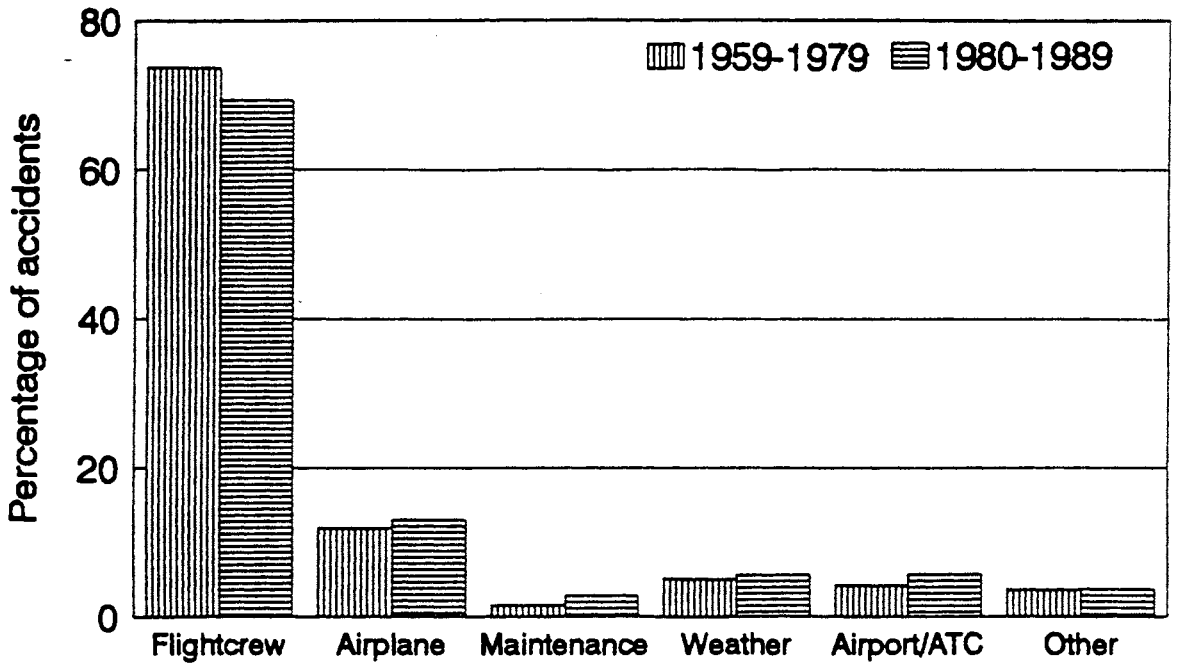

Figure 1. Percentage of Accidents From 1959-1989 Resulting in Hull Loss.

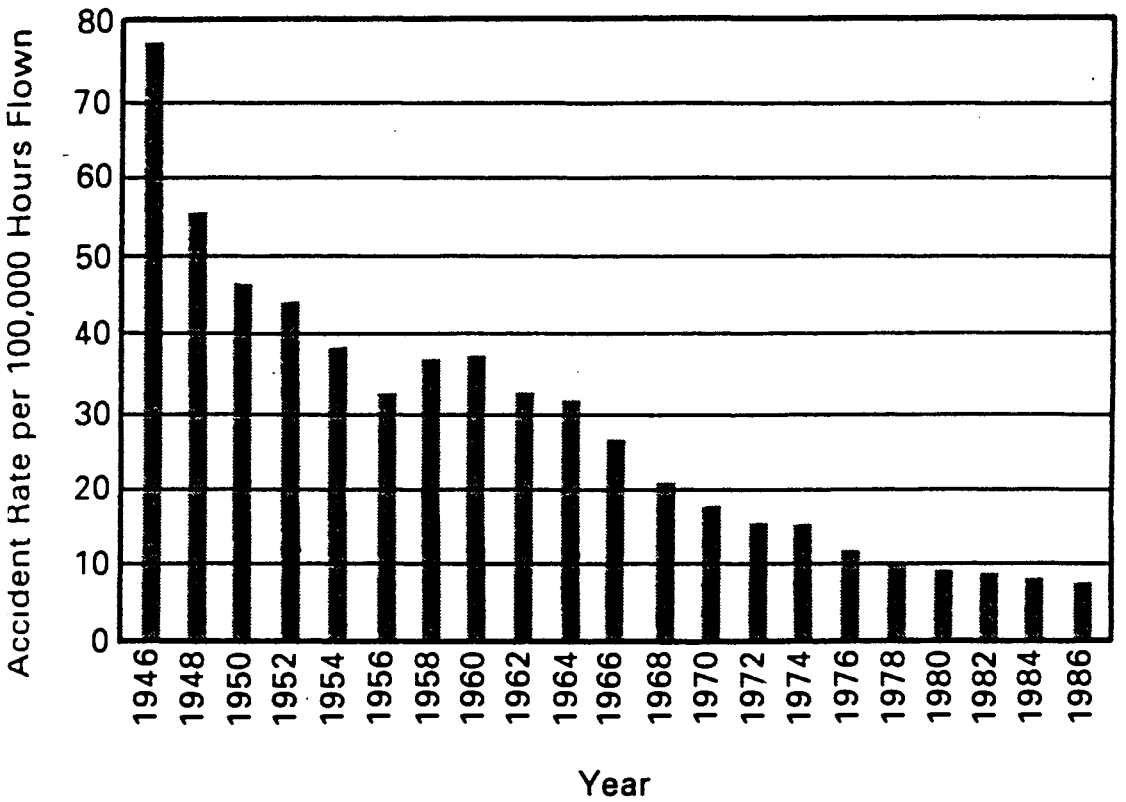

Figure 2. Accident Rate per 100,000 Hours Flown in General Aviation, From 1946-1986.

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VITA

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Candidate for the Degree of

Masters of Science

Thesis: CREW RESOURCE MANAGEMENT DEVELOPMENT TRAINING FOR THE NON-INTEGRATED FLIGHT CREW OF THE CIVIL AIR PATROL

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OKLAHOMA STATE UNIVERSITY
INSTITUTIONAL REVIEW BOARD
HUMAN SUBJECTS REVIEW

Date: 10-17-95 **IRB#:** ED-96-039

Proposal Title: CREW RESOURCE MANAGEMENT DEVELOPMENT TRAINING FOR THE NON-INTEGRATED FLIGHT CREW OF CIVIL AIR PATROL

Principal Investigator(s): Aaron S. Wardlaw, Steve Marks

Reviewed and Processed as: Exempt

Approval Status Recommended by Reviewer(s): Approved

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ANY MODIFICATIONS TO APPROVED PROJECT MUST ALSO BE SUBMITTED FOR APPROVAL.

Comments, Modifications/Conditions for Approval or Reasons for Deferral or Disapproval are as follows:

Signature: John H. Wardlaw Date: October 27, 1995

Chair of Institutional Review Board