

Crew Coordination Training: It Isn't Just For Aircrew Anymore

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ABSTRACT

Crew Resource Management (CRM) was developed by the airlines in the late 1970's to address mishaps linked to crew coordination breakdowns. The military services adopted CRM in the early 80's and modified it to meet their needs. Subsequent research conducted by the Navy identified seven common behavioral skills that, when not used, lead to flight mishaps: Communication, Assertiveness, Mission Analysis, Decision Making, Situational Awareness, Adaptability / Flexibility and Leadership. Recently, the Naval Safety Center determined that many aviation ground mishaps result from a breakdown in the crew concept and a lack of the same behavioral skills. Consequently, a Groundcrew Coordination Training (GCT) program is being developed by the Naval Safety Center for U.S. Navy and U.S. Marine Corps aircraft maintenance and line personnel.

INTRODUCTION

General Background

All designated Naval Aircrew are required to take both initial and refresher Aircrew Coordination Training or "ACT." ACT as a program has gone through an evolutionary process over the years. The first ACT program was a direct adaptation of the Cockpit Resource Management (CRM) course developed by the commercial airlines in the late 1970's to attack a growing problem of mishaps linked to crew coordination breakdowns, crew size reductions, greater workload and new technology. The Navy-Marine Corps Aviation Team and the other military services modified the CRM program during the early 1980's to meet their needs. Subsequently, many Naval Aviation communities, such as the A-6 *Intruder* and the CH-53 *Sea Stallion*, tailored ACT to be more platform and mission specific. ACT was also expanded to include cabin personnel and is now being integrated into all phases of flight training and standardization evaluation. Overall, the dramatic decline in Class A Fight Mishaps in recent years has been attributed in part to the development, implementation, and enculturation of ACT in the Fleet.

Research conducted by the Naval Safety Center in conjunction with the then Naval Training Systems Center identified seven common "Behavioral Skills" that, when not used, lead to Flight and Flight Related Mishaps. They are: Communication, Assertiveness, Mission Analysis, Decision Making, Situational Awareness, Adaptability / Flexibility, and Leadership. These behavioral skills are the cornerstone of the Naval ACT program. Recently, a Naval Safety Center analysis of Aviation Ground Mishaps, those mishaps where there is no intent for flight, determined that the majority depict a lack of behavioral skill use by maintainers and linemen and a breakdown in crew coordination. As a result, a Groundcrew Coordination Training (GCT) program is now being developed for U.S. Navy and U.S. Marine Corps aircraft maintainers and line personnel.

OBJECTIVE STATEMENT

The purpose of this effort is to observe the need for GCT in Naval Aviation. The objective is to suggest a plausible course of action for addressing it.

PREVIOUS INITIATIVES

Before outlining the scope of the Naval Safety Center's GCT program, it is appropriate to acknowledge the ground breaking work underway in the commercial airline industry. In *Maintenance Resource Management*, [Bradley \(1995\)](#) stated "The push for applying resource management training to (maintainers) is almost entirely industry driven." Given the competitive nature of commercial airlines to meet schedules, provide safe and reliable service, and keep operation costs down this it is not surprising. However, it is also important to note that the Federal Aviation Administration's National Plan for Civil Aviation Human Factors and Human Factors in Aircraft Maintenance and Inspection program has fostered much interest in such human factors efforts.

Continental Airlines' Crew Coordination Concepts (CCC) program, initiated in 1991, is recognized as the pioneering effort to apply CRM in aviation maintenance ([Bradley, 1995](#)). According to [Taylor and Robertson \(1994\)](#) its charter is: "to equip all maintenance personnel with the skill to use all resources to improve safety and efficiency." Originally designed for supervisory personnel, CCC is now mandated for all staff levels and consists of a interactive two day workshop that includes lectures, case studies, videos, and exercises. The course is facilitated by a human factors expert and technical maintenance representative, and its objectives are to diagnose organizational norms and impacts on safety, promote assertive behavior, evaluate individual leadership styles, understand and manage stress, enhance rational problem solving and decision making skills and develop interpersonal skills. The results reported by [Stelly and Taylor \(1992\)](#) after the first year of CCC at Continental Airlines were remarkable:

- | 1200 total out of the targeted 1800 personnel were trained
- | Cost of repair maintenance caused ground damage was down 68%
- | Maintenance caused ground damage incidents were down 34%

I Occupational injury hours paid are down 27% and medical paid are down 12%

Taylor and Robertson (1993) state the strengths of CCC program were: timing and content was well received by participants; training produced improvements in most attitudes measured; performance appeared to improve due to CRM training and specific attitude changes may cause specific performance changes. It also was contended that CCC creates an atmosphere of active change and continuous improvement. They recommend helping participants plan for using their new skills at work, focusing directly on assertiveness skill training and widely publicizing CRM training. In a final report on Continental's CCC program after three years of experience, Taylor and Robertson (1995) found attitudes improved following training as well as in the months that followed, participants reported shifting from passive to active job behaviors and CRM skills were clearly linked to improved safety, efficiency, and dependability performance.

GROUNDCREW COORDINATION TRAINING

Overview

The Groundcrew Coordination Training or "GCT" format and content is based on the P-3 *Orion* ACT syllabus and the author's experience as an ACT instructor. It includes an introduction to the crew coordination concept, coverage of the seven behavioral skills, their importance and barriers to their use (with illustrative examples) and a number of case examples for discussion.

Introduction to GCT

Naval Aviation has developed and implemented several programs to reduce Class A Flight Mishaps over the past 50 years ([Figure 7-1, appendix](#)). Notable efforts include establishing the Naval Aviation Safety Center (NASC), implementing the Naval Aviation Maintenance Program, developing the Replacement Air Group (RAG) concept, initiating the Naval Aviation Training and Operations Standardization (NATOPS) program, starting the Squadron Safety Program and most recently the Aircrew Coordination Training (ACT) program. ACT has been attributed as being a major factor that has led to the dramatic reduction in Class A Flight Mishaps over the past decade.

Crew Resource Management (CRM) was developed by the airlines in the late 1970's to attack a growing problem of mishaps linked to crew coordination breakdowns. The Navy-Marine Corps team and the other military services modified the program during the 80's to meet their needs. Several communities (i. e., A-6, CH-53, etc.) tailored the program to be more platform specific. Research subsequently identified seven common behavioral skills that, when not used, are tied to aviation mishaps. Recent Naval Safety Center analysis has determined that many Aviation Ground Mishaps also show a lack of skill use and poor crew coordination. Approximately one third of the Class C Aviation Ground Mishaps (those costing over \$10,000, but under \$100,000 and/or involve serious personal injury) each year for the last 10 years involved a breakdown of the crew concept as outlined in the Naval ACT program.

Clearly, there is a need to develop and foster the crew concept among aircraft maintainers and line personnel if the Naval Aviation Safety Program is to further increase its effectiveness in reducing mishaps. So it can now be said about Crew Coordination that "Its Not Just for Aircrew Anymore!"

What is Crew Coordination? It is the process of coordinated action among crew members which enables them to interact effectively while performing mission tasks. Many times aircraft maintainers and line personnel approach their tasks as individuals and not part of a team. They may look out for themselves, but not for those around them (e.g., a wingwalker crouched in front of a mainmount to block the wind was crushed when movement started). Many people have paid dearly for someone not being part of the team (e.g., a maintainer working on the main rotor head spun it, mangling the hand of another working on the tail rotor linkage). The key is that in many instances effective crew coordination would prevent such mishaps from occurring.

Why is Crew Coordination important? Good Crew Coordination can increase mission effectiveness by minimizing crew error, maximizing crew resources and optimizing risk management. It minimizes crew error and maximizes crew resources by bringing to bear all the sensory, attentional, perceptual, cognitive, decision making, problem solving, etc. capabilities that are available in a group. In other words, the eyes/ears, minds, knowledge and experiences of all the team members can be used to prevent error(s) that lead to mishaps (e.g., while towing an aircraft wingwalkers must maintain a sharp lookout, yet there are collisions with hangars, aircraft, etc.). Resources that prevent errors and increase effectiveness are also essential to manage risk. Generally, military activities have risk and associated hazards; if they are accidentally or intentionally ignored the outcomes can be quite disastrous (e.g., maintainers climbing on aircraft are required to wear "cranials," yet individuals fall from aircraft in front of peers without them). So there is a clear need for crew coordination, what constitutes it?

Seven Behavioral Skills

As was mentioned earlier, research conducted by the Naval Safety Center, in conjunction with the then Naval Training Systems Center, identified seven behavioral skills that were common themes in mishaps involving aircrew error: Communication, Assertiveness, Mission Analysis, Decision Making, Situational Awareness, Adaptability / Flexibility and Leadership. Each has its own operational definition, stated importance, and associated barriers. This discussion covers each using "interesting" examples.

Communication - the ability to clearly/accurately send and acknowledge timely information, instructions, or commands and provide useful feedback. This skill is important as it helps aircraft maintainers and line personnel perform tasks effectively, avoid error and prevent accidents as well as facilitate timely dissemination of data/information and maintain group situational awareness. Known barriers include passive listening, no/poor feedback, non-standard terms and inappropriate method.

Example - Carrier flight deck crew moved an aircraft to be refueled. Later the sailor operating the fuel hose walked away, thinking refueling was completed the crew moved the aircraft. The attached line was ripped out and spewed fuel into the aircraft, damaging it and onto the deck, fouling it. Was there a breakdown in communication in this mishap scenario? Could communication prevent this from happening again?

Assertiveness - the ability, willingness, and readiness to take action: making decisions, displaying initiative and maintaining position until convinced by the facts. It is important as it encourages aircraft maintainers and line personnel to provide relevant data, raise timely issues, make suggestions, confront ambiguities, maintain position when challenged, give position on decisions and refuse inappropriate requests. Known barriers to assertiveness include rank gradient, position power, inexperience and personal coercion.

Example - Two maintainers in completing a maintenance task were securing a wire bundle in the nose landing gear compartment. The senior marine wanted to move part of the gear assembly and disregarded warnings to use a required jack. When the part was removed the nose landing gear immediately collapsed on the maintainer, killing him. Should the junior marine have been more assertive in this mishap scenario? Could assertiveness prevent this from happening again?

Mission Analysis - the ability to effectively coordinate, allocate, and monitor all crew resources, organize/plan tasks, monitor situations and provide feedback on what was done. It is important for aircraft maintainers and line personnel to develop a good plan and revise it as the situation changes to prevent mission failure or a mishap; it establishes mission requirements/constraints, specifies plans/expectations and critiques/updates existing plans. Known barriers include high operations tempo, time pressure, and personal coercion.

Example - Ordnanceman was tasked to retrieve additional sonobuoys by the mission commander. He drove a panel truck into the hangar by the storage locker. While backing up, he hit the nose of a nearby parked aircraft. Should the mission commander have made an analysis to determine how many personnel were required in this mishap scenario? Could mission analysis prevent this from happening again?

Decision Making - the ability to use logical and sound judgment based on the data/information available. This ability includes: assessing the problem, verifying information, identifying solutions, anticipating consequences, explaining rationale and evaluating the situation. It is important for aircraft maintainers and line personnel to make good decisions that minimize error and optimize risk management as poor judgment is a leading cause of mission failure and mishaps. Known barriers include inaccurate and ambiguous information, pressure to perform and rank differences.

Example - A sailor walked into the paraloft from the line shack with a lit cigarette. Entering the room he was told to "put it out." He instantly responded by putting it in the closest thing that looked like an ashtray -the "expended" rocket motor of a salvaged ejection seat. This ignited the solid propellant residue and the seat fired, killing one and maiming another. Should the lineman have taken some time to consider the available information in making a decision in this mishap scenario? Could decision making prevent this from happening again?

Situational Awareness - the ability to identify the source/nature of problems, extract/interpret essential data, maintain accurate perception and detect any conditions requiring action. It is important for aircraft maintainers and line personnel to detect/appraise deviations, identify potential problems and show awareness of task status. Known barriers include insufficient communication, fatigue/stress, task over/under load, group mind-set, "press-on" attitude and degraded conditions.

Example - Civil servant was moving some maintenance ladders out to the flight line and drove through the hangar bay. He took great care to avoid the aircraft and drove under the tail of one to ensure he had clearance. Unfortunately, the driver forgot that the ladders combined with the truck height were taller than bottom of the aircraft. This aircraft had to be taken off the schedule due to the damage it sustained. Should the driver have observed the situation before proceeding in this mishap scenario? Could situational awareness prevent this from happening again?

Adaptability /Flexibility - the ability to alter one's course of action contingent on or a function of another's action or as the situation changes. It is important for aircraft maintainers and line personnel to alter behavior to properly address the situation, remain open to other ideas, assist others, keep cool under pressure, and adapt to change; it is especially useful if unplanned events come up, emergencies arise, or the crew is shorthanded. Known barriers include confusion, lack of information, time pressure and new unfamiliar situations.

Example - The airframers decided to stop drill the a fatigue crack on an aircraft to keep it from propagating. The drilled crack looked "bad" and it was elected to put a plate over it. The quality assurance personnel removed the plate and seeing the crack "hard downed" the aircraft. Should the airframers have been more flexible and adapted to the situation in this mishap scenario? Could adaptability/flexibility prevent this from happening again?

Leadership - the ability to direct crew member activities and get them to work together as a team. It is important for aircraft maintainers and line personnel to inspire crews to work together. The leader directs, coordinates, and delegates tasks, ensures all know objectives, focuses on critical issues and is informed, gathers relevant data, gives feedback, and creates a professional atmosphere. Known barriers include micromanagement, poor interpersonal skills, inexperience, time pressure and new unfamiliar situations.

Example - Mechanic was sent to do a final check on an engine prior to a functional check flight. Instead of using a ladder to reach the engine compartment, the sailor elected to drive a tow tractor next to the aircraft. After completing the check he started for the hangar, but unfortunately he hit a snag, the propeller. He hoped the 4" chunk missing from the blade would not be noticed. Luckily the aircrew did a good preflight. Should the sailor have shown more leadership by owning up to the mistake? Could leadership prevent this from happening again?

Note. All the behavioral skills are key ingredients to developing, fostering and maintaining the crew concept for aircraft maintenance and line personnel. Further, all seven behavioral skills are intertwined and must be part of any crew activity.

Case Examples

Here are a few Aviation Ground Mishaps from the past few years. Can you pick out the breakdown in crew concept and what behavioral skill(s) could have been used to prevent these scenarios?

I Maintainer was told to retrieve a forklift from the other side of hangar. The supervisor was not in visual contact during move and the forklift struck a parked aircraft.

(Mission Analysis, Decision Making, & Situational Awareness)

I Lineman waiting for crew members started the tow tractor and inadvertently released the brakes. The vehicle jumped forward and struck a parked aircraft.

(Decision Making, Adaptability/Flexibility, & Leadership)

I Checker's view of crew position on the flight deck was obscured by catapult steam. During aircraft spotting a member's ankle was pinned by a main gear.

(Communication, Situational Awareness, & Adaptability/Flexibility)

I Tow director pushing back an aircraft did not maintain proper clearance and the wingwalker did not signal to stop move. The towed aircraft struck a parked one.

(Communication, Assertiveness, & Situational Awareness)

I Maintainer, without supervision, loosened aircraft jacks for removal. The loosened side slipped, the aircraft shifted, and it rolled onto its side.

(Mission Analysis, Decision Making, & Situational Awareness)

I Fuel truck was en route to transient line. Driver moved out to negotiate around a parked aircraft and stuck another waiting for clearance.

(Mission Analysis, Situational Awareness, & Adaptability/Flexibility)

Note. Clearly there is more than one behavioral skill involved in each of these cases.

SUMMARY AND CONCLUSION

Despite GCT being developed in "isolation," without knowledge of Continental's CCC program, it is clear that the two efforts parallel each other and emphasize the development and nurturing of the same team building behaviors and skills. As the GCT program evolves, complimentary features of the CCC program will be incorporated and lessons learned followed. Currently, the GCT brief is highly requested by the Fleet and has been given to over 50 active and reserve operational squadrons and maintenance units. Generally, aircraft maintainers and line personnel, ranging from fairly junior airmen to mustang maintenance officers, see the merits of this initiative and want more. The full course will be completed later this spring, and after formal review, made available throughout the Fleet. Finally, there is an ongoing analysis of all Aviation Ground Mishaps and Personnel Injury Reports for the past ten years to assess the magnitude of the crew coordination problem and its associated costs. The results will be used to develop metrics, similar to those used by Continental Airlines, to determine the effectiveness of this new program.

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APPENDIX



Figure 7-1 Class A Flight Mishap Rate