ARI Newsletter

U.S. Army Research Institute for the Behavioral and Social Sciences

Volume 11 | Number 1 | Winter 2001

Battle Command Stories

Soldiers have always been good storytellers." So says GEN (ret.) Frederick M. Franks, Jr. in the introduction to the book *66 Stories of Battle Command*. "Along with the doctrine and training and drills, along with the study of military history," writes General Franks, "the personal recollections of fellow soldiers are an important source of developing a feel for the art of battle command. Stories are a primary means of transmitting the wisdom of the profession of arms from one generation to another."

Looking to exploit the power of stories to illustrate and teach, and to assess the value of incorporating battle command lessons in a colloquial format, ARI approached commanders of units from battalion through division. The commanders were asked to first, tell a good story about how they learned a lesson in battle command and then to identify the lesson. What resulted was a collection of highly readable and memorable stories.

After seeing the early draft of the book, the School for Command Preparation of the Command and General Staff College (CGSC) at Fort Leavenworth decided to use the book in its pre-command training for battalion and brigade commanders.

Continued on page 3

IN THIS ISSUE

From the Director

A recent Army Science Board study stated "Training innovations offer improvements comparable to those of new battlefield technologies." Engagement simulation is an example of a training innovation. Frequently, such dramatic changes in training effectiveness occur through a process of spiral development or repeated incremental innovation that provide a dramatic improvement in effectiveness. By this process an existing technology is improved and is provided with new features year after year. Although the process is evolutionary, the cumulative effect of these incremental changes can be profound. This process of incremental innovation through research has provided dramatic improvements in rifle marksmanship and in initial entry rotary wing training highlighted in this issue. For example, the article summarizing the 2000 ARI Special Report "Shooting Straight: 20 years of Rifle Marksmanship Research", summarizes research programs which led to over 50% gains in both basic and advanced marksmanship. These gains were obtained not through research on a new concept or idea, but through improvements in many facets of marksmanship training including instructional development, design of new training materials for students and instructors, training device development and program evolution. Similar improvements are underway in aviation training, in distance learning, and in other important Army training technologies. Their gains will come from the cumulative impact of continuing improvement and spiral development of the human dimension.

Edgar M. Johnson, PhD.

Battle Command Stories

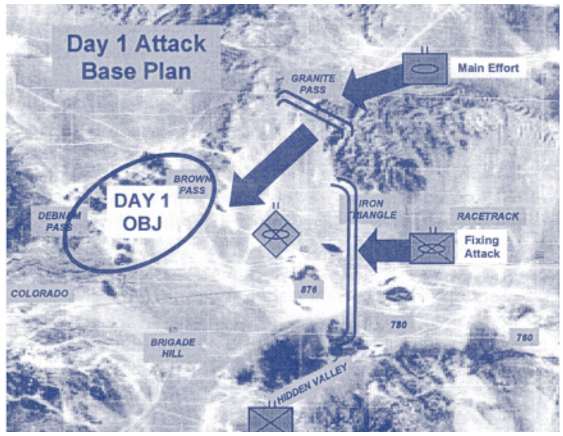
Continued from page 3

Working together ARI and CGSC prepared the final manuscript and incorporated the lessons into the Tactical Commander's Development Course, using the stories to generate discussions during the class.

The stories come from experiences in training exercises, mostly at the National Training Center. Although all the stories relate lessons in battle command, few are about tactical maneuvers and doctrinal principles. Instead, they are stories of friction and confusion - friction generated by the challenging task of orchestrating the actions of a large complex force to gain and maintain the initiative. This, under the pressure of a hostile environment, time, and a wily, punishing OPFOR, who know the habits of BLUFOR commanders as well as they know the terrain. And they are stories of growth, as the commanders strengthen their intuitive feel for battle command, a process achieved through study, practice, interpreted experience, and the observations and experiences of others.

Here are a few brief excerpts from the book:

The problem was I had generated too much energy in my engineers and they were hell bent on breaching. They didn't give a damn what it was, they were going to breach. We emerged down at the Whale Gap, and lo and behold there was a single strand of wire and one row of mines sitting there. It ended about 70 meters to the left of where they went in. We could of drove right around. About the time I get up on the hill and see all this, we're already committed to breaching operations. So, the report was it was triple stranded wire with three rows of mines. The reality was it was a single strand of wire with one row of mines and it ended 70 meters to the left. The moral of the story is, Battalion Commander, get your butt up to the high ground and start picking



that point and looking at the ground so that you can assist the maneuver task force commander with picking the optimal point of penetration…. And sure enough we launched MICLICs, we cut wire, and we stagnated for about twenty minutes doing all this hocus stuff when in two minutes we could have driven right around it.

LIEUTENANT COLONEL DAVID HANSEN
Commander, 20th Engineer Battalion, 1CD, 1998

As some background, before I took command of the battalion, I was an observer-controller at the NTC. I was training guys coming through there for about 16 rotations. One of the observations I made, that was somewhat of a trend, is that FSCOORDs would not believe their eyes, their FA observers. Their observers would report accurate information to them, would want to shoot missions that would kill the enemy. And typically the FSCOORD or brigade commander would think they understood the battle better than their eyes did, wouldn't believe them and would do something else. So, I made a vow to myself I would never do that.

And then, there we were…

LIEUTENANT COLONEL STEPHEN MITCHELL
Commander, 2nd Battalion, 82nd Field Artillery, 1998

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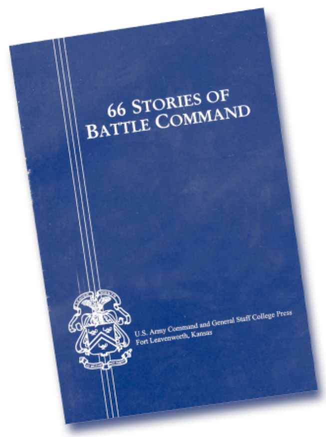
Battle Command Stories

Continued from previous page

Every single day I would go look commanders in the eye. And you could just tell what they are going through. You can tell whether you are wasting your time talking to them or if, in fact, their batteries are charged enough to understand what you are saying. Be very conscious when you wake your commanders up, and what you are putting your staff through in preparation for the battle. What you don't want to have happen is they get to the fight and say let's get this over with. They are so mentally and emotionally drained from everything they've done prior that they are not ready to fight. It's that delicate balance that you have to see face to face and you can't do that by talking to someone on the radio. You have to go look them in the eyes. That's probably a brilliant flash of the obvious, but you would be surprised the number of junior leaders that folks did not get down and see every day and look them in the eye, even though they have a critical role in the fight.

LIEUTENANT TED KOSTICH

Commander, 2nd Brigade, 4ID(M), 1999



What I thought I'd do is race to the Neckar River and get there as quickly as I possibly could. But, even when things started going wrong, I continued to push to the Neckar River and we just got our butts kicked at the Neckar River. I got to thinking why that happened. That happened because I got in a hurry. You don't have to be in a hurry given today's technology and tomorrow's technology. Rather, you can manage the tempo of the battlefield because you know where you are and you know at what rate you are moving and what's going on in your area of the world. And, you know what the enemy is doing and at what rate he is moving, and what is going on in his area of the world. Then you can make decisions to do what you have to do, to get where you want to be, by managing the tempo of the battlefield. People are starting to get fixated on this idea that things happen quicker on tomorrow's battlefield given all this digital capability and that is exactly wrong. What is exactly right is, it is going to happen at the pace that you want it to happen because you are now in charge of the tempo.

COLONEL RICK LYNCH

Commander, 1st Brigade, 4ID(M), 1999

For additional information, please contact Dr. James Lussier, U.S. Army Research Institute, Armored Forces Research Unit, ARI_AFRU@ari.army.mil.

The *ARI Newsletter* is produced by the U.S. Army Research Institute for the Behavioral and Social Sciences
Dr. Edgar Johnson, *Director* • Dr. Harold Wagner, *Chief, Research Support Group* • Mr. John S. Kay, *Communications*

The *ARI Newsletter* is mailed and/or delivered routinely to active duty Army units and individuals. You may make corrections to your mailing label and send it to us for revision.

U.S. Army Research Institute for the Behavioral and Social Sciences
5001 Eisenhower Avenue • Alexandria, Virginia 22333-5600
Web site: www.ari.army.mil • E-mail: news@ari.army.mil

A Commanders Tool for Assessing the Unit Environment Company Relations: the Windows-based Command Climate Survey (CCS)

A Command Climate Survey is an important tool designed to assist commanders in assessing the overall climate of their Army units. The CCS is a simple tool for commanders to measure and understand the current health of his or her unit.

The CCS must be administered by commanders of company-size units within 90 days of assuming command, and annually thereafter. Initially, the U.S. Army Research Institute developed the CCS as a paper and pencil version. This version required hand tabulation of results. Then, an MS-DOS version was developed to facilitate automation on PCs with the speed of 286 MHz and up. Today, a Windows-based version is available and is designed for those commanders whom have PCs equipped with Windows 95, 98, or NT.

The CCS consists of 22 basic questions that address climate areas such as officer leadership, NCO leadership, immediate supervisor, supervisor/leader accessibility, supervisor/leader concern for families, supervisor/leader concern for single soldiers, company cohesion, counseling, training, racist materials, sexually offensive materials, stress, training schedule, sponsorship, respect, company readiness, morale, sexual harassment, discrimination, and reporting harassment/discrimination incidents. Questions on gender and race are included to facilitate analysis. Additional space is provided for narrative comments on company strengths and areas most needing improvement.

A commander can add up to 5 Likert-scale questions and 2 open-ended questions. These options allow commanders to ask questions unique to their unit. Although the CCS administration is left solely to the discretion of the commander, it is far less cumbersome than the traditional paper and pencil method. Overall, once a CCS is customized and administered, it will only take company personnel about 15 minutes to complete. For example, a commander can administer a customized CCS to his company on a Monday morning and by late afternoon on Wednesday he can compile the results. On Thursday morning he can then present the feedback to all company personnel. Company personnel will then realize that their comments and opinions make a difference. The commander can then initiate positive changes immediately. In addition, the commander can track changes over time by re-administering the same survey at least one more time within 12 months after assuming command.

Now, with the Windows-based CCS, commanders can administer the CCS via Local Area Network (LAN). Company personnel who have access to the LAN can click on a LAN link icon and the CCS will appear on their computer screens. Upon completion of the survey, all data is centrally collected in one master data base file for analysis.

Top Army leaders encourage the use of the CCS and emphasize that commanders and other company personnel should not fear the survey. All company personnel should be surveyed and respondents need not worry about being identified. The CCS features multiple safeguards to protect a respondent's privacy (e.g., the database is password protected for anonymity). The reporting program includes automatic lockouts to disable sorting by gender or race when there are fewer than 5 respondents of any given sub-category (male, female, black, white, or other).

Commanders should take ownership of the

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Get an understanding on leadership, cohesion, stress, family, and more.

A Commanders Tool for Assessing the Unit Environment Company Relations: the Windows-based Command Climate Survey (CCS)

Continued from previous page

CCS by introducing the survey to the company, explaining its intent, administering it, analyzing the results, and providing feedback to the company. In addition, a commander should supplement the CCS with other climate methods such as personal interviews, focus groups, observation, and feedback from subordinate leaders to assess and sustain the positive aspects within the company while improving human relations. Using these methods as a baseline to the overall assessment, combined with the CCS results, commanders can develop and initiate action plans within a company. Moreover, senior commanders are encouraged to be mentors and coaches for their junior commanders by assisting them in formulating their plans of actions.

Commanders who would like a copy of the Windows-based CCS can access it through the ARI web site. The address is **http://www.ari.army.mil**. At the web site, click on "Surveys" then "Command Climate Survey" or "Training Module (Command Climate Survey)" to obtain information on the Command Climate Survey Training Program. The Training Module is designed to provide commanders with guidance for preparing to survey, reading survey results, analyzing/interpreting data, developing action plans and holding a feedback meeting.

For additional information, please contact Dr. Morris Peterson.
ARI-Army Personnel Survey Office,
ARI_APSO@ari.army.mil.

PC Usage in the Military

Did you know that…

1.3% (not 98.7%) of all officers and 15.4% of enlisted personnel (PV2-CSM) report that they do not have access at all to the Internet (not at work, at home, in a training classroom, or some other accessible location)?

91.7% of all officers and 60.8% of enlisted personnel (PV2-CSM) have access to a personal computer (PC) at home?

79.8% of all officers and 38.2% of enlisted personnel (PV2-CSM) have access to a personal computer (PC) at work?

83.9% of all officers and 56.9% of enlisted personnel (PV2-CSM) have access to the Internet at home?

81.6% of all officers and 44.6% of enlisted personnel (PV2-CSM) have access to the Internet at work?

Of those who have access to the Internet…

79.2% of officers and 51.8% of enlisted personnel (PV2-CSM) connect to the Internet every day or almost every day?

11.4% of officers and 16.4% of enlisted personnel (PV2-CSM) have a their own, personal web site?

Results from the **Fall 2000 Sample Survey of Military Personnel**, *conducted by the Army Personnel Survey Office (ari-apso@ari.army.mil).*

Shooting Straight: 20 Years of Rifle Marksmanship Research

Early research contributions to rifle training, plus use of current simulator programs.

Soldiers receiving rifle marksmanship training in the past 20 years have benefited from ARI research products, probably without being aware of it. Special Report 44 highlights the many contributions made by ARI to marksmanship research since 1977. These contributions have included the development and evaluation of new training programs, along with a host of instructional materials for Army trainers. Our scientists have either developed or evaluated most of the marksmanship simulators and training devices in use today. In recent years, most of our work has centered on solving the complex operational and training problems surrounding night fighting, as well as predicting live-fire qualification scores from simulator performance.

Beginnings

Based on growing concerns that rifle marksmanship training was not producing qualified marksmen for Army units, ARI began a systematic examination of basic, advanced, and unit marksmanship training programs in 1977. At that time, the average soldier could only hit 55% of stationary personnel targets from distances between 50m and 300m. ARI began to tackle this problem by defining the rifle defeatable combat threat (i.e., briefly exposed stationary and moving personnel targets within 300m), by examining previous marksmanship research, and by investigating existing and alternative training procedures.

A Better Way

After conducting a series of field experiments to evaluate solutions to some of the identified problems, a revised BRM training program was developed and tested in 1979 with 1,151 soldiers at Fort Jackson, SC. The revised program differed in four major ways from the existing program at that time. First, it used a revised zeroing target that was easier to understand. Second, scaled 25m silhouette target exercises were introduced to help increase the overall amount of performance feedback provided. Third, downrange feedback exercises were used, where soldiers walked downrange to place spotters in paper silhouette targets at 75m and 175m. This enabled instructors on the firing line to see which individuals needed additional coaching, and illustrated the ballistic effects of wind and gravity to soldiers firsthand. Fourth, instructors emphasized a simplified set of four marksmanship fundamentals: steady position, aiming, breath control, and trigger squeeze. Before this program was introduced, instructors had emphasized over 20 teaching points, including eight "steady hold" factors. This amount of information was too much for soldiers to remember on the firing line and many of the old teaching points had little influence on whether soldiers hit or missed targets.

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Summary of Problems Identified in Basic Rifle Marksmanship (BRM) Training

Trainees	Limited ability to maintain and operate rifle. Limited knowledge of shooting fundamentals. Little knowledge of zeroing process. Poor zero achived by many. Limited knowledge of wind and gravity effects.
Instructors	Too few competent instrcutors. Limited BRM knowledge. Limited diagnostic skills. Unable to conduct effective remediation.
Ranges, Targets & Training Aids	Difficulty using zeroing targets. No feedback on quality of pop-up target hits. No feedback on pop-up target misses.
Weapons	Insufficient quality checks. Hard trigger pull for some rifles. Poor grouping ability of some rifles.

Shooting Straight: 20 Years of Rifle Marksmanship Research

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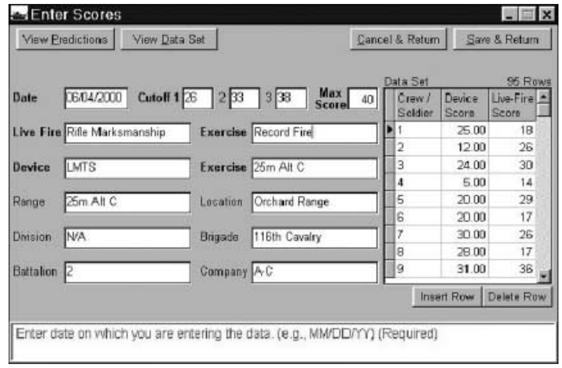
Soldiers receiving the revised BRM training program at Fort Jackson achieved significantly higher record fire scores than those receiving existing training. During a period of additional refinement and testing, the revised BRM program was then provided to more than 8,000 initial entry soldiers at Fort Benning, GA, with equal success. As a result, the U.S. Army Infantry School, as proponent for rifle marksmanship training, officially approved the revised BRM program in 1980. It was subsequently implemented at all Army Training Centers by 1982. Following implementation, the average soldier could hit almost 75% of stationary personnel targets between 50m and 300m, compared to only 55% a few years earlier. Subsequently, similar improvements were made to advanced and unit rifle marksmanship training programs.

Training Devices and Simulation

ARI has long recognized the difficulty of providing precise and timely performance feedback to soldiers in rifle marksmanship training. To partially address this problem, ARI began to investigate the potential benefits of a variety of marksmanship training devices and simulators in the early 1980s. ARI Special Report 44 summarizes our research efforts with five training systems: the Superdart projectile location system (Australasian Training Aids), Weaponeer (Spartanics), Multipurpose Arcade Combat Simulator (ARI), Engagement Skills Trainer (Firearms Training Systems), and Laser Marksmanship Training System (BeamHit). To various extents, these five systems continue to play a role in Army marksmanship training programs today. Recently, ARI has developed a software tool that trainers can use to predict live-fire scores from training devices scores, including the Engagement Skills Trainer and the Laser Marksmanship Training System.



Night Firing

The 1990s saw an increased emphasis on night operations within the Army. Integral parts of this effort were attempts to improve the dismounted soldier's ability to see and hit targets at night. Today night equipment, including night vision goggles (NVGs), aiming lights, and thermal sights, is becoming relatively common within the Infantry and other branches of the Army. Initially, ARI conducted research on aiming lights and NVGs. Later, marksmanship training and performance with both aiming lights and thermal sights were assessed.

Two major lessons emerged from these assessments. First, inconsistency in device design for windage and elevation adjustments created confusion for the soldier, led to errors, inefficient training, and wasted ammunition. Second, the diagnosis of shooting problems has become more complex for soldiers and trainers, because the number of potential causes for problems has increased almost exponentially.

When soldiers miss targets with iron sights, the immediate reaction of a trainer is to check their application of the four marksmanship fundamentals. With the advent of aiming devices, optics, and borelights to the world of small arms, there are many more potential reasons why a soldier could be missing targets. Today's trainers need to ask a host of diag-

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Shooting Straight: 20 Years of Rifle Marksmanship Research

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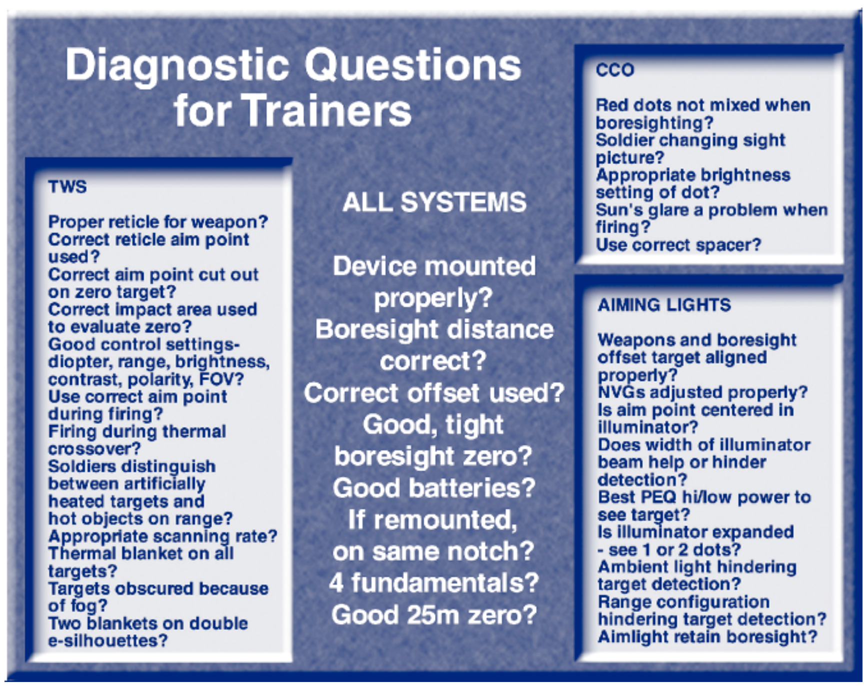
nostic questions to determine why soldiers are missing targets. To effectively diagnose shooting problems, soldiers, trainers, and leaders must now fully understand each technology, how to use each device, and the complete collection of steps and procedures that result in effective rifle marksmanship performance, both during the day and at night.

Research Questions

As weapons and simulation technologies continue to evolve, the need for additional rifle marksmanship research will remain throughout this decade. Special Report 44 briefly explores future training issues and associated research needs in three broad areas: the improved integration of existing systems, the development of training programs for new systems, and the need for an overall strategy to harness advances in simulation technology.

An example of new systems training is the Objective Individual Combat Weapon (OICW), scheduled for initial fielding in 2007. The OICW could radically affect the development of future doctrine and training within Infantry units and Infantry One-Station Unit Training. Although the OICW may eventually reduce the need to train selected advanced rifle marksmanship, M203 grenade launcher, and M249 squad automatic weapon tasks, the overall training resource burden associated with OICW fielding will be high, at least initially. Due to the greater relative costs of its 20mm ammunition, simulation will likely have an even more important role in the OICW's overall training strategy than it has in current small arms training. Developing effective and affordable systems for marksmanship simulation and tactical engagement simulation will be a challenge. Further, procedural tasks appear more complex in the OICW than in current weapon systems. Overall, OICW tasks appear to be more cognitive and less psychomotor in nature, with numerous situational (if-then) contingencies. The amount of training needed to rapidly execute such tasks under conditions of extreme stress may be much greater than presently realized.

For additional information, please contact Dr. Ken Evans, ARI-Infantry Forces Research Unit, ARI_IFRU@ari.army.mil.



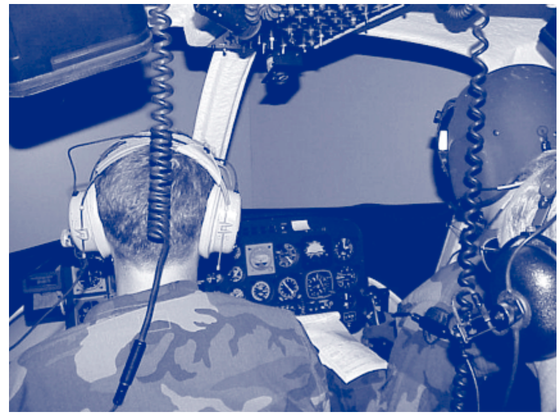
Toward a Simulation-Focused Training System for U.S. Army Aviation

Proficiency measures identify flight-training imporvements and cost benefits.

Traditional Training in a World of High-Technology Simulation

The 21st Century will see an expansion in the use of simulation in aviation training. Simulation technology is evolving so rapidly that even experts have difficulty keeping abreast of it. By contrast, the way in which simulation technology is used to train aviators has shown minimal evolution (Salas, Bowers & Rhodenizer, 1998). In the Army and in most other military aviation training settings, flight grades remain the benchmark for evaluating student performance. Conventional measures of student performance are: course pass/fail, setbacks in the course, classroom, flight training, checkride, and instructor pilot "putup" grades (the grade the student is expected to receive on a checkride), and class standing.

Stewart, Dohme & Nullmeyer (1999) explain how traditional grading can be problematic, when flight grades are used as a criterion for evaluating performance. In the case of Army Initial Entry Rotary Wing (IERW) training, grades awarded for daily training are A, B, C, and U (unsatisfactory). The modal grade is B. If the instructor believes that the student pilot deserves an A or C, then he or she must justify this in writing on the grade slip. Hence, the incentives and demands on the instructor's time reinforce giving B as the default grade. According to Stewart et al. (1993), past research has shown that the limited variation in flight grades renders them ineffective either as criteria for measuring performance or as predictors of future performance. In addition to flight grades, Army IERW training uses the Basic Qualities (attitude, flight safety, knowledge of procedures, and coordination) to reference student pilots' underlying knowledge, skills and abilities. The Basic Qualities are not empirically derived, but are constructs that reflect beliefs and assumptions. Dohme (1979) found



that the Basic Qualities, like flight grades, were not effective performance criteria.

Training proficiency measures which are possible but not currently in use are: Flight hours to proficiency, iterations (i.e., repetitions) to proficiency. Objective aircraft performance measures such as heading and altitude variation, deviation from ground track, and airspeed can be gathered electronically during "flight" in a simulator. It is also possible to collect the same data with inexpensive, PC-based equipment in the aircraft (Benton, Corriveau & Koonce, 1993). Whatever measures are selected, they must be sufficiently sensitive to identify relatively small changes in the efficiency of training.

Lock-Step Flight Training Programs

Most military aviation programs of instruction (POIs), including those employed by the Army, use the concept of the flight training class. All students are assigned to a class, which follows a fixed schedule. However, students do not all learn the material and meet the training objectives at the same rate. Differential learning rates are handled by mechanisms such as the setback in which a student is reassigned to another class, to repeat a portion of the curriculum. In this class-based (lock-step) POI, a student who is learning rapidly is nonetheless required to stay with the curriculum. Students

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Toward a Simulation-Focused Training System for U.S. Army Aviation

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who have already met the training objectives of a given training phase continue to fly in order to meet the flight time requirement.

Enhancing Training Effectiveness through Simulation

The traditional view of simulation as a cost-effective method for reducing aircraft flight hours may be slowly changing (Stewart et al., 1999). Until recently, training developers have considered simulators to be substitutes for aircraft; the goal of simulation technology was to reproduce as closely as possible the characteristics of the aircraft so that flight hours could simply be shifted from aircraft to simulator. This concept was based upon the time-honored notion of identical elements (Thorndike, 1903), and sought to maximize similarity between the location where training takes place (simulator) and where performance is demonstrated (aircraft). However, the simulator can never be a perfect replica of the aircraft. By this reasoning, training in the simulator can never be more effective than training in the aircraft. Since simulator hours were swapped for aircraft hours, it also perpetuated the class-based training concept in which every student pilot received a pre-set number of hours of training.

A more recent view states that with proficiency-based training, simulation can produce superior outcomes than training in the aircraft alone (Rakip, Kelly, Appler & Riley, 1993; Selix, 1993). Not only are the hourly operational costs of helicopter simulators low when compared to the aircraft, but more repetitions of a specific maneuver can be performed within a given time frame. If a maneuver is failed, the student has more time to repeat it until it is mastered. Furthermore, the student can practice critical tasks without distractions that may occur in the aircraft (e.g., noise, vibration).

The perception that training in the simulator is an inferior (though cheaper) substitute for training in the aircraft should continue to evolve as more simulation research is conducted. Dohme (1995) for example, using ARI's Training Research Simulator, demonstrated the effectiveness of simulation and proficiency-based training for IERW student pilots. Each student performed each flight maneuver until he or she mastered it, notwithstanding hours. Evidence that is more recent shows that a well-designed, simulation- and proficiency-based training system can produce a superior product than training in the aircraft alone.

This success story (Selix, 1993) concerns the design of a simulation-focused training system for the Air Force's MH-53J Pave Low helicopter. Its development was driven by the increasing complexity of aircraft systems. With increasing upgrades to the aircraft, the number of flights needed to qualify increased. At the same time, flight hours were being reduced. Add to these considerations the high hourly operational costs for the MH-53J, and it became obvious that something had to be done.

The answer to this challenge was development of a training system founded upon proficiency-based training. Students were trained on part-task training devices until performance

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Toward a Simulation-Focused Training System for U.S. Army Aviation

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standards were met for a particular set of tasks. They could not proceed to the next level of mastery until proficiency had been demonstrated. Having done this, they were then introduced to crew-level practice in a high fidelity, full mission simulator. Selix described the 1993 curriculum as an approximate 50:50 mix of synthetic and aircraft training hours. The current curriculum, at this writing, is 24% aircraft and 76% synthetic-based. Before redesign of the program, it took 18 flights in the Pave Low aircraft to qualify. After the change, only three flights were needed. Granted, the intervention described by Selix was cost-effective, but how did this affect the quality of product (i.e., the qualified Pave Low crew)?

This question was addressed in a follow-up evaluation by Rakip, et al. (1993) who surveyed experienced Pave Low crewmembers and their commanders. They were asked to evaluate new crews assigned to their units based on their knowledge, understanding and execution of critical mission functions. Some of these crews had been trained in the simulation-based training system, whereas others had been trained only in the aircraft. New crews trained in the simulator were rated as superior to their aircraft-only counterparts on all mission criteria except Night Vision Goggles ability, for which ratings were virtually the same. Furthermore, simulator-trained crewmembers took less time (2 to 3 months) to be brought up to standard in the aircraft, versus one year on the average for those trained only in the aircraft.

Future Directions in Army Aviation Training Research

Although successful, Dohme's program of research did not result in the Army's class-based training system giving way to a proficiency-based system. However, the Army's current Flight School XXI initiative, which seeks to define the future simulation-based training system, has sparked a renewed interest in this and other pioneering ARI efforts. Specific ARI-initiated issues like training iterations to proficiency replacing hours, have resurfaced. As Army aviation training becomes more simulation-dependent, more research demonstrating the advantages simulation-focused, proficiency-based training will be necessary. Research could be conducted, beginning with the Primary Phase of IERW training. An experiment could reveal whether students who train to proficiency meet performance criteria in fewer total training hours and/or at less training expense than under the current hours-based flight class system. The same training resources could be retained, (classroom, procedures training devices, in-simulator, and in-flight instruction). Students could also be administered self-paced academic and hands-on-performance exams. With increased use of visual flight simulation, training in the aircraft could be reserved for evaluation. The aircraft could be used to "fine tune" training already begun in the simulator until the student pilot displayed mastery on a specified training objective. This method would change the role of the in-aircraft checkride. It would be administered primarily to validate the effectiveness of synthetic training. If successful in the context of primary training, this research approach could be applied to various advanced phases of aviation training. The ultimate goal would be a more efficient, cost-effective training system at all levels of aviation training, which would produce proficient aircrews.

For additional information, please contact Dr. John Stewart, ARI- Rotary-Wing Aviation Research Unit, ARI_RWARU@ari.army.mil.

Automatic Essay Grading

Background

The demands of future conflict will place great responsibility on leaders at all levels to accept change readily, and become proficient in the use of a wide range of new technologies, particularly information technologies. This will require more formal training, education, and the development of a culture of continuous education (Wass de Czege , 2000). Although simulations of many kinds are effective for learning many Army tasks, education still depends on texts and essays. Essay assignments are widely acknowledged as an excellent means of generating complex understanding and practical learning within the schoolhouse, but they place an unwieldy burden on senior officers for grading and feedback, particularly in distance learning. Fortunately, new knowledge-based technologies can effectively measure how well understanding is expressed in writing.

Intelligent Essay Assessment

Over the past decade ARI's Research and Advanced Concepts Office has supported the development of essay scoring software that understands the meaning of written essays, evaluates them, and provides feedback as accurately as a professional educator. Some of the potential advantages of machine scoring of essays are:

- A computer can examine an almost unlimited amount of relevant source material before being used to score essays on a particular topic.
- A computer can compare every essay with every other from the same class, and from previous years-something that would be impossible for a human to do.
- A computer can be consistent in its evaluations, from essay to essay, one year after the next. It will not get tired, bored, irritated, or inattentive, nor will its standards drift.
- A computer can be entirely free of bias based on race, gender, ethnicity or any other irrelevant characteristic.
- A computer can perform sophisticated analyses beyond humans' unaided capability.

Knowledge Analysis Technology (KAT), supported by ARI's small business technology transfer research program, has established of a small business to implement this new technology. KAT's Intelligent Essay Assessor (IEA) is the only essay evaluation system in which meaning is measured foremost. IEA measures abstract factual knowledge, based on extensive background readings, texts, and news sources, not just superficial factors such as word counts, word length, keywords, or punctuation. In this way IEA's assessment focuses on the complex understanding that goes into the creation of an essay.

For example, before scoring essays on military leadership, IEA reads all of FM 22-100, Military Leadership, other relevant essays that have been graded by senior officers, and books such as Woodward's "The Commanders". From its reading, IEA constructs a very large semantic

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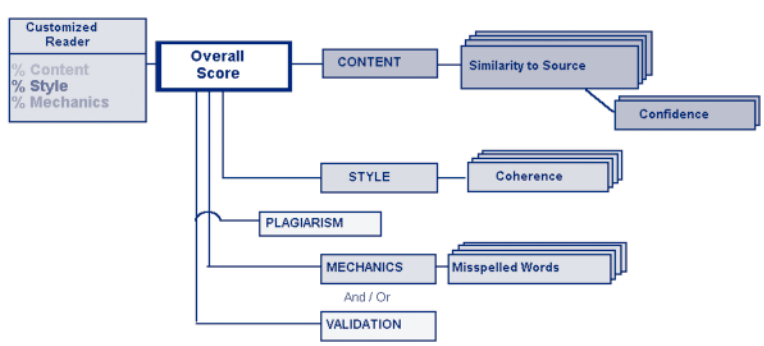
Figure 1. IEA is based primarily on meaning and content, but it also can measure mechanics and style.

Effective Automated scoring of EssaYs (EASEY)
The Intelligent Essay Assessor architecture



Automatic Essay Grading

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network of all the words in all the contexts found in the background texts. It can also supplement this text, if it is too specialized, with a representative sample of the kinds of materials an average American reader encounters. This network permits IEA to read any essay and understand the many synonyms and alternate ways of stating the same important ideas. As a result IEA can grade essays as effectively as an expert on the topic.

Although the original analysis of these huge amounts of text require real time algorithms that take long periods of time on powerful computers, the output of this analysis can be used for text analysis in very short processing times. Examples of these uses are available on the web at http://lsa.colorado.edu/ As a powerful web-based learning tool IEA can accept an essay and provide tutorial commentary, plagiarism detection, and other feedback almost immediately. As Figure 1 shows, IEA grades on the basis of content and meaning contained in the essay, as well as mechanical and stylistic issues. In most practical applications, the grade is based mainly on content, and much less on style and mechanics.

Findings

IEA has been extensively tested with thousands of essays, from students of many different ages, in topics ranging over biology, history, psychology, business, GMAT, and military leadership

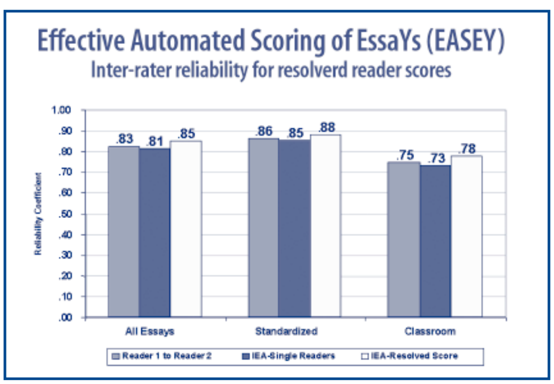

Figure 2. IEA grades more like the average of expert graders, suggesting that IEA is a better grader than the individual graders.

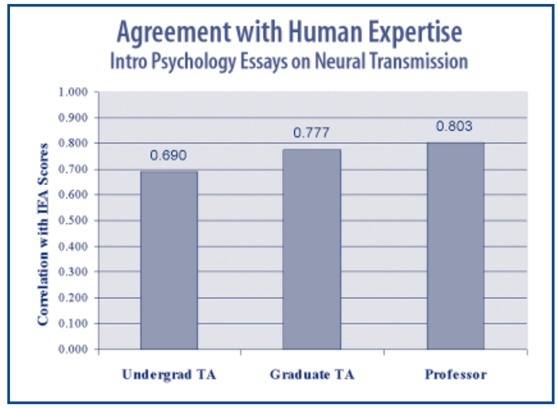

Figure 3. IEA grades most like the expert, and better than novices in the topic.

(Landauer & Dumais, 1997). Classroom essays, where the correlations with IEA are in the 0.70's, are not as rigorously graded as standardized essays such as the GMAT, where the correlations with IEA are in the 0.80's (See Figure 2). One suggestive finding in this work is that IEA grades more like the average of expert graders, suggesting that IEA is a better grader than the individual graders. It consistently has scored classroom essays like expert instructors do, and better than novices. For instance, in a test of its power, IEA scored essays most like the course professor, and somewhat better than the graduate teaching assistants, and much better than undergraduate teaching assistants (See Figure 3). In current work under the small business grant, KAT is applying this technology to the assessment of tacit knowledge for military leadership essays. Working with Yale University and the University of Colorado, an interactive web environment is being created for knowledge sharing and discussions of current Army issues. This work will be reported in more detail in a future edition of this newsletter.

Recommendations for Future Research

The pattern of positive results obtained with

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Automatic Essay Grading

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IEA has led ARI and TRADOC to establish a testbed for determining the operational cost - effectiveness of the automated essay scoring software within CAS3 resident courses at Ft. Leavenworth, Project EASEY (Effective Automatic Scoring of EssaYs). If this is successful, automatic grading could be applied widely to distance learning and non-resident studies. As the Army moves to increase use of distance learning to reduce travel costs and the disruptions to work and home life, automated essay assessment holds promise for enhancing instructional efficiency, and even effectiveness. It can improve the quality of distance learning instruction by moving from passive environments based on multiple choice questions, to more constructive environments based on the active production of knowledge in essays.

For additional information, please contact Dr. Joe Psotka, ARI-Selection and Assignment Research Unit, ARI_SARU@ari.army.mil.

Using the Web

The most common uses of the Internet are:

	Officers	**Enlisted**
Using it to send and receive email and faxes	90.4%	76.3%
Obtaining prices for travel information	74.6%	55.0%
Getting news and other up-date-information	73.8%	48.8%
Accessing data bases for technical information	63.8%	42.8%
Getting phone numbers, addresses, road maps	62.6%	42.2%
Buying other items, such as books	62.3%	34.7%
Buying travel items, such as tickets	60.4%	37.0%
Obtaining prices for retail items	59.3%	42.2%
Doing office work at home	55.7%	32.2%
Checking balances of accounts	48.2%	29.3%
Read magazines, newspapers on-line	41.6%	24.9%
Obtaining financial information	41.0%	18.1%
Playing games	31.5%	50.7%

Results from the *Fall 2000 Sample Survey of Military Personnel*, conducted by the Army Personnel Survey Office (ari-apso@ari.army.mil).

Dismounted Soldier Simulation – Technology Development & Evaluation

The Army's new missions and equipment mean increasing challenges for small unit Infantry leaders. ARI is leading a four-year effort to develop and evaluate Virtual Environment systems for dismounted Infantry soldiers, leaders, and small units.

The ARI Simulator Systems (Orlando, FL) and Infantry Forces (Fort Benning, GA) Research Units are leading a four-year joint Science and Technology Objective (STO) with the Army Simulation, Training and Instrumentation Command (STRICOM) and the Army Research Laboratory (ARL). The STO, "Virtual Environments for Dismounted Soldier Simulation, Training, and Mission Rehearsal," was established to develop, and evaluate technologies, techniques, and strategies for using virtual simulations for dismounted soldier, leader, and small unit training, mission rehearsal, concept development, and test and evaluation. The STO emphasis is on developing the capability to conduct Military Operations in Urban Terrain (MOUT), night, and contingency operations within Virtual Environments.

Description of the Culminating Event

Each year a culminating event is held to evaluate progress and demonstrate accomplishments. The first STO culminating event was held at the Dismounted Battlespace BattleLab in September 1999. The second, held in September 2000, used networked Individual Combatant Simulators (ICSs) located at STRICOM's Technology Development Center and the ARI Virtual Environment Research Testbed. Both facilities are located at the University of Central Florida's Institute for Simulation and Training in Orlando, FL.

Figure 1. RealGuy (left) and Fully Immersive Team Training (right) Individual Combatant Simulators.

Squad-level missions using a mix of soldiers and computer-generated forces were conducted on three successive days. A different set of soldiers participated each day. The soldier participants were from the Florida National Guard, Active Army Infantry (Fort Benning), and Active Army Special Forces (Fort Bragg). Each set of soldiers provided different perspectives on the applications of Virtual Environment technologies to their respective organizations.

Figure 1 shows STRICOM's RealGuy Immersive ICS (left) and ARI's Fully Immersive Team Training ICS (right). Two of each of these were employed as well as a RealGuy desktop station. This permitted five soldiers to participate simultaneously in the same exercise. These ICSs represent different approaches to visual display, locomotion, and body and weapon tracking in VEs.

The other squad members were represented by Dismounted Infantry Semi-Automated Forces (DI SAF). DI SAF provides visual and behavioral representations of friendly, enemy, and neutral forces at the level of individual entities. Each year the set of DI SAF behaviors is expanded and control issues are addressed. Currently, a skilled operator is required to control the DI SAF during a mission. During this culminating event initial evaluations were conducted with voice recognition and gesture recognition systems as means of controlling DI SAF.

Four different missions were designed to exercise new capabilities developed under the STO. Tasks performed by soldiers during

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Dismounted Soldier Simulation – Technology Development & Evaluation

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those missions included: clear building, react to contact, move through built-up area, reconnoiter area, and assault. The Virtual Environments for the missions were generated from a simulated urban terrain database that represented the McKenna MOUT site at Fort Benning and a new database simulating a modern built-up area, including high-rise structures (Figure 2). The model included a complex system of tunnels under part of the McKenna MOUT site.

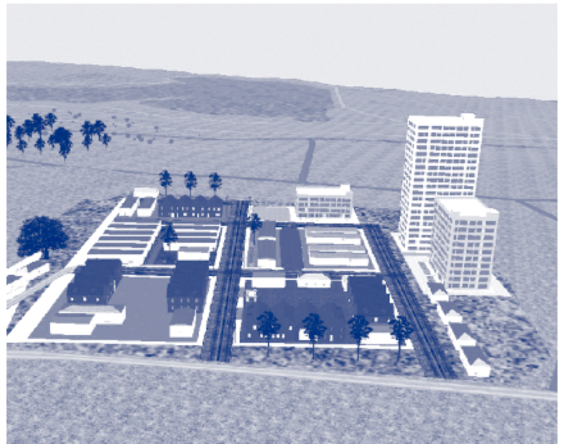

Figure 2. Urban terrain Virtual Environment with high-rise structures.

Findings and Lessons Learned

After completion of the exercises, the soldier participants completed questions and engaged in structured group interviews to assess the various VE technologies and potential procedures and strategies for using them. Issues covered varied from very specific aspects of the individual ICSs to general questions about the VE simulation of dismounted operations.

There was a general consensus among the soldiers that the VE technology would be of greatest value for training new small unit leaders (e.g., Basic NCO Course, Infantry Officer Basic Course) and for mission rehearsal for experienced leaders and units. Soldiers' ratings of their capability to perform mission subtasks indicated areas in which system improvements are required (particularly tasks requiring quick or precise movements), as well as areas in which current capabilities are good (such as visual identifications of types of individuals or gross motor movements).

The representations of the buildings and the terrain, and the night vision simulation were highly rated. The DI SAF automated building clearing behavior was considered good. However, interactive control of DI SAF during the mission was considered unacceptably slow. The current implementations of voice and gesture recognition as a means of controlling DI SAF require further improvement.

In preparing for the culminating event there were several lessons learned. VE representations of urban terrain such as high-rise buildings are computationally intensive. Their use caused slow ICS operation, which in turn likely made quick or precise movement more difficult and contributed to simulator sickness symptoms reported by some of the participants. Integrating the different but compatible ICSs forced compromises resulting in the lowest common denominator, eliminating features unique to each system.

The findings and lessons learned from the STO 2000 Culminating Event will be used to prioritize subsequent STO activities. Additional culminating events are planned for FY 2001 and 2002. For additional information, please contact Dr. Bruce Knerr, ARI-Simulator Systems Research Unit, ARI_SSRU@ari.army.mil.

Aircrew Coordination Training Enhancement Program

Web-based improvements for aviation training

Overview

At the request of the United States Congress, The ARI Rotary Wing Aviation Research Unit (RWARU) is undertaking applied research and development to enhance the Army's Aircrew Coordination Training (ACT) program and its day-to-day mission application.

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. These behavioral skills include decision-making, assertiveness, mission analysis, communication, leadership, adaptability/flexibility, and situational awareness. 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.

The overall purpose of this effort is to improve the coordination effectiveness of Army aircrews and aviation leaders in their daily mission planning and flight operations. Properly utilized, this program will provide a tool for leaders at all levels. As an important control measure in the risk management process, the Army estimates that the enhancement of ACT is capable of showing a potential reduction in accident costs of 144 million dollars.

The enhanced ACT program will build on the original exportable training package ARI fielded in the mid-90s, revitalizing it from a one time training event and enhancing it to a dynamic, relevant program that is continuously updated and improved.

The Master Plan for ACT Enhancement was developed under the guidance and oversight of an aircrew coordination working group (ACWG) made up of key personnel from the

US Army Aviation Center (USAAVNC), US Army Safety Center (USASC) and other subject matter experts interested in contributing to the revitalization effort. The plan provides a proactive, multi-phased course of continuous improvement to maximize Army aviation modernization investments and complement leadership training initiatives. The current ACT Enhancement program, with its focus on upgrading and sustaining ACT, constitutes Phase One in a three-part plan to bring crew coordination training into the 21st Century.

Phase One: Upgrade and Sustain the Current ACT Program

Phase One of the revitalization effort began in late 2000. Major actions in this phase include:

- Establish an interim Aircrew Coordination Working Group to guide the ACTE applied research effort.
- Review current programs.
- Include information and discussion on ACT policy and program enhancement initiatives in aviation leader conferences.
- Recommend adding ACT as a permanent item of interest for Senior Readiness Oversight Council.
- Develop a behaviorally-anchored ACT performance evaluation system.
- Develop core-training modules.

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Aircrew Coordination Training Enhancement Program

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- Pre-test courses of instruction.
- Demonstrate and validate courseware.
- Field test and refine courseware with both active and reserve units.
- Develop an evaluation-based feedback system to evaluate, manage, and maintain overall program effectiveness.

Phase Two: Refresh and Maintain the Upgraded Sustainment Program

Phase Two completes the applied research effort and will further advance the upgraded program by establishing a permanent ACT working group consisting of Interim ACWG plus MACOM, ARNG, and USAR representatives, designating an ACT program manager and instructional model manager, and developing a separate ACT policy or preparing an ACT specific supplement to TC 1-200. Additional Phase Two major actions will include:

- Tailor training scenarios for specific aircraft and missions.
- Integrate ACT into Readiness Level training, Annual Proficiency and Readiness Test (APART) evaluations, and Flight School XXI.
- Provide an accident investigation tool and training materials for accident investigations and field use.
- Include ACT in distance learning developments.
- Develop a web site for ACT related data and anonymous reporting.

Phase Three: Develop and Deploy Advanced Applications

Phase Three incorporates the prototype training products into normal flying operations and deploys advanced ACT applications. This final phase will include the development of training packages for non-rated crewmembers and implementation of the accident investigation tool. Additional Phase Three tasks will include:

- Develop advanced ACT scenarios for the Aviation Combined Arms Tactical Trainer (AVCATT) or reconfigurable simulator, e.g., multiple aircraft team operations and Unmanned Aerial Vehicle (UAV) interactions.
- Develop a web-based repository for ACT training resources, applications examples, and lessons learned.
- Establish an ACT Operations and Maintenance recurring funding plan.
- Establish a formal team training and evaluation research and development program.

Summary

The Army's ACT program effectiveness has greatly declined since 1995 and requires revitalization and enhancement. Current opportunities exist to: 1) integrate ACT into all aspects of aviation operations, 2) reinforce ACT in the Flight School 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, and 5) capitalize on advances in distance learning and web-based instructional technologies. Researchers at ARI-RWARU believe that the current revitalization plan will accomplish these goals.

For additional information, please contact Dr. Larry Katz, ARI Rotary Wing Aviation Research Unit, ARI_RWARU@ari.army.mil.

U.S. Army Research Institute
5001 Eisenhower Avenue
Alexandria, VA 22333-5600

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