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Review of Current Aircrew Coordination Training Program and Master Plan for Program Enhancement: Aircrew Coordination Training Master Plan

Gary Grubb
Dynamics Research Corporation

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Grubb, G., Simon, R., Goddard, J. and Kline, K. (Dynamics Research Corporation)

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
Dynamics Research Corporation
60 Frontage Road
Andover, MA 01810

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13. ABSTRACT (Maximum 200 words)
This report presents the results of reviewing the training and evaluation of aircrew and team coordination aspects of the Army's current Aircrew Coordination Training (ACT) program to develop a master plan of continuous improvement. Research source materials included policies, training courseware, evaluation guides, research papers and reports, and assessment summaries of operational trend data. Information was developed from interviews with team coordination subject matter experts and published information across the Department of Defense military services, commercial carriers, and academia. Interviews, reviews, and information results focused on ACT policy, training, evaluation and risk management, and future plans and research. The results of the review lead to the conclusion that the Army's ACT program effectiveness has greatly declined since 1995 due to limited funding and requires revitalization and enhancement. Because Army aviation reorganization and modernization initiatives impact all units and components, it is now more important than ever to develop an integrated strategy of corrective actions. The report includes a recommended Master Plan for ACT Enhancement in the form of a proactive, multi-phased course of continuous improvement to maximize Army aviation modernization investments and complement leadership training initiatives.

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REVIEW OF CURRENT AIRCREW COORDINATION TRAINING PROGRAM AND MASTER PLAN FOR PROGRAM ENHANCEMENT: AIRCREW COORDINATION TRAINING MASTER PLAN

EXECUTIVE SUMMARY

Research Requirement

This applied research effort reviewed the training and evaluation of aircrew and team coordination aspects of the Army's current Aircrew Coordination Training (ACT) program to develop a master plan of continuous improvement actions.

Procedure

Research included the use of standard information gathering techniques including personnel interviews, Internet searches, and document reviews. Source materials included policies, training courseware, evaluation guides, research papers and reports, and assessment summaries of operational trend data. Information was developed from interviews with team coordination subject matter experts (SMEs) and published information across the Department of Defense (DoD) military services, commercial carriers, and academia. Interviews, reviews, and information results were focused on ACT policy, training, evaluation and risk management, and future plans and research. The Army's Aircrew Coordination Working Group (ACWG) provided valuable guidance and assistance. The ACWG is chartered and staffed with representatives possessing recognized knowledge and experience in aircrew coordination training, standards and evaluation, safety, and human factors to coordinate and review the research.

Findings

The current ACT program does not adequately support the dramatic changes in Army aviation mission complexity, operational tempo (OPTEMPO), declining experience levels, and modernized systems. Unlike other DoD services and commercial carriers, there is no annual sustainment training or formal system to evaluate program performance. Cockpit automation coupled with the trend to move from side by side seating (e.g., OH-58D Kiowa Warrior) to tandem seating (e.g., RAH-66 Comanche) will require extensive and continuous training to reinforce the team coordination skills required to operate these systems. Progressive fielding of Army distance learning facilities supports the use of web-based training delivery systems. Distributive Interactive Simulation (DIS) is currently in the developmental and testing phase with limited linking of simulators for aviation training exercises.

ACT is a key risk management control measure. The Army's Aviation Safety Investment Strategy Team (ASIST) estimates that an ACT sustainment program would realize a significant reduction in aviation accidents and accident costs. The current accident investigation process does not adequately address ACT and accident investigators are not trained to recognize ACT basic qualities as a factor in the accidents they investigate. The Army's formal development plans for the future make minimal reference to team training. Unlike other DoD services, there is

no dedicated ACT program management, research and development program, or recurring funding plan.

Utilization of Findings

The results of the review lead to the conclusion that the Army's ACT program effectiveness has greatly declined since 1995 due to limited funding and requires revitalization and enhancement. Program requirements include major actions in the areas of policy, training, evaluation and risk management, and plans and research to realize potential opportunities.

Because Army aviation reorganization and modernization initiatives impact all units and components, it is now more important than ever to develop an integrated strategy of corrective actions. The Master Plan for ACT Enhancement provides a proactive, multi-phased course of continuous improvement to maximize Army aviation modernization investments and complement leadership training initiatives. Phase One begins the applied research effort to upgrade the current Army ACT program and sustain the upgraded program. Phase Two completes the applied research effort to refresh and maintain the upgraded program to provide graduate-level ACT training. Phase Three incorporates prototype research products developed in previous phases as part of normal flying operations and deploys advanced ACT applications.

Results of the investigation suggest that opportunities exist to: 1) integrate ACT into all aspects of aviation operations, 2) reinforce ACT in the Flight School XXI (FS XXI) initiatives to include aviation leadership training and junior officer professional development, 3) incorporate ACT into all aspects of mission training, 4) recognize ACT as a key component in Army aviation's risk management and decision making process and controls, 5) capitalize on advances in distance learning and web-based instructional technologies, and 6) contribute to and apply results of team coordination research and development initiatives of other DoD services.

REVIEW OF CURRENT AIRCREW COORDINATION TRAINING PROGRAM AND MASTER PLAN FOR PROGRAM ENHANCEMENT: AIRCREW COORDINATION TRAINING MASTER PLAN

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Introduction

Background

Beginning in 1988, the US Army Research Institute (ARI) began conducting a program of training research that responded to the Army's need for better crew coordination training. This program of research was conducted in close cooperation with the US Army Aviation Center (USAAVNC) and its efforts to revise its training standards to reflect increased emphasis on crew-level performance.

The USAAVNC formed a Working Group in early 1990 to incorporate the results of the aircrew coordination research into revisions of the total Aircrew Training Program (Training Circular 1-210, Aircrew Training Program: Commander's Guide to the Aircrew Training Program) and Aircrew Training Manuals (ATMs) for all Army aircraft. The March 1992 revised Training Circular (TC) 1-210 introduced battle rostering and crew coordination as policies designed to improve effectiveness and safety by shifting the training emphasis from individual to crew-level performance.

The new crew coordination policy, designed to standardize crew behaviors, required the development of a training course of instruction. Dynamics Research Corporation (DRC) worked closely with the USAAVNC Working Group to draft training and evaluation methods and materials for a crew coordination validation testbed effort. During the 1992 validation testbed, Fort Campbell, KY units selected UH-60 crews who completed four missions in the visual flight simulator. The testbed demonstrated and validated the program for training and evaluating crew coordination skills. Testbed results showed that the crews performed their missions significantly more effectively and safely after the training than before the training (Simon & Grubb, 1993). The USAAVNC approved the Aircrew Coordination Exportable Training Package (ETP) (Pawlik, Simon, Grubb, & Zeller, 1992) late in 1992.

Crew coordination training promotes a set of aircrew coordination skills and abilities that can increase mission effectiveness, while decreasing the errors that lead to accidents. The initial Aircrew Coordination Training (ACT) program was first implemented in 1993 as an ETP. In June 1995 the requirement was established that all active duty flight crewmembers would be qualified in aircrew coordination not later than 31 May 1997. The reserve component (RC) had a required completion date of 31 May 1998. This training was deemed to be so important that the Army redesignated Readiness Level (RL) 1 crewmembers, without ACT, to RL 2 until the training was completed. This adversely affected a unit's RL reporting (USAAVNC Message dated 141500Z Jun95).

Following implementation of the initial ACT program, the aviation accident rate dropped dramatically. Commanders and aircrews alike acknowledged the benefit of the mandatory, one-time training that was received by all crewmembers within the Army. The initial program did not

address sustainment issues and did not package the training in a manner that would facilitate updates. Sufficient funds were not provided for developing a program to sustain this training. The Army National Guard (ARNG) recognizes the aircrew coordination program as a key element of the unit commander's safety and standardization program, and periodically develops and distributes ACT-related training materials. The ARNG has an interest in improving the quality of this training. Several factors are believed to limit attaining and maintaining high levels of Army aircrew coordination. These include significant personnel turbulence associated with downsizing and high operational tempo (OPTEMPO), the lowering of experience levels, and the atrophy of skills due to reduced flying hours that has resulted from successive years of limited funding.

In early 1998, the USAAVNC formed a special Aircrew Coordination Working Group (ACWG) to explore the increase in ACT-related accidents. The ACWG addressed the immediate problem of spatial disorientation by incorporating the issue into an overall assessment of the ACT program (see Figure 1). Results of the ACWG effort and their recommendations were noted but not acted on due to inadequate funding. These results continue to guide the enhancement effort and are included in this review of the current program and assessment of future actions.

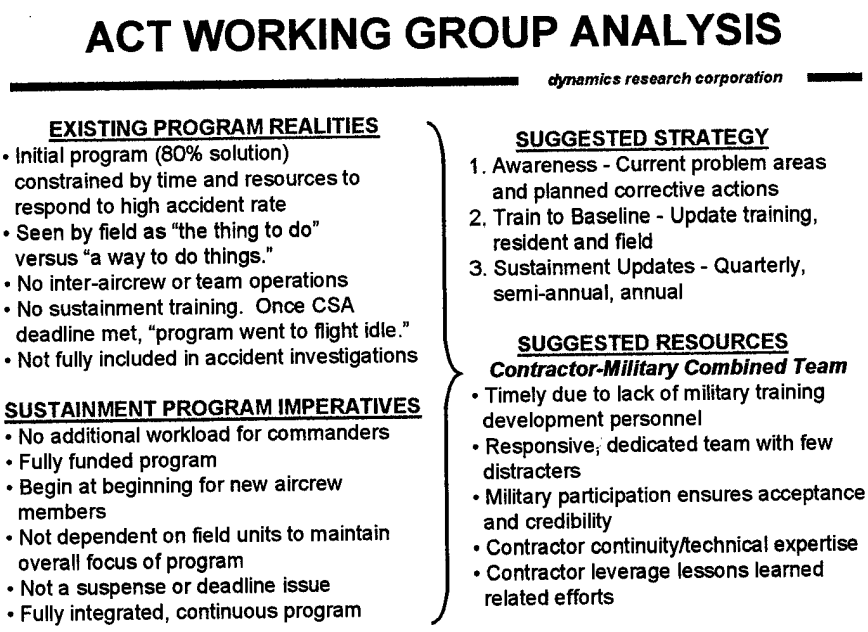


Figure 1. ACWG analysis, 1998.

Lack of effective aircrew coordination continues to be cited as a factor in a substantial number of aviation flight accidents, and it is a factor limiting attainment of the full mission effectiveness of Army aviation. For example, the Director of Army Safety reported in the December 1999 issue of Flightfax, "In fact, FY99 produced Army aviation's worst safety performance since Desert Shield/Desert Storm (Lacoste, 1999)." The ACT program has not been updated since its original introduction. Among the factors believed to limit attaining and

maintaining high levels of Army aircrew coordination is the lack of a mechanism to effectively sustain the program. In his recent CSA Sends: Risk Management Message, the Army Chief of Staff stated, "Ensure aircrew coordination training is sustained. The Aviation Center is building an exportable training package. Review your requirements, and enforce the training standards established by Aircrew Training Manuals (ATM)."

Purpose

ARI is undertaking applied research and development to design and develop prototype training and evaluation products for enhancing the Army's ACT program. The overall purpose of this research is to improve the crew and team coordination effectiveness of Army aircrews and aviation leaders in their day-to-day mission planning and flight operations. Properly utilized, this program will provide a tool for leaders at all levels to use as a hazard control in risk management integration. The enhanced ACT program will build on the original exportable training package, revitalizing it from a one time training event and enhancing it to a dynamic, living program that is continuously updated and improved. The purpose of this investigation is to review the current ACT program with emphasis on the training and evaluation of aircrew and team coordination and to develop a master plan of actions to enhance, integrate into daily operations, sustain, and maintain ACT.

Objectives

The intent of this research is to establish and maintain a unit-level command climate that promotes the use of team coordination behaviors and places equal emphasis on technical and team coordination skills in daily flight operations. When fully developed and deployed, the Aircrew Coordination Training Enhancement (ACTE) program will provide mission oriented sustainment training and provisions for annual updates. The ACTE program will use advanced adult learning technologies to deliver team coordination skills instruction. Included in this program will be tools and techniques for applying and evaluating the effectiveness of the unit's crew coordination skills. The mature program will provide for ongoing program evaluation and management to keep the training realistic, relevant, and responsive to the needs of Army aviation.

The first objectives in the enhancement effort are to:

1. Conduct an analysis of the current aircrew coordination training program from a total systems perspective to identify conflicts, bottlenecks, and deficiencies in the conduct and implementation of aircrew and team coordination in daily flying operations.

2. Develop a Master Plan of tasks that once intergrated into daily operations will enhance, sustain and maintain ACT utilizing state of the art training methods.

Assumptions

The ACT Master Plan is an integral element of support for the Army Aviation Modernization Plan. The ACT Master Plan ensures protection of aviation assets by assisting in accident reduction while increasing mission effectiveness. The assumptions in this ACT Master Plan provide the foundation for an effective, ongoing ACT program.

1. Policy updates, in the form of the Aircrew Training Program (ATP), will be expanded to provide greater emphasis on ACT and specific direction for aircrew coordination sustainment and evaluation.

2. ACT will be formally integrated into career progression training and unit assignments for rated and non-rated crewmembers to achieve and sustain ATP standards in crew coordination.

3. Instructors and evaluators will formally evaluate ACT to provide aircrew and unit level performance feedback.

4. Assistance visits for the purpose of evaluating standards, safety, and training will include collection and assessment of ACT data to measure program effectiveness and establish trends.

5. Investigation of aircraft accidents and incidents will reflect the framework used to define the ACT program to identify and record aircrew coordination contributing factors.

6. Future plans and investments will provide distance learning, distributed interactive simulation, and leadership support to deliver and maintain ACT enhancements.

7. Funding will support an ongoing commitment to a formal Army ACT sustainment program.

Method

The research methods included the use of standard information gathering techniques. These techniques included interviews, Internet searches, review of published papers and reports, conference and symposium proceedings, and review and analysis of operational trend data. In April 2000, the ACWG was chartered and staffed with representatives possessing recognized knowledge and experience in aircrew coordination training, standards and evaluation, safety, and human factors for the purpose of reviewing measures, methods and training materials developed by the contractor, DRC. The ACWG is composed of designated representatives of USAAVNC and Fort Rucker, and other agencies that may have information or resources that could contribute to planning or developing the program, or have a role in implementing or evaluating the program.

Subject Matter Experts (SMEs) and Resource Organizations

Information was developed from interviews and published information from the following aviation and ACT SMEs:

1. ACWG consisting of representatives of the following offices:

   ARI, Directorate of Training, Doctrine, and Simultion (DOTDS), Aviation Branch Safety Office (ABSO), Aviation Training Brigade (ATB), United States Army Safety Center (USASC), Directorate of Evaluation and Standardization (DES), and Army Reserve Components

2. DRC consisting of:

   Institute for Team Performance (ITP), Crew Performance Group (CPG), and Interactive Courseware Development Team (ICDT)

3. Other Agencies including:

   US Navy ACT/Cockpit/Crew Resource Mangement (CRM) Instructional Model Manager
   Air Force Research Laboratory (AFRL)
   US Army National Guard Western Area Aviation Training Site (WAATS)
   A Company 1-14th Aviation (Boeing Longbow Factory, Mesa, AZ)
   CRM Industry Workshop representatives from commercial carriers

Materials

Materials used include print, digital and videotape. The assessment of current ACT programs included interviews with current program managers and a review of their respective ACT/CRM policies. Categories of materials used for the purpose of developing the ACT Master Plan are summarized in Table 1. This table is a representative display of current materials

reviewed and should not be construed as an all-encompassing list. The review of current publications was limited by the applicability of non-military research to military applications.

Table 1.

Research Materials

Document	Policy	Training	Eval/Risk Mgmt	Plans
ATM's (Current & Drafts)		X	X	
TC1-210 & TC1-200 Draft	X	X		X
ACT ETP 1992 & 1995		X		
AR 95-1 thru AR 95-3	X	X	X	
ACT Policy Messages	X	X		
AFI 11-290 CRM Training	X	X	X	
Army Distance Learning MP		X		X
2000 Army Aviation Mod Plan				X
TEMO Domain Management MP				X
OPNAVINST 3710.7R Jan 97	X	X		
OPNAVINST 1542.7B Sep 98	X			
ASIST Briefing Nov 2000				X
Evolution of CRM in Com Avn		X		
Flightfax-Various issues		X	X	X
Army Aviation				X
AFRL Tng. Effectiveness in DMTE				X
Current Commercial Avn. Products		X		X

Procedure

Prior to conducting interviews of ACT SMEs, members of DRC's staff completed a review of relevant publications and policies that had been written by the subject matter experts themselves or had originated from their office or organization. The review of previously published information by the interviewer allowed the DRC team to focus and structure relevant questions around topic areas that would lead to a productive interview (see Table 2). The document review also served as a means to ensure that the data and trends were in line with current ACT best practices and emerging research insights. Additionally the purpose of the visits and interviews was to develop a mutually beneficial working relationship with selected program individuals to assist in the overall research effort.

Table 2.

Interview/Research Topics

Subject Area	Specific Areas of Interest	Military Organizations	Civilian Organizations	Research Scientists	Safety Professionals	Publications
Current ACT/CRM Program	Key Milestones	X	X			X
	Behavioral Organizing Structure	X	X	X		X
	Accident vs. Incident Tracking	X	X		X	X
Basic ACT/CRM Program	ACT Intro. Point	X	X			X
	Evaluation Frequency of ACT	X	X	X	X	X
	Evaluation "Go/No Go" Standards	X	X	X	X	X
	In Flight Standards	X	X	X		X
Advanced ACT/CRM Programs	Individual/Collective Training	X		X		X
	Mission Focus	X		X		X
	Multi-Aircraft ACT	X		X		X
	Evaluation Criteria	X	X	X	X	X
	Sim. Usage/ACT Scenarios	X	X	X		X
Continuation Refresher Sustainment Programs	Follow on Training	X	X			X
	Refresher ACT	X	X			X
	Post Mission Debriefs	X	X	X	X	X
	Crew Teams	X	X	X		X
	Accident Incident Evaluations	X	X		X	X
Cockpit Automation	Multi-Mission Effects	X		X	X	X
	Cockpit Upgrades	X	X	X	X	X
	Peacekeeping Ops	X			X	X
Distance Learning & Unit Updates	Deployment Training	X		X	X	X
	Internet, Web Based Training	X	X	X	X	X
	Current Accident/Incident Information	X	X		X	X
Future Plans for ACT/CRM		X	X	X	X	X

Results

Other Department of Defense (DoD) and commercial ACT and (CRM) training programs are discussed first to provide a baseline for comparison with the U. S. Army ACT program. The terms ACT and CRM are used synonymously for team coordination training.

Other DoD ACT and CRM Training Programs

During the investigation phase DRC staff reviewed and evaluated the current DoD ACT and CRM training programs. The two major programs reflected here are the US Air Force and Naval (includes Marine Corps) Aviation. In general, both services have active ACT/CRM programs and working groups backed up with mandatory flight regulations and directives. A summary of each service's program follows:

US Air Force CRM

The Air Force CRM program, through policy guidance in Air Force Instruction (AFI) 11-290 and Major Command (MAJCOM) supplements, provides crewmembers with performance-enhancing knowledge and skills directly applicable to their roles in the aerospace mission of the Air Force. CRM training is a key component of a combined effort to identify and manage the conditions that lead to error. The CRM program begins with crewmembers' initial Air Force flying training and is continuously built upon throughout their operational careers. Training objectives are tailored to the knowledge and skill level of the aircrew member. As the aircrew member becomes more proficient, CRM training emphasizes performance skills more than academic objectives. Lead commands define "crewmember" in terms of their own operational mission requirements and determine the primary weapon system for all dual-qualified personnel. CRM training is oriented toward the primary weapon system. Each MAJCOM, Field Operating Agency (FOA), and Direct Reporting Unit (DRU) CRM training program:

1. Provides training to develop and improve CRM knowledge and skills.
2. Updates annually to incorporate: "real-world" operational experiences, mishap data, research data, critiques, and flight evaluation trends.
3. Identifies the process for gathering, analyzing, and incorporating trend data into existing training and evaluation programs.

CRM managers, at all levels, insure continuity of course content with the introductory courses. CRM skills and training are:

1. Integrated into flight briefings and debriefings.
2. Integrated into training syllabi.
3. Assessed during initial qualification and evaluations.

Air Force CRM training is conducted in five separate phases. These different levels of training allow for a building block concept of training. Each phase of training relates to and builds upon the previous training. Each level of training allows for review of the basics then capitalizes on the experiences of the crewmembers. Training progresses from the lecture method

through guided discussion on to a full-facilitated method of instruction. The changes in teaching style reflect the knowledge acquired by the crewmembers over the span of their careers.

Phase 1-Introductory or awareness training. This phase is similar to Army Initial Entry Rotary Wing (IERW) ACT. This may be a crewmember's first exposure to CRM. Air Education Training Command conducts it in a formal training environment. Crewmembers learn standard CRM terminology and core concepts. Lesson plans include a description of the building block approach to CRM training that crewmembers participate in throughout their operational career.

Phase 2-Formal training unit (FTU)/Combat Crew training school (CCTS) CRM training. This phase is similar to Army aircraft qualification course, though there is no Army ACT equivalent for combat crew training. Students learn to apply knowledge and skills related to their assigned aircraft. Academic training is complemented during aircraft/simulator training. Emphasis is placed on preflight planning, briefing, in-flight utilization, and debriefing techniques for CRM. This phase of training includes a brief review of CRM core concepts. Mission Oriented Simulator Training (MOST) sessions or other simulated or actual operational scenarios are used as integral parts of CRM training. Crewmembers are evaluated on technical expertise, as well as their skills based on six core CRM concepts. If aircrew-training devices are not available, students participate in-group problem-solving exercises.

Phase 3-Mission-specific continuation training. This phase is similar to Army operational unit RL progression, though there is no standard ACT RL requirement. MAJCOMs, FOAs and DRUs are responsible for CRM continuation training. This phase reinforces the aircrew's CRM academic knowledge and refocuses on skills to accomplish the mission. It also helps aircrews identify and respond to the conditions that lead to error. Emphasis is placed on CRM skills in the mission qualification and continuation training programs so they become inseparable parts of operational practices. Frequency for recurring CRM continuation training is defined in command policies, generally speaking annual training is the norm. Lead commands are responsible for providing guidance to standardize CRM mission design and series (MDS) specific training policy and requirements. All aircrews require mission-specific continuation training. Separating training by crew position is avoided. However, a complete crew is not required to conduct continuation training.

Phase 4-Flight instructor training. This phase is similar to the Army's instructor pilot course consisting of a four-hour review of ACT skills as a non-testable block of instruction. All flight and simulator instructors will complete instructor specific CRM training. This training is normally accomplished as part of an instructor upgrade program. Courseware is built upon the previous blocks of training, both to reacquaint instructors with CRM fundamentals and to maintain continuity of terminology and techniques. MAJCOMs, FOAs and DRUs develop courseware related to instructing and evaluating key skills that apply to command and aircraft specific missions. Personnel conduct this training at operational units, flying training units, or a combination, as required. Training includes the proper use of AF Form 4031, CRM Skills Criteria Training/Evaluation Form. CRM instructors and evaluators are highly proficient in all CRM skills, and experts in the recognition, observation, and reinforcement of these skills as aircrew members apply them.

Phase 5-Facilitator training. This phase is similar to ETP for instructors, though there is no Army equivalent formal training. A trained CRM facilitator delivers formal CRM academic curricula. Facilitator training includes training in running exercises, structured crew observation, and effective academic feedback (AFI 11-290, July 1998).

Air Force Distributive Mission Training (DMT). The DMT program is one of several ongoing research projects in ground-based training that will allow pilots and other warfighters to train for complex, multi-player combat operations. Researchers from the AFRL, Warfighter Training Research Division (AFRL/HEA) and others are investigating strategies for using DMT to augment advanced flying training in operational units. Research on training effectiveness of multi-ship simulation systems has been ongoing at AFRL/HEA for almost ten years. In addition to research on networked simulation technologies, activities have focused on effective and efficient application of DMT for continuation training of fighter pilots and air weapons controllers. Effective application of multi-player simulation for enhancing individual and team skills has been demonstrated for fighter, ground attack, and helicopter crews. An example from one such study indicates that F-16 pilots who have flown in a distributed environment rated DMT as particularly effective for training four-ship air-to-air employment against multiple enemy aircraft (Crane, Schifflet, & Oser, 2000). Individual skills identified by F-16 pilots as being enhanced by DMT include radar mechanization (i.e., using the various modes and capabilities of the air-to-air radar to efficiently detect, track, and target multiple aircraft), communication, and building situation awareness. Improved team skills include maintaining mutual support, tactical execution, and flight leadership.

Researchers state that DMT capabilities like programmable scenario generation tools and computer-generated threats with the capability for autonomous action permit instructors to take advantage of findings from research on instructional principles to design training and rehearsal events that will meet specified objectives. In multi-ship air combat, training objectives for upgrading pilots include learning to recognize enemy aircraft formations and selecting an appropriate tactic, communicating the plan to the rest of the flight, executing the plan, and changing tactics as required. Another key element in the success of DMT is the capability to replay and debrief missions. Using the replay system, pilots can review the information that was available to them inside the cockpit together with the plan view display's depiction of the complete tactical situation. Execution errors, poor communication, and unplanned contingencies are quickly apparent. Several studies have been conducted that seek to relate CRM to mission performance. Research continues on this subject.

U.S. Navy ACT

Naval ACT programs, which include Marine aviation, through guidance in the Office of the Chief of Naval Operations Instruction (OPNAVINST) 1542.7A Chief of Naval Operations (CNO) policy provides Naval aviation with an integrated ACT program. Standardized training strategies are used in such areas as academics, simulators and flight training. All personnel whose duties involve flying as an aircrew member in naval aircraft receive integrated ACT. The goal of naval ACT is to improve mission effectiveness by minimizing crew preventable errors, maximizing crew coordination, and optimizing risk management. Integration of specifically

defined behavioral skills throughout Naval Aviation academics, simulators and flight training is accomplished using task-based analyses developed by Naval Air Warfare Center (Training Systems Division) (NAWCTSD), and taught by the Instructional Model Manager. This instruction establishes minimum standards for each aircraft type/model (T/M) integrated ACT program. Naval ACT is a five phased program designed to acquaint aircrew members with T/M-specific aircrew coordination requirements.

1. Initial ACT occurs during undergraduate aviation training (UAT) and during all Fleet Replacement Squadron (FRS) training leading to T/M designation under the Naval Aviation Training and Operational Procedures Standardization (NATOPS) Program.

2. Recurrence training occurs annually while in a flying position. Training includes ACT history, seven (7) critical skills, OPNAVINST 1542.7B, 1998, a T/M specific case study or scenario, and a flight evaluation conducted by an ACT instructor or ACT facilitator.

ACT flight evaluations may be conducted concurrent with any simulator flight, operational flight, and training flight or NATOPS check ride. Training is required to be completed annually during the evaluation period, similar to the Army Annual Proficiency and Readiness Test (APART) period. Personnel who perform duties as an aircrew member in more than one T/M aircraft receive ACT in each T/M aircraft. Full recurrence training is completed in at least one T/M aircraft and modified recurrence training, consisting of a T/M case study or scenario and a flight evaluation, is completed for all other T/M aircraft. ACT is logged in the individual NATOPS Flight Personnel Training/Qualification Jacket (OPNAV 3760/32). The pilot in command of any naval aircraft is required to ensure that personnel on orientation and indoctrination flights are thoroughly briefed on aircrew coordination requirements.

Phase 1-Initial ACT instruction. This initial phase is similar to Army IERW ACT training conducted during initial flight training and consists of academic instruction and case study analysis. The purpose of this training is to develop the student's basic knowledge of ACT's seven critical skills and Navy ACT policies and procedures.

Phase 2-Individual aircraft ACT. This phase is similar to Army aircraft qualification course though there is no Army ACT equivalent T/M training, i.e., an ACT program developed specifically for aircraft type and mission. This level of training builds on the skills learned during initial ACT instruction and utilizes case studies of the particular aircraft.

Phase 3-FRS. FRS training is similar to Army operational unit (RL) progression though there is no Army wide ACT equivalent training requirement. FRS training is conducted at the FRS to prepare a unit for a ship borne deployment. This preparation period is similar to Army units preparing to deploy on extended missions, i.e., Kuwait and Bosnia. This training emphasizes the unit as a whole and ACT's relationship to naval operations. Commanders have been known to conduct evaluations in this phase and not certify a crew "ready for deployment" due to deficiencies in ACT skills.

Phase 4-Aircrew coordination facilitator training. This phase is similar to ETP for instructors though there is no Army equivalent training or review. Designated T/M ACT Instructors provide the instruction. The course of instruction is T/M specific and includes: ACT history, seven critical skills, OPNAVINST 1542.7B, ACT program administration, and ACT instruction and evaluation techniques.

Phase 5-ACT instructor training. Similar to the Army's instructor pilot course consisting of a four-hour review of ACT skills as a non-testable block of instruction this training provides ACT Instructor training. This course of instruction includes; ACT history, the seven critical skills, ACT methodology, computer aided curriculum development, contract administration, ACT instruction and evaluation, case study and scenario development, instructional techniques, program management and administration, and OPNAVINST 1542.7B.

Naval aviation is conducting on-going ACT research. This research, centered at the NAWCTSD includes both hardware development and human factors studies. Hardware developments such as the 2F87C(T) P-3C Aircraft Tactics Team Trainer has allowed for studies of the team environment in a simulator that allows full interaction of team members. Human factors studies have focused on areas such as effective leadership/ followership in the cockpit, the impact of pre mission-briefing style on crewmembers assertiveness, and aircrew recognition of aircrew coordination behaviors. Naval research, in concert with the Federal Aviation Administration (FAA), has taken an interagency approach into research of Air Traffic Control (ATC) personnel and teamwork in the control tower.

Summary of Other DoD Team Training Programs

In general several key points can be derived from the other DoD services concerning their ACT/CRM training programs:

1. Other DoD services have well staffed and funded ACT/CRM working groups.
2. There is Flag Officer influence in ACT/CRM programs.
3. Program managers are assigned to specific ACT/CRM positions.
4. Annual training is required and failure to complete the training is cause to ground an aircrew member.
5. Training is aircraft and mission specific.
6. Training continues throughout an aircrew member's flying career.
7. Training is mission based.
8. There is ongoing research and development in ACT/CRM related issues.

Commercial Aviation Team Training Programs

CRM in U.S. commercial carriers is an outgrowth of National Aeronautics and Space Administration (NASA) research into the causes of air transport accidents. Research results presented at a workshop in 1979 identified the human error aspects of the majority of air crashes as failures of interpersonal communications, decision-making, and leadership. The label CRM was applied to the process of training crews to reduce "pilot error" by making better use of the human resources on the flight deck. United Airlines implemented the first comprehensive U.S. CRM program in 1981 and within five years a growing number of commercial carriers had initiated CRM training. A new generation of CRM courses emerged emphasizing group dynamics bringing about a change in name from Cockpit to Crew Resource Management. Delta Airlines pioneered the new courses by focusing on more specific aviation concepts related to flight operations with more modular instruction that was team oriented in nature (See Helmreich, et.al, 1999, for a complete discussion of the evolution of CRM training).

CRM training in the early 1990s began to reflect characteristics of the complex aviation system in which crews must function. Efforts began to integrate CRM with technical training and to focus on specific skills and behaviors that pilots could use to be more effective, e.g., flight deck automation. Programs began to address the recognition and assessment of human factors issues as well as advanced training in CRM for check airmen and others responsible for training, reinforcement, and evaluation of technical and human factors. The FAA made the major change in flight crew training and qualification with the initiation of its Advanced Qualification Program (AQP). AQP is a voluntary program that allows air carriers to develop innovative training that fits their specific organizational needs. With this greater flexibility in training, carriers are required to provide both CRM and Line Oriented Flight Training (LOFT) for all flight crews and to integrate CRM and technical training. Most of the major U.S. airlines and several regional carriers are transitioning into AQP and developing programs that address the human factors (CRM) issues in each aspect of training. Special training is required for those charged with certification of crews and formal evaluation of crews using full mission simulation, i.e., Line Operational Evaluation (LOE).

The premise that human error is ubiquitous and inevitable underlies the latest generation of CRM. If error is inevitable, CRM can be viewed as a set of error countermeasures to avoid, trap, or mitigate the consequences of errors that occur and are not trapped (see Figure 2).

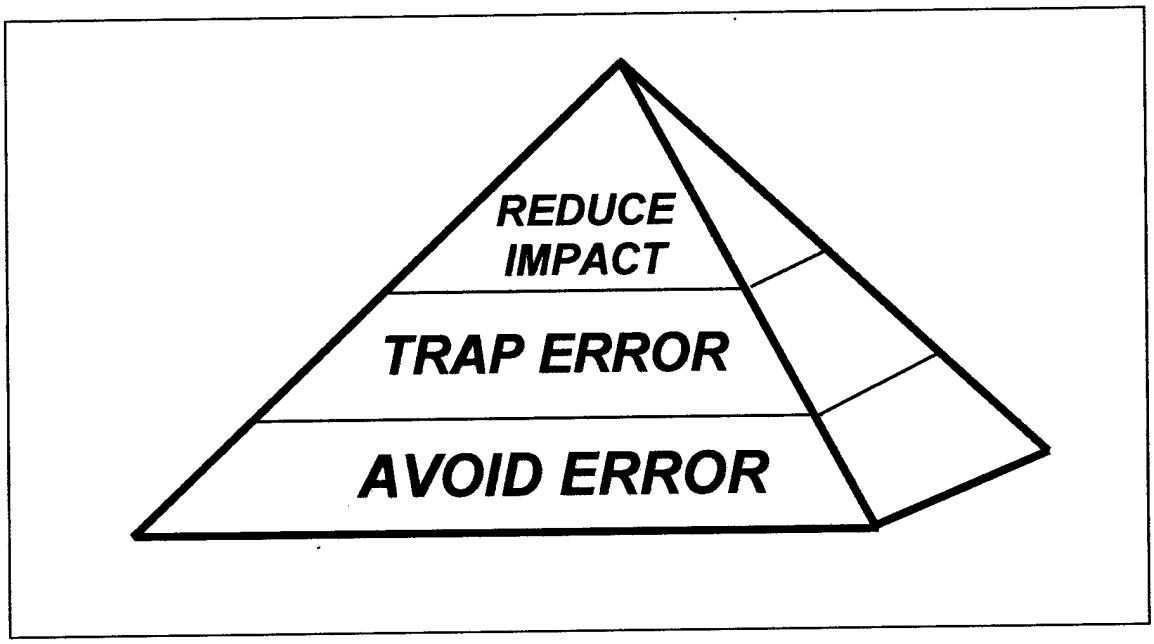


Figure 2. Error management model.

Commercial aviation has discovered that to implement an effective error management program, organization leaders at all levels must communicate their formal understanding that errors will occur. Organizations should adopt a non-punitive approach to error. This does not mean that an organization should accept willful violation of its rules or procedures. Additionally, organizations need to take steps to identify the nature and sources of error in their operations. The FAA's initiative, Aviation Safety Action Programs (ASAP) encourages incident reporting within organizations to deal with safety issues proactively.

American Airlines has implemented the program with the cooperation of the pilots' union and the FAA. American's confidential, non-jeopardy reporting system has allowed pilots to report more than 22,000 safety concerns and errors via their web site over the past six years. This commercial carrier includes ASAP events with reports from their Flight Operations Quality Assurance program for review, recommended corrective actions, and crew advisories. Events are reviewed weekly with updates to pilots and staff every six weeks and formal analysis reports published semi-annually. Trend analysis is used to identify hazards and threat areas as the basis for realistic, relevant events for classroom and simulator training materials. The University of Texas is conducting research into the sources of error using a Line Oriented Safety Audit method to collect data from multiple, participating commercial carriers. Preliminary findings indicate that 31 percent of all errors are automation related and 54 percent of all errors are due to noncompliance.

U.S. Army ACT Program

The current Army ACT program was fielded in 1993 as a one-time, unit level ETP designed to train the aircrew members assigned to the unit at that time. The training consisted of eighteen hours of academic training and twenty hours of simulator or flight training conducted by ACT instructors (see Table 3).

Table 3.

Army ACT ETP Hands on Components

Flight Period	Premission Planning	Flight Period	Crew Debrief
1	1.5 hrs	1.75 hrs	1.75 hrs
2	1.5 hrs	1.75 hrs	1.75 hrs
3	1.5 hrs	1.75 hrs	1.75 hrs
4	1.5 hrs	1.75 hrs	1.75 hrs
Total Time	6.0 hrs	7.0 hrs	7.0 hrs

The program was considered an 80% solution to Aircrew Coordination and was not funded to receive annual updates. The USAAVNC took the ETP, changed it to an eight-hour block of academic instruction without simulator or flight periods, and is teaching it to all IERW students. Aviator Qualification Courses (AQC) conducted by the USAAVNC do not have formal aircrew coordination as part of their Program of Instruction (POI). Upon graduation from flight training a crewmember is considered qualified in ACT. The instructor pilot courses provide a four-hour, non-testable, version of the block of instruction without any simulator or flight periods (see Figure 3).

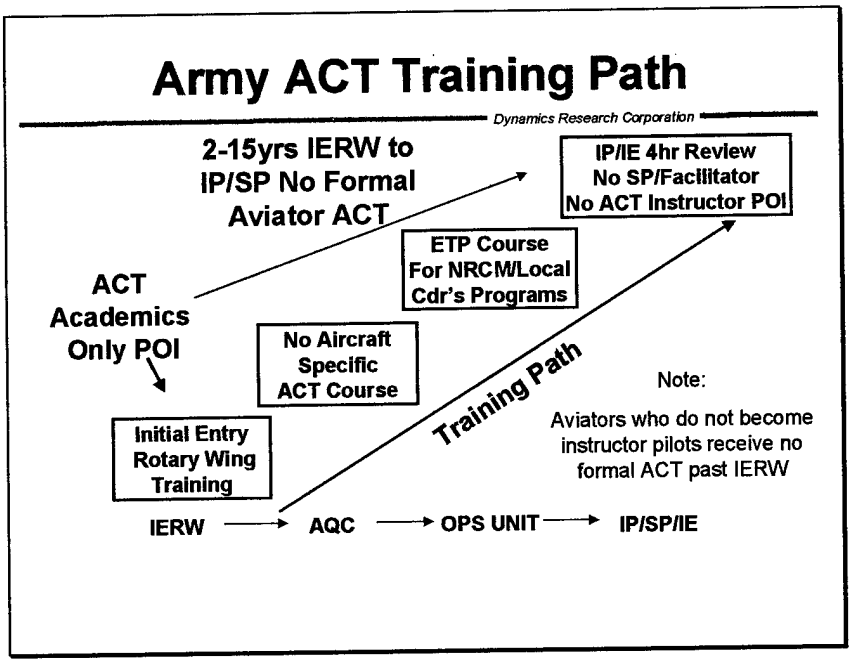


Figure 3. Army ACT training path.

A recent survey of 108 Army crewmembers revealed that over 93% felt that the crew coordination course they received was beneficial to them in the performance of their duties. Over 58% of these same crewmembers indicated, their current units did not have a continuation program, but 81% thought that a continuation program was necessary.

In 1999, the V Corp Aviation Safety and Standardization Detachment (CAASD) published a memorandum stating that all United States Army Europe (USAREUR) aviation units would conduct an ACT sustainment program. The main points in the memorandum are:

1. ACT will be conducted during training flights with authorized trainers.

2. Aircrews will use existing aircraft-system and flight simulator on-board video-recording equipment to supplement unit training on ACT training flights.

3. Aircrews are encouraged to review and critique videotape recording to receive maximum value from the training flights.

4. Commanders, instructor pilots, and aviation safety officers will periodically review videotape recordings to evaluate aircrew coordination and other training.

5. Units are required to complete semiannual ACT academic refresher training.

6. Units will review crew coordination for critical tasks in their mission profile.

7. Review as a group, selected videotape recording from ACT training flights or simulator sessions.

8. Unit ACT sustainment training and use of videotape recordings will be evaluated during aviation inspections.

The 160th Special Operations Aviation Regiment (SOAR) has developed a supplement to the current TC 1-210. This supplement provides for mission focused ACT in various phases of a 160th crewmembers progression.

ACT Program Challenges

Evaluation of the current Army ACT program. The DES conducts assessment and evaluation of unit ACT programs. These evaluations are completed during scheduled assistance visits with the units in the field and the results are provided to the unit commanders. Some of the observations, as listed in the October 2000 Flightfax, indicate that documentation and/or conduct of the ACT program is not being accomplished in all units (Seale, 2000).

Cockpit Automation. Automation and the "mission creep" that is occurring in today's advanced cockpits has led to more cockpit and mission equipment management than hands and feet flight skills. The hazard analysis phase of the USASC Aviation Safety Investment Strategy

Teams (ASIST) program has determined the number one goal in hazard control is to "Implement a change to the flight control system to improve aircraft stability and control in low speed flight (attitude command, attitude hold and hover hold).

The need for the automation of such a basic flight skill as attitude control is testimony to the concept that the modern tactical rotorcraft is an integrated system of mission equipment that requires constant attention to the mission package to achieve the full tactical capabilities of these systems (e.g., AH-64D, RAH-66 and OH-58D). The ability to project the information on a heads up displays doesn't negate the fact that when a pilot is looking at a piece of display symbology, or typing a data message into a message center, he is diverting his attention from the hands and feet aspects of aviation. "The helicopter Spatial Disorientation (SD) accident is not one of classical vestibular or visual illusion giving the pilot 'vertigo' but one of loss of orientation cues leading to a ground or object strike. Factors such as loss of Situational Awareness (SA), task overload, poor aircrew coordination and marginal weather may all contribute to SD" (Jones & Powell, 2000). This tunnel vision effect is currently an issue being studied by the SME's at the Army's first Comanche unit at Ft. Rucker, AL. The current trend is to allow the flying to be conducted by the low flight time, low experience crewmember while the more experienced crewmember operates the Mission Equipment Package (MEP). This trend is a quantum leap for Army Aviation.

In the past aircraft with complex mission equipment, e.g., EH-60, RC-12, released the operation of complex equipment to the mission crew in the cargo portion of the aircraft. This allowed the flight crew to concentrate on flying the mission profile. Other services that employ aircraft at low altitudes in high threat environments, e.g., A-6E, F-14, F-15E, MH-53E Pave Low, have crewmembers whose job it is to get the aircraft into position while a weapon system operator (WSO) operates the MEP. The conduct of crew operations in near term Army Aviation aircraft, such as the AH-64D and RAH-66, will require retraining and reinforcement of aircrew coordination. These advanced aircraft will have crewmembers communicating with other team members separated by thousands of miles. The concept of crewmembers in the next 5-8 years will move from the pilot and co-pilot to a team including Unmanned Aerial Vehicles (UAV) and every system that is connected to the aircraft in the real-time digital world.

Cockpit Configuration. With the tandem cockpit configuration of the Apache and Comanche, crew coordination between these two members of the team is a training requirement that cannot be overlooked. Each crewmember must know exactly what the other is doing. This can only be accomplished with proper signals that are sent, received and understood by both crewmembers. The Apache ATM (TC 1-238, Draft) points out in paragraph 6-3 that there are "crew coordination factors unique to AH-64A tandem cockpit crew stations." The separate pilot and co-pilot/gunner stations in the AH-64A present unique challenges to crew coordination because:

1. All tasks required to fly and fight the aircraft as a system are not achievable from any one-crew station.

2. The tandem seating arrangement and acrylic blast shield separating the two crew stations prevent crewmembers from visually confirming items or procedures that crews of other aircraft take for granted. For example, visual confirmation of change of controls is not possible as the crew accomplishes this task solely by voice over the intercom.

Crews must thoroughly brief responsibilities and strictly comply with this briefing. The pilot must fly the aircraft and focus his attention outside the aircraft. The gunner must cross monitor the pilots' performance and operate the mission equipment package (MEP).

Standardized Training. ACT in Army Aviation is not standardized. The ACT exportable training program is the standard to which all Army ACT is linked. TC 1-200, Commander's Guide to the Aircrew Training Program (Draft) states "Units will conduct initial aircrew coordination qualification training according to this publication and the USAAVNC Aircrew Coordination Exportable Training Package."

1. IERW students are not trained in accordance with the provisions of the ETP. Yet, graduates of IERW are considered "qualified" in aircrew coordination.

2. ACT instructors/trainers are not trained and certified in accordance with the ETP. This is left to the individual units to accomplish.

3. Students in aircraft qualification courses do not receive ACT training. The assumption here is that they are already qualified. If additional training is required the unit is responsible for the training.

4. The Aircrew Coordination ETP does not provide gradeslips or scenarios for OH-58D, AH-64D, or the RAH-66 yet the training for these aircraft must be in accordance with the ETP.

Accident Investigation and Hazard Reporting Process. The USASC investigates all Class A aviation accidents (damages of $1,000,000 or more and/or destruction of an Army aircraft, missile or spacecraft and/or fatality or permanent total disability) and selected Class B aviation accidents (damages of $200,000 or more but less than $1,000,000 and/or permanent partial disability and/or hospitalization of five or more people as inpatients). [Online- Army Statistical Report, 2001]. The local aviation safety officer or safety board investigates all other aviation accidents and the data is sent to the safety center for entry into the Risk Management Information System (RMIS) database.

The current accident investigation techniques collect data through personal interviews with witnesses and personnel who were involved in the accident. This is a very systematic approach with the primary focus on the cause of the accident. The process is designed to investigate the root cause of the accident and provide recommendations on how to prevent the same type of accident from happening again.

The only current means of capturing the multitude of errors that don't result in an accident is the Operational Hazard Reporting (OHR) system as outlined in Army Regulation (AR) 385-95. The OHR is a voluntary and, if desired, anonymous reporting system for hazards and is used within the Army for accident prevention purposes. Some of the uses for the OHR that are listed in AR 385-95 are:

1. Near mid-air collisions between aircraft or near collisions between aircraft and other objects in the air or on the ground.

2. Flight or maintenance training and education.

Anyone can use this program and submit the report to their unit safety officer. The safety officer is required to investigate the incident and then report the results of the investigation in accordance with AR 385-95. A copy of the report is returned to the originator, provided the report includes the originator's name and address.

ACT Related Initiatives

Aircrew training program update. The revision of TC 1-210 to TC 1-200, Aircrew Training Program Commander's Guide to Individual and Crew Standardization, is currently being staffed. This revision specifies qualifications for ACT instructors and procedures for documenting ACT qualifications and evaluations (see Figure 4). The aircrew training manual (ATM) for each aircraft is being revised to address specific tasks, conditions, and standards as they apply to ACT training and evaluation.

AIRCREW COORDINATION

Aircrew coordination is a set of principles, attitudes, procedures, and techniques that transforms individuals into an effective crew. It is a vital part of the overall ATP. Units will conduct initial aircrew coordination qualification training according to this publication and the USAAVNC Aircrew Coordination Exportable Training Package (ETP). To obtain information about this ETP, units may write to the Commander, U S Army Aviation Center, ATTN: ATZQ-TDS-T, Fort Rucker, Alabama 36362-5263. All active Army and NG / USAR crewmembers must be qualified. Crewmembers who are not qualified will remain RL 2 until qualification is completed.

A-1. QUALIFIED INSTRUCTORS

Evaluator/trainers who have completed the aircrew coordination trainer course per the ETP (ARNG requires designation by NGB-AVN-OTS) may conduct aircrew coordination training/qualification as follows:

a. Academic Instruction. Evaluator/trainers may conduct academic training.

b. Flight Training (aircraft/simulator). IPs and SPs may conduct all RCM and NCM flight training. FIs and SIs may conduct all NCM flight training. IEs may conduct RCM flight training using instrument scenarios. UTs may conduct RCM flight training of tasks that they are authorized to instruct. (For example, a UT authorized to instruct tactical tasks may perform aircrew coordination training using tactical scenarios.)

c. Evaluations. IPs and SPs may conduct all RCM and NCM evaluations. IEs may conduct RCM evaluations using instrument scenarios. FIs and SIs may conduct all NCM evaluations.

d. Qualified instructors may qualify other IPs, IEs, SPs, UTs, FIs, and SIs as trainers. FIs and SIs may qualify other FIs and SIs as trainers.

A-2. DOCUMENTATION

The aircrew coordination qualification will be annotated on the individual's DA Form 7122-R (Crewmember Training Record) and in the remarks section of the individual's DA Form 759 (Individual Flight Record and Flight Certificate-Army) on close out.

a. Aircrew coordination will be emphasized during readiness level progressions and will be evaluated during all evaluation flights.

b. The inclusion of aircrew coordination in ATM task descriptions reflects the "crew concept" philosophy that generally no task is an individual undertaking. Each task can be performed more effectively and safely by the coordinated efforts of the entire crew. ATM revisions will include crew actions in the task descriptions, as appropriate. Crew actions define responsibilities, whether individual or crew, by describing the parts of a task that an individual or group of crewmembers will perform. Knowledge of the crew actions for tasks being performed will help crewmembers perform their individual actions more effectively and enhance crew coordination.

c. Research and studies conducted by the US Army Aviation Center, the US Army Research Institute, and the US Army Safety Center show the importance of good aircrew coordination. An analysis of US Army aviation accidents revealed that a significant percentage of these accidents resulted from one or more crew coordination errors committed before or during the flight. Often an accident was the result of a sequence of undetected crew errors that combined to produce a catastrophic result. Additional research by USARI showed that even when accidents are avoided, these same errors can result in degraded performance. A systematic analysis of these error patterns identified specific areas where crew-level training could reduce the occurrence of such errors and break the error chains leading to accidents and poor performance.

d. Broadly defined, aircrew coordination is the interaction of crewmembers necessary for the safe, efficient, and effective performance of tasks. Working with this definition, the USAAVNC and USARI translated crew coordination concepts into a set of 13 basic qualities. These qualities have been incorporated into the USAAVNC Aircrew Coordination ETP. Each basic quality is defined in terms of observable behaviors that represent superior, satisfactory, or unsatisfactory levels of crew coordination. These basic qualities and goals are summarized in each Aircrew Training Manual. (Refer to the USAAVNC Aircrew Coordination ETP for more detailed guidance). Commanders will use these performance descriptions in evaluating and qualifying all crewmembers.

Figure 4. TC 1-200 (as adapted from TC 1-200).

Figure 5 provides an example from the Apache ATM TC 1-238 (Draft) on the integration of Aircrew Coordination in all tasks.

> Standards. The standards describe the minimum degree of proficiency or standard of performance to which the task must be accomplished. The terms, "Without error", "Properly", and "Correctly" apply to all standards. The standards are based on ideal conditions. Many standards are common to several tasks. Individual instructor pilot techniques are not standards, nor are they used as grading elements. Unless otherwise specified in the individual task, the standards below apply. Alternate or additional standards will be listed in individual tasks. Standards unique to the training environment for simulated conditions are established in TRAINING CONSIDERATIONS section of each task.
>
> All tasks. Perform crew coordination actions per Chapter 6 and the task description.
>
> It is essential for the PC to brief specific duties before entering the aircraft. The ability for either crewmember to perform most aircraft/system functions breaks down the standard delineation of duties. This could mean that during an unforeseen event, one crewmember might attempt to resolve the situation by himself, rather than seeking assistance from the other crewmember.

Figure 5. Example ATM standard and crew coordination task.

Flight School XXI (FS XXI). Current AQCs do not provide tactical units with RL2 crewmembers. FS XXI supports the concept of advanced aircraft and mission orientated ACT. By conducting a higher level of training in advanced aircraft such as, night-vision goggles, external loads, and aerial gunnery, opportunities will arise for mission orientated ACT training. FS XXI is an initiative currently being tested for implementation in the near future (12 months). The objective is to meet warfighting requirements in our combat formations by producing aviators who arrive at their initial duty stations basic-mission qualified, proficient in their go-to-war aircraft and ready to begin unit training. The FS XXI concept will replace the current UH-1 and OH-58 Basic Combat Skills phase of IERW with immediate tracking into an advanced aircraft. Students will complete the flight portion of IERW in their advanced aircraft. All students graduating from IERW will go to their first assignments more proficient in basic combat skills. Experience and proficiency in night-vision goggles, external loads, aircraft systems and crew coordination will be greatly increased in all modernized aircraft.

FS XXI will reduce the amount of time students spend at Fort Rucker by an average of six weeks, while increasing the students' experience and proficiency in their go-to-war aircraft. The result is lieutenants and warrant officers who spend increased time in junior leadership positions in the field prior to promotion to first lieutenant and chief warrant officer. FS XXI will allow instructors to teach in their tactical aircraft. This will return Instructor Pilots (IP) to the field with greater experience in their go-to-war aircraft. (Jones & Powell, 2000)

ASIST. The ASIST was chartered to define measurable accident prevention goals and identify the most important Army-wide investments needed to achieve them. Specifically, ASIST was established to achieve the following objective:

Within ten years, reduce by 50% the:

- Rate of fatalities and serious injuries*
- Annual cost of aviation accidents**
- Class A-C accident rate*

The baselines are:
* Average FY 94-98 rate per 100,000 flight hours and
** Projected annual aviation accident cost, considering future fleet mix and aircraft acquisition and repair cost.

Figure 6. ASIST objectives.

The Hazard Analysis phase of ASIST identified 290 hazards across the five aircraft types analyzed. Five of the top ten hazards identified were of a nature that would put the crew of the aircraft as the center of attention for the hazard. For example, "Maneuvering among obstacles in a degraded visual environment may cause an escalation in workload, increased fatigue and diminished capacity to safely maintain aircraft position, resulting in collision with ground or obstacles." or "Hovering in close proximity to terrain in a degraded visual environment and high workload may result in loss of situational awareness, resulting in inadvertent hover drift and collision with terrain."

ACT is a key risk management control measure. The ASIST study conducted in 1999, reported that by developing an ACT sustainment program, the potential for an aviation accident reduction of 6.4% or a cost reduction of $144 million dollars could be realized over a ten-year period. The ASIST identified 249 potential controls for the 290 hazards that were identified. Number four on the "One to Goal List" of controls that would help attain the Army accident reduction goals at the least investment cost was, "Develop, monitor and evaluate a Crew Coordination Sustainment Training program integrated into aviation tasks"(Hicks & Puesch, 2000).

Distance Learning (DL). DL is delivering standardized training using multiple media and technologies when and where it is needed. It includes providing individual, collective, and self-development training to Army members and units. DL may involve student-instructor interaction in both real time (synchronous) and non-real time (asynchronous). It may also involve self-paced asynchronous student instruction without benefit of access to an instructor.

A goal of DL is to increase Army readiness, train soldiers and units when and where needed by exploiting information delivery methods and technology, and deliver standardized training. DL provides standardized collective and individual training at Active Component (AC) and Reserve Component (RC) locations in the continental United States (CONUS) and outside the CONUS (OCONUS).

Objectives of distance learning include:

- Providing critical training on-demand at soldiers' locations. Wide unit-dispersion (especially in the RC) combined with frequent overseas deployments, places severe constraints on training delivery capabilities. Distance learning can be used to train deploying personnel to standard just before the training is required operationally. The training is more relevant and less subject to erosion or decay.

- Establishing an Army training delivery system by linking proponents and the field through a telecommunications common operating environment. This objective supports a fully networked training delivery, training development, and training management environment. By leveraging national, governmental, and commercial networks connectivity will be established among DL sites and proponent training and training development activities. These links will allow up-to-date training that is focused on soldiers needs and provided when and where needed.

The Total Army Distance Learning Program-Master Plan (TADLP-MP) identifies three types of DL facilities. The capabilities of each type depend on the configuration, location, and mission of the facility.

Distance Learning Center (DLC)

The DLC is a fixed site located at installations hosting Army service schools and training/training development (task) proponents. Each site has hardware and software that support the TADLP infrastructure, and three DL classrooms. The DLC will be used to store, deliver, and receive DL instruction. Installation commanders will control the classrooms and support units and individuals within their geographical area. The DLC will also support Classroom XXI facilities located at the same installation.

Distance Learning Site (DLS)

The DLS will be located at other Active Army installations in CONUS and OCONUS, at RC Total Army School System (TASS) battalions/brigades, and other RC locations. The DLS contains the same components as the DLC. Additional classrooms may be added as more DL courses are available and student populations increase.

Transportable Distance Learning Site (TDLS)

The TDLS will be transported to remote locations to provide the same education/training capabilities as the fixed DL sites. The TDLS depends on external transportation for mobility. Its purpose is to support deployed units, students in sparsely populated areas, and temporary student increases at an installation. The TDLS can be used at the combat training centers (CTC) and can provide connectivity between CTC and other DL facilities.

Army Aviation Simulation Master Plan. Current generation aircraft simulators are single ship, single mission training devices that are not linked to any other member of the combined

arms team. The inability of current generation simulators to operate together prevents the development of multi-aircraft ACT. This is evident even at the USAAVNC's Goodhand Simulator Complex where two AH-64A Combat Mission Simulators (CMS), three UH-60 Flight Simulators (FS) and one CH-47 FS are housed in the same building but cannot operate together. This inability to link current aviation simulators prevents ACT from being taken to the next level.

Distributive Interactive Simulation (DIS) will permit the linking of all types of unit training into the same network. This capability would allow wide-scale integration of various simulation systems and live training without regard to geographical constraints. Ultimately, satellite relays will provide an electronic linkage with Training Exercise Without Troops (TEWT), Simulation Network (SIMNET), training/task proponent schools, and live exercises at the CTCs. Such linkage will provide the foundation for larger scale simulations involving joint and combined exercises.

The Close Combat Tactical Trainer (CCTT) is the first operational DIS system and is part of the Combined Arms Tactical Trainer (CATT) family of virtual trainers. CCTT is composed of computer-driven combat vehicle simulators and emulator workstations that operate interactively over local and wide area networks. Through computer workstations, CCTT adds logistics, artillery, mortar, and aviation units to a synthetic battlefield depicting real-world terrain. Warfighters move, shoot, and communicate on this battlefield by operating with or riding inside combat vehicles and employing simulated weapon systems. All of these CCTT components have passed rigorous US Army validation against actual weapon systems, tactical doctrine, and behaviors. The system allows unit commanders to train their unit's collective tasks in a myriad of virtual environments to include day, night, and varying fog densities, own force complexity, and selectable enemy capability/skill levels.

CCTT provides real-time, interactive collective task training for units from individual crew to battalion task force levels, with growth capability to regimental task force. Key features include DIS, manned simulation modules with high-fidelity visuals, realistic terrain and entity models, fixed and mobile configurations, intelligent semi-automated forces (SAF), real-time data logging, and after-action-review (AAR). As the first simulation system to include the Army's entire combined arms team, CCTT will serve multiple functions, including training, tactics and doctrine evaluation, weapon system evaluation, and mission planning and rehearsal.

Aviation Combined Arms Tactical Trainer (AVCATT) is a distributed interactive, networked simulation system that allows for collective and combined arms training. A number of manned aviation simulators will be fielded to replicate attack company, reconnaissance, troop and assault platoon configurations. AVCATT-A in its objective configuration will comprise the AH-64A/D Apache attack helicopters, RAH-66 Comanche, CH-47D Chinook, OH-58D Kiowa Warrior, and UH-60 Blackhawk helicopter systems. In addition, emulator workstations represent command, control, communications, and intelligence (C3I), combat support and combat service support aspects of the combined arms battlefield. Robust semi-automated forces replicate enemy forces and augment friendly forces. Battlefield operating systems will be represented in the simulation. AVCATT-A will provide for both stand-alone aviation collective training and interaction with other US Army collective task trainers, i.e., CCTT program simulators.

The Training, Exercises and Military Operations (TEMO) domain management plan intent is to simultaneously field models and simulations that support the Army Modernization Plan and provide training support capabilities for the digitized Army. As the Army fields digital command and control systems, TEMO will develop and field high-level architecture compliant simulations across the live, virtual, and constructive environments that are capable of operating in a common operating environment. The domain maintains relevant simulation systems to train units using both digital and analog command and control systems until replacement systems become available. TEMO objectives are to provide continuous synthetic training support for commanders and trainers while enhancing that support commensurate with technological advances

The TEMO priority for FY 00-03 is the development and fielding of virtual and constructive simulations that will form the backbone of the Army synthetic training environment. These simulations will promote advantageous use of live training resources in the future. Simulations support initial fielding of Army Battle Command System (ABCS) program by achieving interoperability via interfaces. Adapted and/or new interim simulations will support digital battle staff training. Instrumentation system improvements and upgrades at the CTCs will integrate new systems, weapons, and the opposing forces (OPFOR) into the current synthetic training battlefield. Commanders will have the ability to train subordinate commanders and staffs from platoon through corps and synchronize the Battlefield Operating Systems under conditions closely replicating the battle space. Completing the CCTT fielding and beginning the fielding of the AVCATT will allow for the development of real-time, mission based, multi-aircraft ACT training scenarios that will be integrated into this new generation of tactical training. This level of simulation will allow for realistic, mission based ACT.

For FY 04-10 commanders will be able to use a realistic synthetic battlefield, a variety of contingency scenarios, and a wide array of threats to train their units in a joint or combined environment. Constructive simulations will provide realistic operational conditions by allowing units to perform their wartime tasks in a wartime setting using their organizational battle command and communications equipment. Virtual simulations enable commanders to conduct combined arms training without ecological, safety, or resource restrictions. Constructive and virtual simulations will provide a seamless interface to organizational battle command and communication equipment. A Common Training Instrumentation Architecture (CTIA) enhances training of digital forces by providing a seamless linkage across the live environment. Training cycles culminate with tough, realistic live fire training exercises that optimize individual and collective skills while synchronizing and employing combined arms assets.

This combining of assets across the battlefield will allow for team based training to leave the single aircraft realm and move into the multi-player environment. In this environment ACT weaknesses, as they pertain to the entire mission element, will become apparent and exposed for correction in a friendly atmosphere. Units will train using their organizational battle command and communications equipment to conduct normal planning, coordination, and mission execution to include simulation interaction. The completed fielding of the AVCATT will bring Army aviation to the next level of ACT (Grandin, 2000). The ability to train ACT factors in a mission-based environment is fully supported by the Army's DIS strategy.

Aviation Modernization Plan. Listed below are selected goals and objectives from the 2000 Army Aviation Modernization Plan. Attaining these goals and objectives will require ACT integration into the infrastructure.

- Fix reconnaissance and security shortfalls. The modernization plan calls for the fielding of the RAH-66 Comanche into the inventory. The Comanche has tandem seating, which by itself requires ACT. The aviation modernization plan states the RAH-66 is an armed reconnaissance and light attack helicopter that can perform missions throughout the spectrum of combat. Comanche will also provide tactical targeting, prioritization, and enemy information to force commanders at all levels. The capabilities of the aircraft require aviators to be fully trained in ACT. This coordination training extends beyond the cockpit and into the operational centers of the force commanders.

- Enhance lethality and survivability while operating as a part of a joint/coalition force, or as a part of the Army Combined Arms Team. ACT will enhance the teamwork that is required when working with other services on the modern battlefield. Knowing what another member of the team is doing requires all members knowing the whole plan. When part of a coalition force, aircrew members will be faced with possible language barriers and equipment interfaces (communication radios), both of which play an important part in aircrew coordination training.

- Insert digital technology. The digital technology being integrated into the cockpits of the Army's airframes requires the crewmembers to be "inside" the cockpit. The digital information may come from aircraft systems or outside agencies. Regardless, ACT is a tool that helps mitigate the problem of who is "outside" and who is "inside" the aircraft.

- The Army Aviation Modernization Plan lists significant changes as; aviation battalions contain a balanced mixture of reconnaissance, attack, and lift assets and companies are modular and can be assigned or attached to other aviation organizations or ground forces for extended periods. These multi-airframe battalions that are attached or assigned to other forces for extended periods must have the ability to operate in a team environment. ACT can be the foundation on which these multi-airframe units build their team training skills.

Training and Operations Records Management System Aviation (TORMS-A). This program, when fielded, fully supports the concept of continuous ACT throughout a crewmembers aviation career. TORMS-A gives commanders the ability to track, analyze, and ensure the completion of all aviation related training to include ACT initial qualification, warfighting aircraft qualification, and when established, annual ACT updates. With TORMS-A, the commander will have the opportunity to review replacement personnel records. This helps forecast the amount of training required to bring the replacement up to unit level readiness. Personnel managers will have the ability to place the right person in the right place by reviewing individual records to ensure requisite training for the job is met. The problems associated with a paper-based program are also alleviated. This program resides on a web assessable server that can only be accessed by authorized personnel.

Discussion

This discussion is organized into four sections. The first section addresses the Army's current ACT policy and the related policies of other services and commercial carriers. The second section examines training systems and issues; updates to the Army ATP, and technology plans related to delivering ACT training. The third section examines ACT performance evaluation and risk management, hazard identification and reduction, and accident investigation plans and strategies. The fourth section examines the aviation modernization plan and the simulator modernization plan. Issues surfaced during the ACWG meeting to initiate the contract research effort are incorporated in the appropriate section.

ACT Policy

Current Army ACT, standardization and one time updates. The current Army ACT program does not support the Army Aviation Modernization Plan, DIS, or the complex aircraft now coming into the inventory. Current ACT training is conducted in the classroom (Eight hours and a two hour 50 question multiple choice exam) with no follow on training in aircraft simulators or mandatory training periods in the aircraft. Instructors that are supposed to be evaluating and reinforcing this academic training receive four hours of academic training with no exam. This training is set and doesn't take into account the amount of ACT training the aviator has previously received. Some instructors in the TH67 Creek have no military flight experience or never received the full ETP course and may not even be ACT trained to the Army's standard. There is no requirement at the Department of the Army (DA) level to conduct ACT. Army aviators spend more time training to fire 9mm weapons and preventing sexual harassment then they do on ACT. An example of this can be seen in Army Code of Conduct training.

Every soldier receives code of conduct training in basic training, this training is required to be reviewed throughout a soldiers career, if a soldier goes into special operations he receives advanced training in code of conduct, if a soldier becomes an officer he receives code of conduct training. This reinforcement of training is what makes the soldiers of the U.S. Army respected throughout the world. The same emphasis on reoccurring training needs to be reflected in ACT training. One time training fails to support the evolution of Army aviation aircraft and procedures. Major Commands (MACOMs) currently conduct training differently. Some MACOMs conduct no ACT training while other have in-depth programs. Without a DA standard for reoccurring training the separate commands are producing different courses of instructions with different emphasis on skills and levels of proficiency.

Other DoD services. Other DoD services, primarily the Navy and Air Force, have active ACT or CRM programs with dedicated program managers assisted by working groups and supported by ongoing research projects. Currently both services have ACT training linked to advanced aircraft qualification and instructor pilot upgrades. The programs are backed by policies that specify currency and refresher training, i.e., how often ACT/CRM training must be accomplished after initial qualification and what specific requirements must be met to remain ACT/CRM current in the particular aircraft one is serving as a crewmember. These policies also include the requirement for major commands to develop and implement sustainment training,

i.e., a policy that clearly establishes the requirement for training program and curriculum update based on "real world" ACT/CRM experiences and issues. In support of this effort, the Navy currently employs both a mixture of active personnel and contractors to ensure relevant, up to date training. Naval regulations require the recording of the annual training in permanent training records. AFI requires CRM training at all levels of aviation training from flight school through instructor training. Active research is being conducted by both services in the use of DIS, referred in the Air Force as DMT. Currently the Air Force has four F-16 full visual simulators linked together with an Airborne Warning and Control System (AWACS) controller station for testing and validation of the CRM program in a tactical scenario. Other DoD services have ongoing research that supports the concept of a continuous ACT program. Table 4 shows a comparison of current DoD ACT related programs.

Table 4.

Current DoD ACT Related Programs

	Initial Qual	Adv Acft	Facilitator Qual	Eval	Training Frequency/ Currency	Program Sustainment	Program Manager	Working Group	Research Program
Army	X		(1)	(2)		(3)		(4)	
Navy	X	X	X	X	X	X	X	X	X
Air Force	X	X	X	X	X	X	X	X	X

(1) ETP Training is conducted at the unit level
(2) Part of the APART
(3) Some major commands within the Army require sustainment training
(4) Formed when ACT becomes a command interest item or contract funding is available

Commercial carriers. There are distinct cultural differences among aviation organizations, both military and civilian, that are recognized by the FAA and CRM Industry research and training communities. These unique differences in mission, organization, and operations account for the diverse number and nature of commercial carrier CRM training and evaluation programs. Every commercial carrier program is deliberately designed to deliver CRM skills in a way that will be accepted and implemented by a particular audience. For example:

1. The number of CRM behaviors and/or skills varies from four (American Airlines, Northwest Airlines) to six (Delta Airlines).

2. The primary training focus is on the flight crew of a single aircraft in a controlled, peacetime environment to achieve safe, on-time departure and arrival while avoiding flight violations and conserving fuel.

3. All commercial CRM training programs provide for initial, recurrent, Captains, and instructor evaluator courses.

4. The length of training varies from three days (US Airways, Northwest Airlines) to five days (Southwest Airlines). Instructor Evaluator training ranges from two days (Northwest Airlines) to six days (US Airways).
5. Frequency of recurrent training is annual for most CRM training programs and is an annual requirement for commercial carriers participating in the FAA's Advanced Qualification Program.

6. Format for training ranges from classroom lecture, to facilitated discussion of video presentations, to line oriented flight training in simulators, to computer-aided debriefings.

7. Best practices in commercial CRM training and evaluation programs include facilitated instruction, case studies, and hands on practice.

Immediate policy issues concerning ACTE. Several members of the ACWG stressed the importance of having the primary individual from each organization present at each formal meeting. Consistent representation is necessary to achieve and maintain continuity of user perspective throughout the multi-phase effort. The ACWG charter allows for additional representation as needed.

Recurring Army Safety Performance briefings to the Chief of Staff, U. S. Army (CSA) and leaders at all levels include ACT improvements along with other high priority, related initiatives, e.g., Readiness Sustainment and FS XXI. ACWG members discussed the possibility of establishing a General Officer Steering Committee initially consisting of the USAAVNC Deputy Commanding General (DCG) and the USASC Commanding General (CG). Other leadership awareness opportunities included the annual Aviation Leader and Training Conference to get feedback from field commanders on current ACT issues and problems facing tactical units, both active and reserve. There may be an opportunity to include a portion of the initial ACTE testing events in the FS XXI effort.

Training Systems

ATP update. All current Army ATM's and the Commanders Guide are available in draft form and are waiting for official publication. The new ATM and Commander's Guide recognize the difference in aircraft (Tandem versus Side-by-Side seating) and go on to indicate that aircrew coordination is a standard in all tasks. The current ATP recognizes these differences yet an aviator may change type aircraft (OH-58D to AH-64) or even more dramatic, category (rotary wing to fixed wing) with no additional ACT training.

Cockpit automation and cockpit configuration. Cockpit automation coupled with the trend to move from side by side seating (OH-58D) to tandem seating (RAH-66) will require extensive retraining and continuous updates to reinforce skills required to operate these systems. The feeder pilots for the RAH-66 are primarily going to be OH-58D crewmembers. This is similar to the initial requirement for AH-64A Apache aviators in the 1980's to be qualified AH-1 Cobra pilots. In light of this many of the "experienced" OH-58D Kiowa Warrior pilots will have no experience with the tandem-seating configuration or helmet mounted weapons and night

systems. Cockpit automation is promoted as a way to reduce pilot workload but in reality the pilot's workload is moved from the job of flying the aircraft, to the job of managing weapons and reconnaissance systems. The automation of the cockpit along with the digitization of the battlefield will require the crews of AH-64D and RAH-66 aircraft to provide the task force commander with continuous data feeds and updates. The concept of RAH-66 crewmembers flying UAVs from the cockpit of their aircraft will increase the crewmembers workload. The crewmember that is flying the UAV will be of little help to the crewmember trying to fly the RAH-66. Groundings of the AH-64D fleet due to generator failures and the restrictions placed on the fleet (no night operations, no training at NOE altitudes) are testimony to the reliance on cockpit automation for aircraft emergency identification. The ability of the pilot to interpret instrument readings and react has been overridden by the pilot waiting for the computer to provide the decision information. ACT skills will become more important to aircrew safety and mission accomplishment in the modern automated cockpit.

DL. The use of the distance learning facilities and methods of training distribution provided by DL classrooms support the ACTE effort of web-based delivery of course materials and sustainment training. DL is currently available at most major installations with smaller facilities coming on line in the near future. The scheduling of the DL facilities is conducted through a traffic manager at Training and Doctrine Command's (TRADOC) Army Training Support Center (ATSC). ATSC is currently conducting unit level "Train the Trainers" for on line classroom operations. The facilitators not only have to be knowledgeable on the course material but on the capabilities and limitations of the DL systems. DL with properly set up facilities allows for instructor interaction and feedback. The continuing development and funding of DL centers worldwide will allow for a cost effective training delivery method of ACTE materials.

DIS. DIS is currently in the developmental and testing phase of the lifecycle. Limited linking of simulators is occurring in reconfigurable aviation simulators such as the battle lab at Ft. Rucker, AL. The fielding of AVCATT-A is two to four years away. The use of the limited DIS capabilities is currently restricted to units preparing for deployment to Bosnia. DIS training in an ACT scenario may be exercised during aviation officer advanced courses to develop leadership training.

Evaluation and Risk Management

TORMS-A. The Army is taking a careful look at ways to improve how it structures and documents training information. For example, the TORMS-A system would make it easier to target training needs and truly tailor the training program. When TORMS-A is approved the ACWG agrees that the database created would support the tracking of all levels of ACT training. This system will give the field commander the ability to identify ACT qualifications from initial ACT qualification through facilitator certification. It will be necessary to identify database protocols and formats being used in emerging training Management Information Systems (MIS) for compatibility with the ACTE Training Management System and Data Management Systems.

ASIST. The ASIST was chartered in March 1999 to enhance aviation readiness by integrating risk management requirements into Army Aviation planning, programming and budgeting. The ASIST team was chartered to identify measurable accident prevention goals and

identify the most important Army-wide investments needed to achieve them. The current army accident investigation process does not include a tool for extracting ACT related information. The development of an accident investigation tool under ACTE would allow the ASIST approach to hazard identification and reduction to evaluate the effects of ACT. This ability to quantify possible ACT hazards can be combined with the team training approach to ACT to give the aviation crew and their commander a dual avenue of approach for recognizing the controls necessary to reduce the risks associated with each mission.

Accident Investigation Process. The current accident investigation/safety officer school has no formal POI for the inclusion of ACT related factors in the process. Many of the ACT related incidents are lumped into the all-encompassing "Human Factor" category. The lack of a defined tool to clearly distinguish ACT factors combined with a lack of recent ACT training for aviation safety officers may contribute to the absence of key elements of the root cause of some aviation mishaps. Development of a accident investigation ACT tool along with reoccurring ACT training for all aviators will make the ACT factors more apparent to all personnel involved in the accident prevention and investigation process.

The ACWG agreed on the need to improve the tools and techniques available to accident investigators that allow them too more thoroughly address ACT factors. DRC outlined a simplified structure to relate ACT basic qualities and operational issues as a start point for development of a Hazard Identification Tool. Related discussions emphasized the need for a methodology and capability to identify ACT problems based on both accident investigations and incident reviews. ACT findings could then be posted to an empirical database and analyzed to identify trends for development of preventive training support packages to both refresh and maintain the ACT program.

Plans and Research

Aviation Modernization Plan. The Army Aviation Modernization Plan requires the retooling of each battalion. The return to mixed battalions will require crews that have been working in focused (one type aircraft) battalions to be able to operate with a mix of aircraft type aircrews. Commanders and operations officers, who may not be rated in all of a battalion's aircraft, may be planning and assessing missions for the aircrews. The ability to train and learn as a team will become a priority. The need to train in peacetime for team operations is paramount for this initiative to succeed. Aviation is moving away from the single aircraft battalion to an integrated, multifunctional unit that includes the joint/coalition forces, ground forces and all other members of the combined arms team, similar to Task Force Hawk.

Army Aviation Simulation Modernization Plan. The ability to link single aircraft simulators into a combined arms team training environment will allow the training of ACT in a seamless environment. This is advanced ACT training. This means that as a crew conducts a mission scenario in a combined arms exercise the concept of team coordination becomes central. The ability to see the communications breakdown and the flow of the other members of a larger force is currently missing from single aircraft simulators. The Army's movement towards CCTT linked AVCATT will fully support the concept of advanced, mission based ACT training.

Conclusions

The review of the current aircrew coordination training program was successful in identifying the full range of aircrew and team coordination training and evaluation issues and developing a master plan of actions to enhance, integrate into daily operations, sustain, and maintain ACT.

Current Army ACT Program Conclusions

Our conclusions concerning the current Army ACT Program are organized by discussion topic areas of policies, training, evaluations and risk management, and plans and research. The following provides a brief recap of the current ACT program.

Policy

1. Army ACT policy is reduced to a section in a TC.
2. There is no Army-wide policy concerning ACT sustainment or mission training.
3. Unlike other DoD services, there is no permanent Army ACT working group or steering committee.
4. Army ACT has no program manager.
5. Commanders are not required to report ACT levels of proficiency.

Training

1. There is no ACT model manager for training standardization.
2. ACT is currently taught in IERW, without "Go to War" aircraft or career progression training.
3. ACT is not scheduled to be taught in FS XXI in the "Go to War" aircraft.
4. ACT is not being integrated into advanced mission training.
5. ACT for nonrated crewmembers is not fully developed or implemented at the unit level.
6. ACT sustainment and refresher training is not being conducted in all tactical units.

Evaluations and Risk Management

1. DES does not conduct evaluations of ACT nor track ACT related evaluation failures.
2. There is no requirement to complete annual ACT sustainment training as part of the APART process.
3. There is no evaluation of overall ACT program effectiveness.
4. There is no unit level standard for current ACT training.
5. Accident investigators are not trained to recognize ACT basic qualities as a factor in mishaps.
6. Accident investigators have no tool to support identification of ACT related factors during interviews.
7. There is no anonymous reporting system for ACT related incidents.

Plans and Research

1. Development plans make minimal reference to team training.
2. Unlike other DoD services, there is no ACT research and development program or recurring funding plan.

Army ACT Program Requirements

The following section lists the program requirements for an enhanced ACT program.

Policy

1. Provide increased awareness and visibility for ACT policy.
2. Institute annual ACT sustainment training in conjunction with APART requirements.
3. Establish an ACT working group and steering committee.
4. Designate a duty position as ACT program manager.
5. Make ACT readiness a unit reporting requirement.

Training

1. Designate an ACT model manager for training standardization, e.g., aircrew training, instructor training, refresher Training Support Packages (TSP).
2. Program ACT as a multi-phased POI, e.g., basics in Intital Entry Flight Training (IEFT), Advanced ACT in "Go to War" aircraft.
3. Present selected portions of ACT using modern web-based interactive learning and electronic updates.
4. Integrate ACT to include all members of the aircrew, i.e., aviators, crew chiefs, flight engineers, mission technicians.
5. Provide a nonrated crewmember training package for units to develop crewmembers from technicians.
6. Develop interactive training and sustainment packages that can be tailored to each aircraft MDS incorporating recent, ACT-related incidents and accidents.

Evaluations and Risk Management

1. Develop aircrew and unit level ACT evaluation tools and procedures.
2. Include ACT as a part of RL 2 criteria.
3. Develop an evaluation-based feedback system (training, standards, safety) to evaluate, manage, and maintain overall program effectiveness.
4. Designate ACT as a unit readiness reporting requirement and have DES track unit ACT-related performance.
5. Train accident investigators to be able to identify ACT-related factors in accident investigations and unit assistance visits.
6. Provide an accident investigation tool and data repository for ACT related information.
7. Develop an independent web site for posting of ACT related "There I Was" incidents free of any negative sanctions.

Plans and Research

1. Establish a formal team training and evaluation research and development program.
2. Establish a recurring funding plan.

Army ACT Program Opportunities

Numerous opportunities exist to leverage ACT into the Army Aviation modernization strategy for an enhanced ACT program and to provide increased protection of these valuable assets. The following section lists some of these potential opportunities.

1. Integrate ACT into all aspects of aviation operations, making the requirement to conduct ACT with other training requirements.
2. Reinforce ACT in the FS XXI initiatives to include aviation leadership training and junior officer professional development.
3. Incorporate ACT into all aspects of mission training, i.e., advanced tactical training, Pilot in Command training, and flight lead training to provide a common set of teamwork principles.
4. Recognize ACT as a key component in Army aviation's risk management and decision making process and controls.
5. Capitalize on advances in distance learning and web-based instructional technologies to reduce cost, decrease response time, and improve ACT relevance to the unit missions.
6. Contribute to and apply results of team coordination research and development initiatives of other DoD services, e.g., automation and error management.

Recommendations

Multiple Phases

This section provides recommended actions to address the previously identified requirements and leverage potential opportunities. The fielding of related capabilities, resource constraints, and the time necessary to meet immediate training needs, underlie the structure and sequence of recommended actions. This roadmap of actions constitutes a Master Plan for ACT Enhancement that provides a proactive, multi-phased course of continuous improvement to maximize Army aviation modernization investments and complement leadership training initiatives.

Phase One-Upgrade and sustain the current ACT program. This phase will consist of reviewing current DoD and Army programs, developing a simplified evaluation system and training product to restore ACT awareness in Army crewmembers and to encourage the use of ACT in all aspects of aviation training. This training product will examine a major issue that has application across the spectrum of Army modernized aircraft, e.g., automation. Testing, demonstration and evaluation of training modules will accomplish two purposes. First, it will ensure the material presented addresses relevant ACT issues. Second, it will test state of the art instructional techniques utilizing distance learning and web-based instruction. The end of phase one will provide Army aviation with upgraded training as a start point on which to sustain and maintain a graduate-level ACT program that supports modern combined arms team training.

Phase Two-Refresh and maintain the upgraded sustainment program. The second phase of continuous ACT program improvement will focus on refreshing and maintaining the enhanced ACT program. Of particular importance will be training unit leaders and instructor pilots in selected aviation units, conducting observations, and evaluating initial implementation of ACTE by units. Training support packages based on the most recent ACT and cockpit/crew resource management (CRM) research will be developed and fielded to support all modernized army aircraft. Results of feedback data trend analysis, changes in aircraft systems, unit missions, and operating conditions will be developed and fielded as required to support all modernized army aircraft. A web-based data management system will be designed and developed to collect and support data analysis of the Army-wide ACTE program and the effectiveness of the training and evaluation system. This phase will include design and development of prototype products and systems that incorporate ACT into current processes and advanced training and training delivery systems, e.g., accident investigation tools, anonymous incident reporting system, distributed interactive simulation, and simulation-based aviation training exercises.

Phase Three-Develop and deploy advanced applications. Phase three of the continuous improvement effort to fully integrate ACT into the Army aviation culture and daily flying operations will focus on applying the previously developed prototype products and systems given Army aviation's emerging capabilities. Expanding the scope of ACT to include all members of the aircrew, i.e., aviators, crew chiefs, flight engineers, mission technicians and providing a nonrated crewmember-training package will help develop mission ready crewmembers from technicians. Implementation of an Accident Identification Tool and training accident investigators to identify ACT-related factors in accident investigations will incorporate

ACT into the accident investigation process and support analysis of reported incidents and lessons learned. Full implementation of the FS XXI concept will utilize modernized aircraft training scenarios for initial aircraft qualification. Realistic training scenarios using state of the art delivery methods and automated tracking of training events will support policy changes to require annual ACT training, evaluation, and readiness reporting. Advanced simulation using AVCATT or the reconfigurable simulator will support development of ACT courseware, improve ACT instructor skills, and assist deploying units in developing team coordination skills in a dynamic, virtual environment. This embedded team training will allow focused ACT in conjunction with leadership and tactical skills building exercises.

Major Actions

Phase One. Begins the applied research effort to upgrade the current Army ACT program and sustain the upgraded program. Major actions in this phase include:

- Establish an interim ACWG to guide the ACTE applied research effort (Command Group).
- Review current programs (ARI-DRC).
- Include information and discussion on ACT policy and program enhancement initiatives in aviation leader conferences (DOTDS).
- Recommend adding ACT as a permanent item of interest for Senior Resource Oversight Committee (USASC).
- Develop an ACT performance evaluation system (ARI-DRC).
- Develop core-training modules (ARI-DRC).
- Pre-test courses of instruction (ARI-DRC).
- Demonstrate and validate courseware (ARI-DRC).
- Field test and refine courseware with both active and reserve units (ARI-DRC).
- Develop an evaluation-based feedback system (training, standards, safety) to evaluate, manage, and maintain overall program effectiveness (ARI-DRC).

Phase Two. Completes the applied research effort to refresh and maintain the upgraded program to provide graduate-level ACT training. Major actions in this phase include:

- Establish a permanent ACT working group consisting of Interim ACWG plus MACOM, ARNG, and USAR representatives (CMD GRP).
- Designate an ACT program manager and instructional model manager (DOTDS).
- Develop a separate ACT policy or prepare an ACT specific supplement to TC 1-200 (DOTDS).
- Develop refresher TSP and scenarios for ACT training for all modernized "Go to War" aircraft (ARI-DRC).
- Train unit leaders and instructor pilots in selected aviation units, conduct observations, and evaluate initial implementation of ACTE (ARI-DRC).
- Incorporate ACT evaluations into RL training and APART evaluations (DES, DOTDS).
- Integrate ACT training into FS XXI POI's (DOTDS).
- Develop an ACT web site for ACT related data and anonymous reporting system (ARI-DRC, USASC).

- Develop an accident investigation tool and training materials for accident investigation training and field use (ARI-DRC, USASC).
- Integrate ACT into DIS testing and AVCATT development (DOTDS).
- Utilize current reconfigurable simulators to conduct advanced ACT for units deploying to high threat areas and prior to high cost training, e.g., National Training Center (NTC), Joint Readiness Training Center (JRTC). (DOTDS).

Phase Three. Incorporates research products as part of normal operations and deploys advanced ACT applications. Major actions in this phase include:

- Integrate ACT to include all members of the aircrew, i.e., aviators, crew chiefs, flight engineers, mission technicians (DOTDS, ARI-DRC).
- Provide a nonrated crewmember-training package for units to develop crewmembers from technicians (DOTDS, ARI-DRC).
- Implement Accident Identification Tool to fully incorporate ACT into the accident investigation process and support analysis of reported incidents and lessons learned (USASC, DRC).
- Train accident investigators to identify ACT-related factors in accident investigations and unit assistance visits (USASC, DRC).
- Develop advanced ACT scenarios for AVCATT or reconfigurable simulator, e.g., multple aircraft team operations, UAV interactions, external resources (ARI-DRC).
- Develop a web-based repository for ACT training resources, applications examples, and lessons learned (ARI-DRC).
- Establish an Operations and Maintenance recurring funding plan for ACT (CMD GRP, USASC).
- Establish a formal team training and evaluation research and development program (ARI).

References

Crane, P.M., Schiflett, S.G., & Oser, R.L., (2000, November). Roadrunner '98: Training Effectiveness In a Distributed Mission Training Exercise. AFRl-Hl-AZ-Tr-2000-0026.

Department of the Air Force. (1998, July) Cockpit/Crew Resource Management Training Program. (AFI 11-290). Washington, D.C.: Author.

Department of the Army. (2000). 2000 Army Aviation Modernization Plan. Washington, D.C.: Author.

Department of the Army. (1996). The Army Distance Learning Master Plan. Washington, D.C.: Author.

Department of the Army.(1996). Preparing and Submitting Scientific And Technical Manuscripts and Other Documents for Publication (ARI 70-3). Washington D.C.: Author.

Grandin, J. (2000). Training, Exercises, and Military Operations: Domain Management Plan. [on-line]. Available: http://leav-www.army.mil/temo/

Helmreich, R.L., Merritt, A.C., & Wilhelm, J.A. (1999). The Evolution of Crew Resource Management Training in commercial Aviation. The International Journal of Aviation Psychology 9 (1), 19-32.

Hicks, J.E., & Peusch, I.R., (2000, November). Protecting the Force Through Risk Management. Paper presented at meeting of Army Safety Investment Strategy Team (ASIST) meeting at Army Safety Center, Fort Rucker, AL.

Jones, A.M., & Powell, J. (2000). Spatial Disorientation in Army Aviation. Army Aviation 49 (8-9), 6-8.

Nullmeyer, R.T., Crane, P. & Cicero, G.D., (2000, November). A Bridge Between Cockpit/Crew Resource Management And Distributed Mission Training for Fighter Pilots. Paper presented at a meeting of Distributed Mission Training at the Air Force Research Lab in Mesa, AZ.

Seale, Noel, (2000, October). DES Observations. Flightfax28 (10), 4.

Pawlik, Simon, Grubb, & Zeller (1992, October). Crew Coordination Exportable Evaluation Package for Army Aviation.

U.S. Army Accident Information (Aviation Statistical Report). (20, February 2001). [On-line]. Available: http://asmis.army.mil/asmis/statis/aviation_statis

Lacoste, Gene (1999, December). Improving Aviation Safety Performance. Flightfax27 (12).1-3.

Appendix A: Aircrew Coordination Training Road Map

- Begin Flight School XXI
- Begin Divestment of Legacy Systems (UH-1, AH-1)
- Begin Conversion to Multi Functional Battalions

- Fully Implement Flight School XXI
- Continue Conversion to Multi Functional Battalions
- Begin Aviation Combined Arms Tactical Trainer Development

- Begin UH-60 L+ Production
- Continue Conversion to Multi Functional Battalions
- 204 Distance Learning Sites Operational

- Divest Legacy/transitional Systems
- Converted All Corp and Division Brigade (AC-RC) to Transitional Force Structure
- Aviation Combined Arms Tactical Trainer Operational

ACTE Master Plan

ACTE Phase I

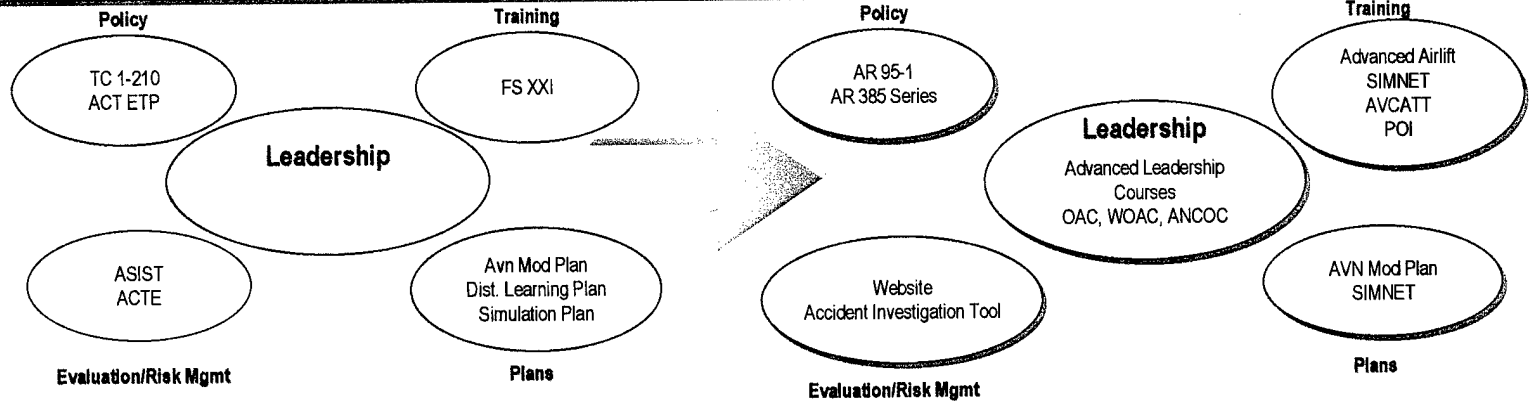
Establish Interim Aircrew Coordination Training Working Group
Review Current Aircrew Coordination Training Programs
Develop Master Plan
Include Aircrew Coordination Training in Aviation Leader Conferences
Recommend as Senior Readiness Oversight Council Interest Item
Develop Aircrew Coordination Training Performance Evaluation System
Develop Core Training Modules
Pre-test, Dem-Val, and Field Test Courses
Develop Evaluation-based Feedback System

ACTE Phase II

Establish Permanent Aircrew Coordination Training Working Group
Designate Aircrew Coordination Training Program and Model Manager
Develop Separate Aircrew Coordination Training Policy
Develop Refresher TSP
Train Unit Leaders and Instructors
Incorporate Aircrew Coordination Training Evaluation into Readiness Level and Aviation Proficiency and Readiness Test
Integrate Aircrew Coordination Training into Flight School XXI
Develop Aircrew Coordination Training Website (Anonymous Reporting)
Develop Accident Investigative Tool
Integrate Aircrew Coordination Training into Distributive Interactive Simulation and Aviation Combined Arms Tactical Trainer Scenarios

ACTE Phase III

Integrate to include all aircrew members
Provide Non-rated Crewmembers Training
Implement Accident Investigative Tool
Train Accident Investigators
Develop Advanced Aircrew Coordination Training Scenarios
Develop Aircrew Coordination Training Website (Resources Repository)
Establish O&M Recurring Funding Plan
Establish Team Training Research and Development Program



List of Acronyms

AAR	After Action Review
ABCS	Army Battle Command System
ABSO	Aviation Branch Safety Office
AC	Active Component
ACT	Aircrew Coordination Training
ACTE	Aircrew Coordination Training Enhancement
ACWG	Aircrew Coordination Working Group
AFI	Air Force Instruction
AFRL	Air Force Research Laboratory
AFRL/HEA	Air Force Research Laboratory, Warfighter Training Research Division
APART	Annual Proficiency and Readiness Test
AQC	Aviator Qualification Course
AQP	Advanced Qualification Program
AR	Army Regulation
ARI	Army Research Institute
ARNG	Army National Guard
ASAP	Aviation Safety Action Program
ATB	Aviation Training Brigade
ATM	Aircrew Training Manual
ATP	Aircrew Training Program
ATSC	Army Training Support Center
AVCATT	Aviation Combined Arms Tactical Trainer
AWACS	Airborne Warning and Control System
C3I	Command, Control, Communications, and Intelligence
CAASD	Corps Aviation Safety and Standardization Detachment
CATT	Combined Arms Tactical Trainer
CCTS	Combat Crew Training School
CCTT	Close Combat Tactical Trainer
CG	Commanding General
CMS	Combat Mission Simulator
CNO	Chief of Naval Operations
CONUS	Continental United States
CRM	Cockpit/Crew Resource Management
CSA	Chief of Staff, United States Army
CTC	Combat Training Center
CTIA	Common Training Instrumentation Architecture
DCG	Deputy Commanding General
DES	Directorate of Evaluation and Standardization
DIS	Distributed Interactive Simulation
DL	Distance Learning
DLC	Distance Learning Center
DLS	Distance Learning Site
DMT	Distributed Mission Training
DoD	Department of Defense
DOTDS	Directorate of Training, Doctrine, and Simulation
DRC	Dynamics Research Corporation

DRU	Direct Reporting Unit
ETP	Exportable Training Package
FAA	Federal Aviation Administration
FOA	Field Operating Agency
FRS	Fleet Replacement Squadron
FS XXI	Flight School XXI
FS	Flight Simulator
FTU	Formal Training Unit
IERW	Initial Entry Rotary Wing
IP	Instructor Pilot
JRTC	Joint Readiness Training Center
LOE	Line Operational Evaluation
LOFT	Line Oriented Flight Training
MACOM	Major Command
MAJCOM	Major Command
MDS	Mission, Design, and Series
MEP	Mission Equipment Package
MIS	Management Information Systems
MOST	Mission Oriented Simulator Training
MP	Master Pan
NASA	National Aeronautics and Space Administration
NATOPS	Naval Aviation Training and Operational Procedures Standardization
NOE	Nape of the Earth
NTC	National Training Center
OCONUS	Outside the Continental United States
OHR	Operational Hazard Report
OPNAV	Office of the Chief of Naval Operations
OPNAVINST	Office of the Chief of Naval Operations Instruction
OPTEMPO	Operational Tempo
POI	Program of Instruction
RC	Reserve Component
RL	Readiness Level
SA	Situational Awareness
SAF	Semi-automated Forces
SD	Spatial Disorientation
SIMNET	Simulation Network
SME	Subject Matter Expert
SOAR	Special Operations Aviation Regiment
T/M	Type/Model
TADLP-MP	Total Army Distance Learning Program-Master Plan
TASS	Total Army School System
TC	Training Circular
TDLS	Transportable Distance Learning Site
TEMO	Training, Exercises and Military Operations
TEWT	Training Exercise Without Troops
TORMS-A	Training and Operations Records Management System Aviation
TRADOC	Training and Doctrine Command
TSP	Training Support Package

UAT	Undergraduate Aviation Training
UAV	Unmanned Aerial Vehicle
USAAVNC	United States Army Aviation Center
USAR	United States Army Reserve
USAREUR	United States Army Europe
USASC	United States Army Safety Center
WAATS	Western Area Aviation Training Site
WSO	Weapon System Operator