Flightfax

ARMY AVIATION RISK-MANAGEMENT INFORMATION

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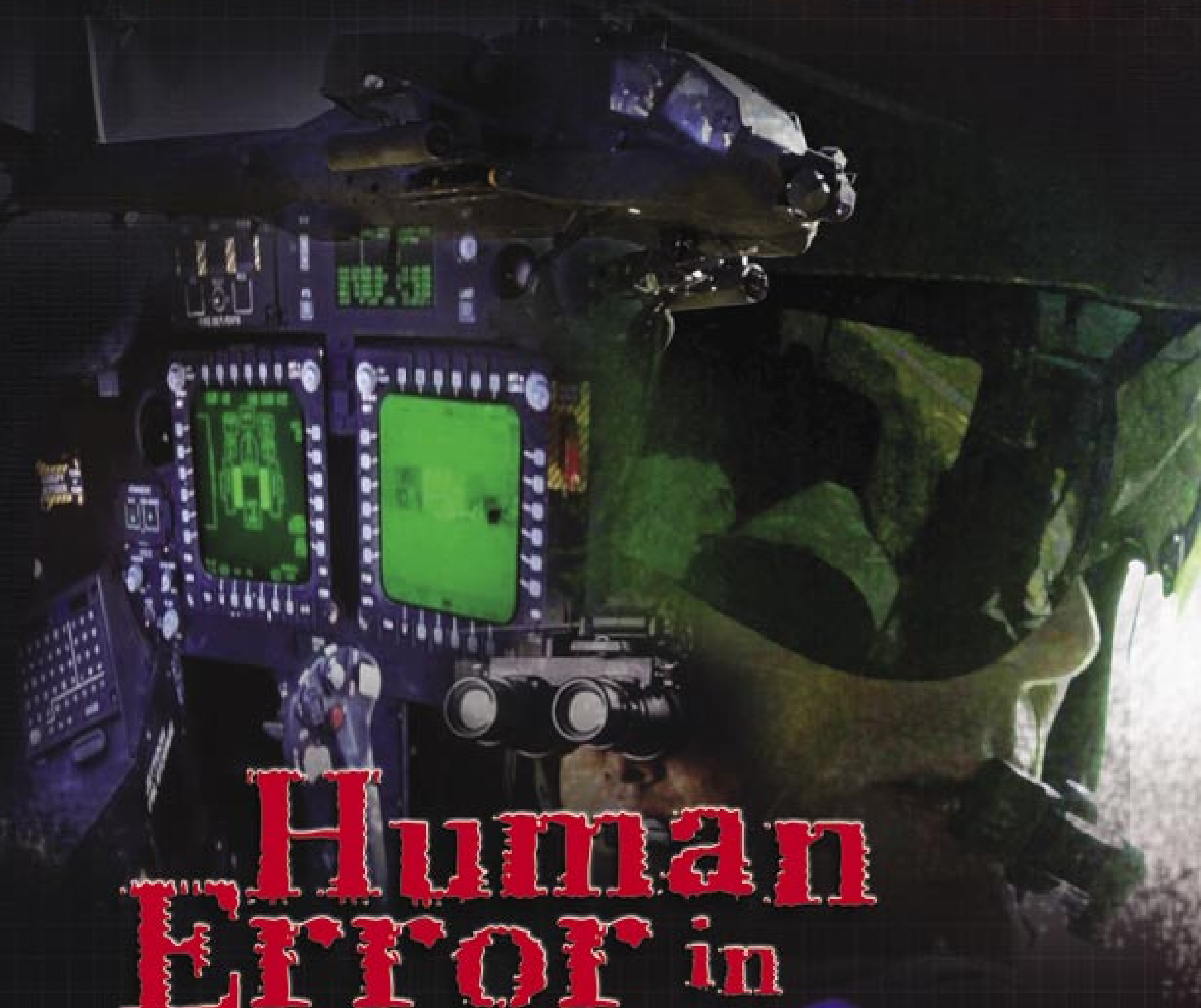

Human Error in Army Aviation Accidents

Flightfax
ARMY AVIATION RISK MANAGEMENT INFORMATION

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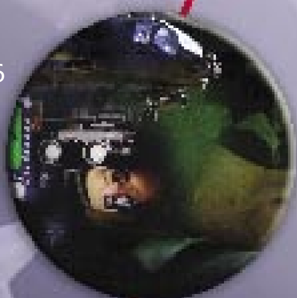

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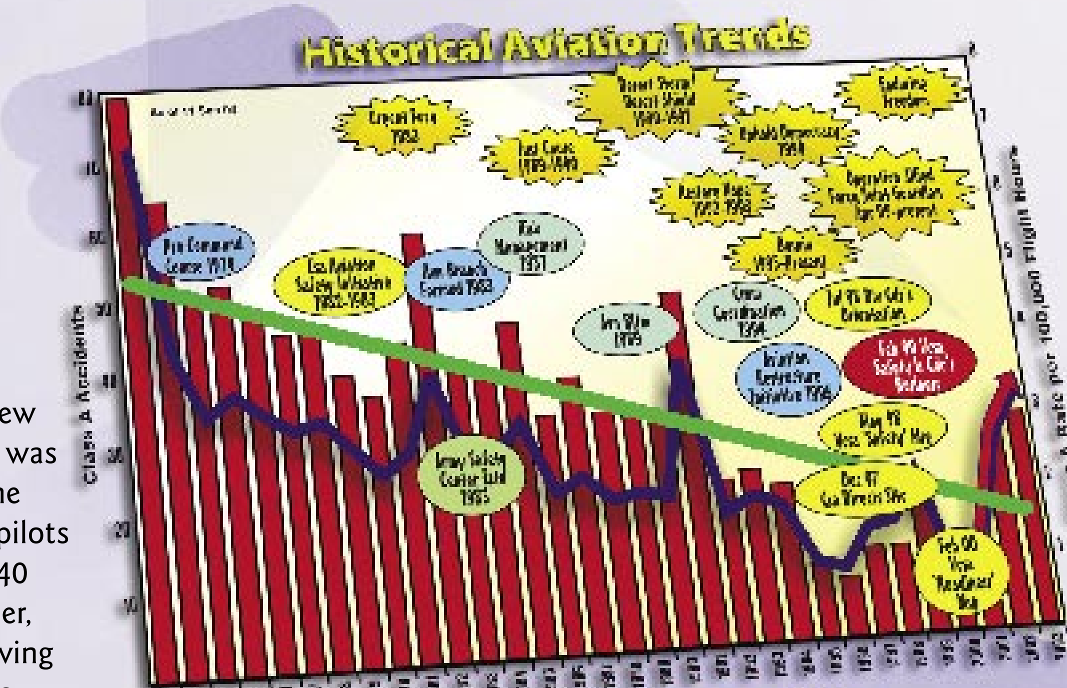
JOSEPH A. SMITH
Brigadier General, U.S. Army
Commanding

DASAF's Corner
FROM THE DIRECTOR OF ARMY SAFETY

Safe Aviation Operations—It's a Team Sport!

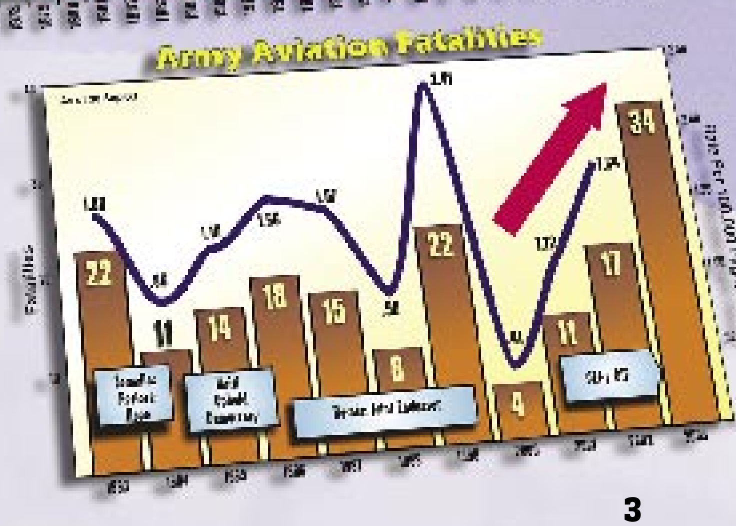
Over the past 30 years, the Army has made great strides in reducing aviation accidents. The green line on the "Historical Aviation Trends" chart clearly shows the downward trend. Initiatives such as crew coordination, flight data recorders, accident investigations, and command emphasis collectively have made a difference.

We have seen a dramatic upward trend in the number of aviation-related accidents and fatalities in the last 3 years. Deployments, OPTEMPO, and flying in adverse environments blend together into a tough challenge, but it is one we can and must overcome. It's time to take a new look at our culture and accident profile to reverse course before we lose more soldiers to aviation accidents.



Looking Back

Before I joined the Safety Center team I would have said, without hesitation, that the aviator most likely to have a preventable accident would be the overconfident, 1,000-hour aviator or the young, 500-hour pilot in command (PC), with crew coordination as a root cause. I was shocked to find the profile in the adjacent chart: our instructor pilots (IPs) are having approximately 40 percent of the accidents. Further, statistics show they are not having accidents on collective missions, but rather during individual crew training. Approximately 50 percent of our accidents occur at night or during single-ship operations. No, they are not inexperienced pilots. As you can see in the profile on the next page, the average hour level for an IP involved in a Class A accident is more than 2,800 total hours. As I look at the aviation accidents from Operation Iraqi Freedom,



FY03 Class A Aviation Trends

Events *

Brown/white out	11 (39.3%)
Collision w/Ground	5 (17.9%)
Tree/Wire Strike	3 (10.7%)
Materiel failure	4 (14.3%)
IIMC	2 (7.1%)
Mesh Rotor Blades	1 (3.6%)
Mid Air Collision	1 (3.6%)
Collision w/Grnd object	1 (3.6%)

Profile */**

Night	**56.0%**
IP	**39.1%**
Single ship	**43.5%**
IP (total/type)	2814/1466
PC (total/type)	1457/900
PI (total/type)	715/338

Causes */**

Individual failure	20 (90.9%)
- Crew coordination	12 (54.5%)
- Overconfidence	12 (54.5%)
- Indiscipline	4 (18.2%)
Environment	13 (59.1%)
Support failure	4 (18.2%)
Leader failure	8 (36.4%)
Training failure	4 (18.2%)
Risk Management	2 (9.1%)
Standards	3 (13.6%)
Unknown	1 (4.5%)

Type (YTD)

(ClassA/Fatal)	FY03	FY02
AH-64	9/3	8/4
MH/CH-47	5/0	5/8
OH-58D	3/0	5/2
MH/UH-60	11/28	5/2
Fixed-wing	1/2	1/1

* Three Accidents still under investigation
** Non-material failures
As of 21 Oct 03

FY03 Class A Aviation Trends OIF AOR

Events **

Brownout	**9 (75%)**
Collision w/Ground	1 (8.3%)
Wire Strike	1 (8.3%)
Materiel Failure	1 (8.3%)

Profile *

Night	**58.3%**
IP	**25%**
Single ship	**41.7%**
IP (total/type)	1271/unknown
PC (total/type)	1166/993
PI (total/type)	602/431

Causes *

Individual failure	8 (88.9%)
- Crew coordination	6 (66.7%)
- Overconfidence	3 (33.3%)
Environment	**8 (88.9%)**
Support failure	2 (22.2%)
Leader failure	4 (44.4%)
Training failure	3 (33.3%)
Standards	2 (22.2%)
Risk Management	1 (11.1%)

Type

(ClassA/Fatal)	
AH-64	5/0
MH/CH-47	1/0
OH-58D	2/0
MH/UH-60	5/8

* Three accidents still under investigation/Non-material failures
As of 21 Oct 03

one other statistic hits me square in the face: 75 percent of our accidents in theater are caused by brownout. Brownout is an obvious hazard in the desert, so why aren't our IPs adequately training crews to operate in this environment? The answer is simple. It's not just an IP problem—it's an Army Aviation problem, and it's time for a cultural change.

Looking Ahead

To conduct proper risk mitigation, an organization must have three levels of experienced leadership involved in the process, a state the Safety Center calls "3-Deep Risk Management." Recently, we have accepted a process that is "1 deep." Centralized accident investigations show over and over again that our IPs are doing most of the risk management at company level. We load up our IPs' rucksacks with the challenge of advanced aircraft and an exorbitant number of young pilots to train. Then we surround them with technically inexperienced leadership and say, "This is all about combat readiness—make it happen!"

One quick example illustrates my point. While in Iraq, I visited an aviation unit that recently fought in An Najaf and Karbala. The standardization instructor pilot (SP) looked worn and tired. After asking some questions, I found the aviation safety officer (ASO) had 700 hours, but was not a PC. When I asked him how he did his job, he said, "I just ask the SP every day and he tells me what I need to do." The company commander and platoon leaders were not PCs either, and the maintenance pilots were, of course, focused on keeping the aircraft mission ready. The only aviators involved in mission planning with enough technical expertise to be a PC were the IPs. We are, in effect, asking IPs to do a big part of everybody's job while they are attacking their own difficult task of progressing young pilots in combat. Risk management 3-deep at the company level needs to be the PC and company and battalion leadership. The triangle of commanders, ASOs, and IPs needs to be tight.

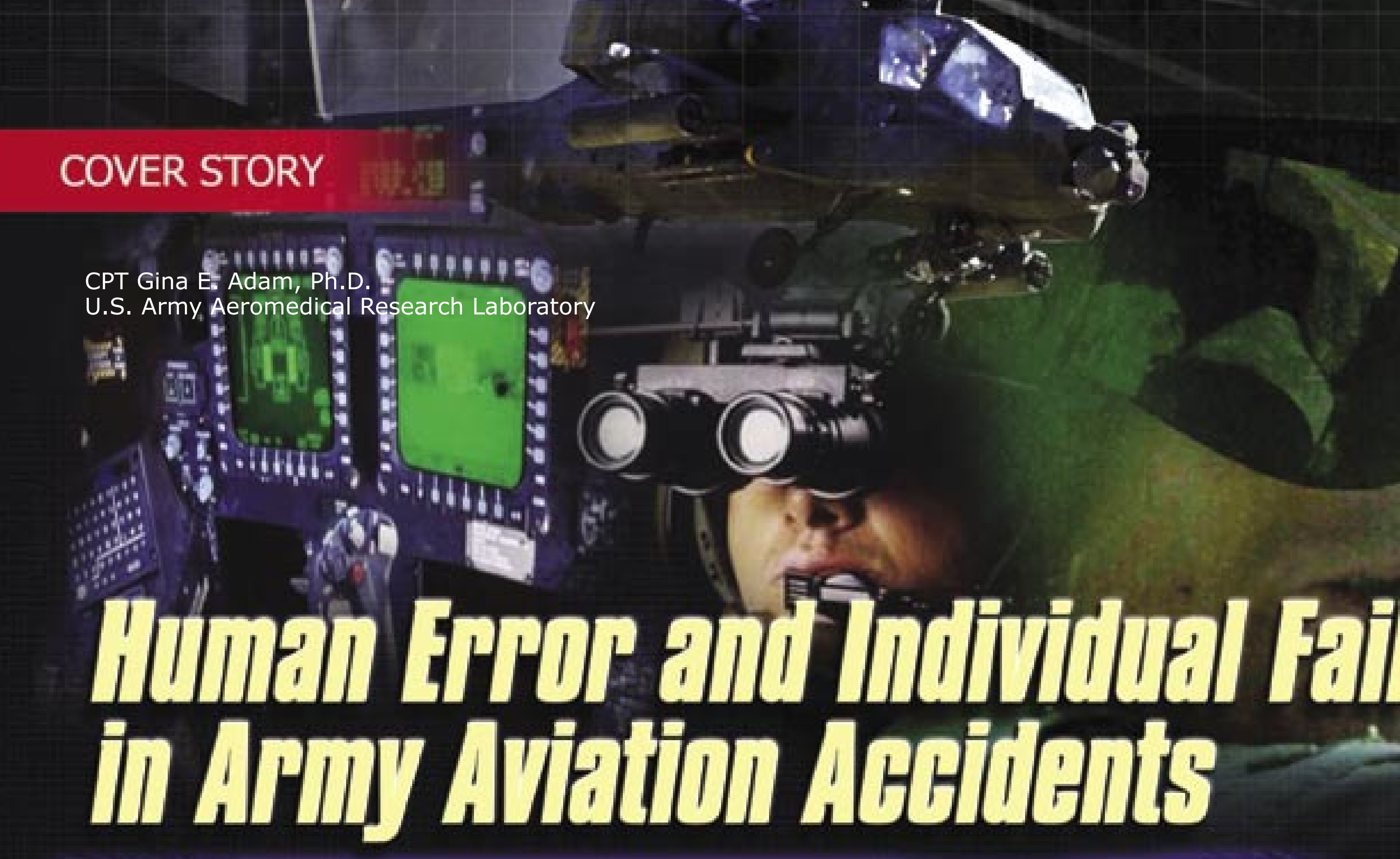
Our young aviators need to start carrying their part of the load. Here at Fort Rucker, I speak to all students in the Aviation Safety Officers course. I recently asked, "Of the 30 of you in this class, how many are PCs?" Three answered they were. What's up with that?!? We must change culturally. Safety officers and company commanders must have the technical expertise of a PC to understand which control measures will mitigate risk effectively. We cannot afford to have "sandbag" front-seaters or mid-level warrant officers who are not PCs. We need young aviators who are actively learning and are part of the risk-management process. Many are hungry and ready for the challenge; we must set the conditions for their success. For brigade commanders, this means resourcing collective training with well-maintained aircraft. Flying 3 days in the middle of the week to protect operational readiness rates is not the solution. **Experience only comes from flying**.

Senior leadership can help IPs by providing the required training time and resources to train aviators properly. A perfect example is environmental training. Statistics show that we are falling short of properly preparing pilots to fly in our current operational environments. We must figure out how to make environmental training a key part of long-range training plans. The IPs cannot train aviators safely unless we give them the means to do so. Again, with the current operation tempo, this will be a tremendous challenge. It's not an IP problem—it's a *system* problem.

The risk-management process must be embedded throughout all stages of the planning and training process. When I was a brigade commander, I didn't get it. Many times I would wait until mission execution before letting my boss in on the known hazards. I thought it was my responsibility to figure out how to get the job done and do it safely. I was focused on supporting the ground commanders. The quarterly training brief process, as well as the military decision-making process, moves quickly, but 3-Deep Risk Management is very powerful. Division commanders have tools to mitigate risks that are not part of the brigade commander's tool kit. You just have to tell them early. The goal is not to be risk adverse; rather, it is to accept residual risk after 3-Deep Risk Management.

As an aviation team we can reduce our accidents by reducing the workload and risk we lay on our IPs. Everyone needs to participate. If any of us fails to do our part, we become just another sandbag in the cockpit and another weight for the IP to carry. Every aviator counts, and every leader makes a difference.

Keep your leader lights on!



CPT Gina E. Adam, Ph.D.
U.S. Army Aeromedical Research Laboratory

Human Error and Individual Fail in Army Aviation Accidents

"The human is the weakest link." This statement often can be heard when people describe accidents of any sort. Given the complexity of the machinery and computer technology that make up today's aircraft, it is mind-bending to think humans would be the weakest link.

Surely, components will break and computers will fail more than aircrew! On the other hand, could it be that machine parts and computer processes perform consistently, whereas humans are more easily affected by situations, environments, and personal factors? This is a question that plagues the field of human factors.

The Army Aviation environment is ripe for human errors due to factors such as operational tempo and the addition of advanced technology in the cockpit. For example, today's aircraft with multifunction displays (MFDs) often have increased capabilities over their traditional counterparts (e.g., map displays vs. kneeboards and paper maps). This increase in functionality might not only increase the amount of information available to aviators in the cockpit, but also increase the missions and tasks they are responsible for while in flight. The addition of functions and tasks requires pilots to spend more time managing the aircraft as opposed to flying it. Essentially, the more time pilots need to spend inside the cockpit managing the aircraft and flight systems, the less time and attention they have to direct towards keeping the aircraft in flight and away from obstacles. Increased heads-down time in the cockpit can significantly impair pilots' abilities to maintain situational awareness, as well as properly coordinate their actions and that of their crew. The combination of these factors might lead to increased aircraft accidents due to human error.

Within the aviation realm, it is common to hear the statistic that 80 percent of accidents are due to human error. In fact, there are whole divisions of researchers working on these questions, trying to determine the incidence of human error, the best way to classify accidents, and how to catalog human error in these accidents. The main reason to do

this is to better learn from accidents in order to improve risk management and thus reduce the potential for future accidents.

While the Safety Center is the organization primarily responsible for accident investigations and analysis, the information gathered by their investigators is useful for many in the human factors field. Their Risk Management Information System (RMIS) Web site provides information regarding accident rates and statistics, as well as details about accident causes and recommendations. Researchers then use this information to answer some of these human factors questions.

There are several frameworks used by different organizations and researchers to evaluate accidents and their causes. Before getting to the big questions regarding human error in Army Aviation accidents, let's review a few facts about accident data. We all know that aviation accidents can be called flight, flight-related, or ground accidents (depending on their circumstances) and are classified according to their severity (Class A, B, C, D, or E accidents). The accident investigators determine the causes (environment, materiel, or human error) of each accident to answer the question of *what happened*. Investigators also evaluate the system inadequacies or root causes present in each accident in order to determine *why the accident happened*. This further classification allows for a more detailed understanding of factors present in the Army Aviation environment that can hinder safe operations.

The system inadequacies or root causes considered include support, standards, training, leader, and individual failures. Each of these root causes is mapped and detailed in the figure 1 located on the following page. Of course, many accidents have more than one causal factor and multiple root causes can be present. For our current purposes, we are interested in examining human error more closely and also looking specifically at individual failures present in those human error accidents.

One important question in analyzing Army Aviation safety is, "How often is human error a cause of accidents?" By looking at the RMIS database for years that both traditional and MFD-equipped cockpits were flying, we see that human error definitely played a role or was suspected in 42 to 72 percent of accidents (see the table below).

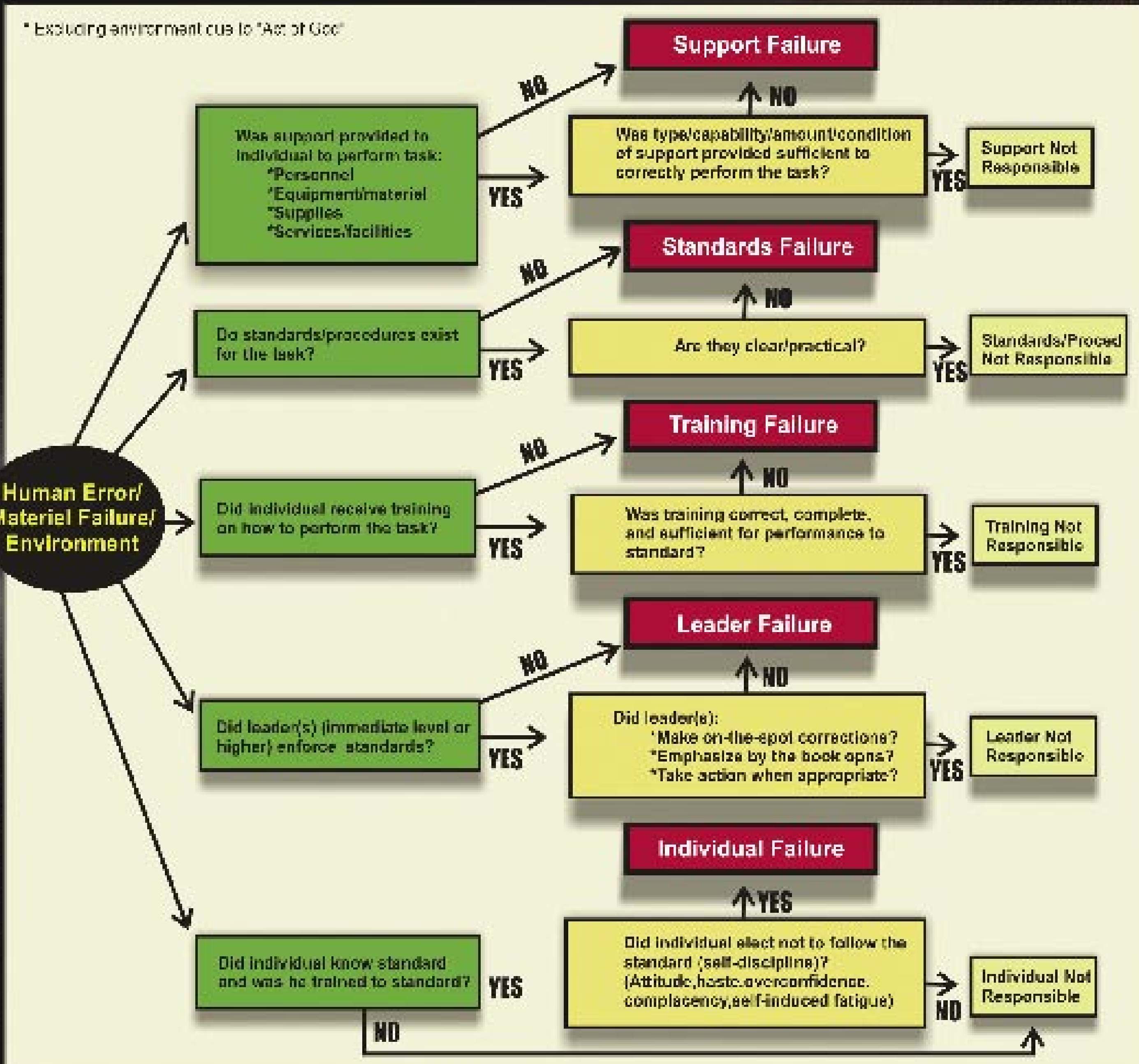
However, acknowledging the presence of human error is merely the first step. A more complete understanding can only be developed when looking at the root causes of these accidents. As described in figure 1 on the next page, there are several root causes, all of which are important. Yet, the individual failure category contains failures that are most typical when thinking about human error. These failures are actions tied directly to the crewmembers. Some errors categorized as individual failures are overconfidence, complacency, crew coordination lapses, crew issues, and distraction due to high workload. While it is not possible in the space allotted here to define every possible individual failure, here are a few descriptions and examples.

Overconfidence and complacency

These two attitudes often are found in similar situations. They are both tied to an individual's confidence in himself, his crew, his aircraft, or his ability to handle situations, and can result in poor decisions while in flight. Pilot confidence is a very good thing; however, in Army Aviation, the saying "You can't have too much of a good thing" is not always the case. A common example of overconfidence is continued flight in decreasing weather, which often leads to problems.

		Chinook		Black Hawk		Kiowa		Apache	
		FY90-02		FY90-02		FY85-02		FY97-02	
		No.	%	No.	%	No.	%	No.	%
	Total	101		267		385		107	
Human Error Present?	Definite	38	38%	159	59%	263	68%	43	40%
	Suspected	4	4%	19	7%	16	4%	8	7%
	Unknown	0	0%	10	4%	6	2%	3	3%
	No	59	58%	79	30%	100	26%	53	50%

FIGURE 1. Determining System Inadequacy(cies)/Root Cause(s) Responsible for Accident Cause Factors (Human Error/Materiel Failure/Environment*)



Crew coordination

Thankfully, much attention and training have been geared toward improving crew coordination. The ability of crewmembers to distribute workload while flying and accomplish their missions is dependent upon their ability to communicate effectively. Unfortunately, there are other crew issues that often are not addressed that can adversely affect a crew's coordination abilities.

Crew issues

The makeup of a pilot crew can be an important factor in crew coordination. How often have you heard of situations where a student pilot said he assumed the instructor pilot (IP) had the controls or knew what he was doing? What about times when there are experience or rank differences in the cockpit? Is it possible that student pilots and junior officers are reluctant to question their copilots' actions, thus hampering crew coordination? In fact,

Figure 2. Percentage of accidents that had a human error cause also had at least one individual failure

Note: Accidents included in this chart are from the same sample as displayed in the table on page 7 due to the author's ongoing research.

accident investigators have found that, oftentimes, a pilot's confidence in his IP or higher-ranking copilot can hamper communication. For example, he might refrain from providing obstacle clearance details because he thinks the other pilot's experience means he doesn't need assistance. However, what the pilots in these situations didn't know (because there had been a breakdown in communication) was that their experienced copilot was involved with other tasks and needed their input.

Distraction due to workload

Workload in aviation operations is often high, especially with the technological advancements of recent years. The susceptibility to distraction while flying is always a great risk and a major contributor to individual failures. The need to maintain attention outside the aircraft is in conflict with the time taken to manage flight tasks with attention inside the aircraft. A brief review of accident findings shows that division of attention is extremely important. For example, in one accident the findings included statements that, "Both crewmembers were focused inside the cockpit…" and "Failure to effectively divide cockpit duties…." Another accident with a completely different flight scenario was found to be the result of "…attention diverted inside the cockpit" and "…both of the crewmembers had focused their attention inside the aircraft…." As you can see, these are very similar findings indicating improper management of workload and cockpit attention is an important and common individual failure.

These individual failure descriptions are examples of how crewmember actions and attitudes can affect human error in Army Aviation accidents. You might be wondering how commonly individual failures actually are identified in the accident database. As it turns out, when looking at the same sample of accidents discussed earlier, we see there are individual failures identified in 84 to 92 percent of accidents classified as having a human error component. Figure 2 shows the percentages for each airframe found in the Army today.

This is not to say that only individual failures are present. These numbers indicate at least one individual failure was identified by either the accident investigators or the author's research team; many of the accidents had a combination of failures, including support, standards, training, and leader failures. For example, of the 42 Chinook accidents in this sample that were due to a definite or suspected human error, 37 (88 percent) had at least one individual failure. The other 5 accidents (12 percent of the 42) had other failures identified, but no individual failures present.

Thus, at least within this sample of human error accidents, individual failures occurred frequently. A more detailed review of all accidents might be of interest to evaluate the prevalence of individual failures across the board. Nonetheless, it is important to remain aware of the importance of workload, crew coordination, and aircrew attitudes such as complacency and overconfidence in order to increase Army Aviation safety. ♦

—CPT Gina E. Adam is a Research Psychologist at the U.S. Army Aeromedical Research Laboratory, Fort Rucker, AL 36362. She can be reached at DSN 558-6806 (334-255-6806), e-mail: gina.adam@se.amedd.army.mil.

Just How Valuable Are Hazard Maps?

MAJ Ron Jackson
U.S. Army Safety Center

With Army Aviation relying more and more on automated systems (e.g., FalconView) to assist in mission planning, can automated systems truly take the place of a good, old-fashioned, 1:50,000 map?

Human error is almost always involved in wire strike mishaps. Rarely does a wire strike occur after an in-flight materiel-related emergency. The following are some examples of the kind of human errors that have resulted in wire-strike accidents this year.

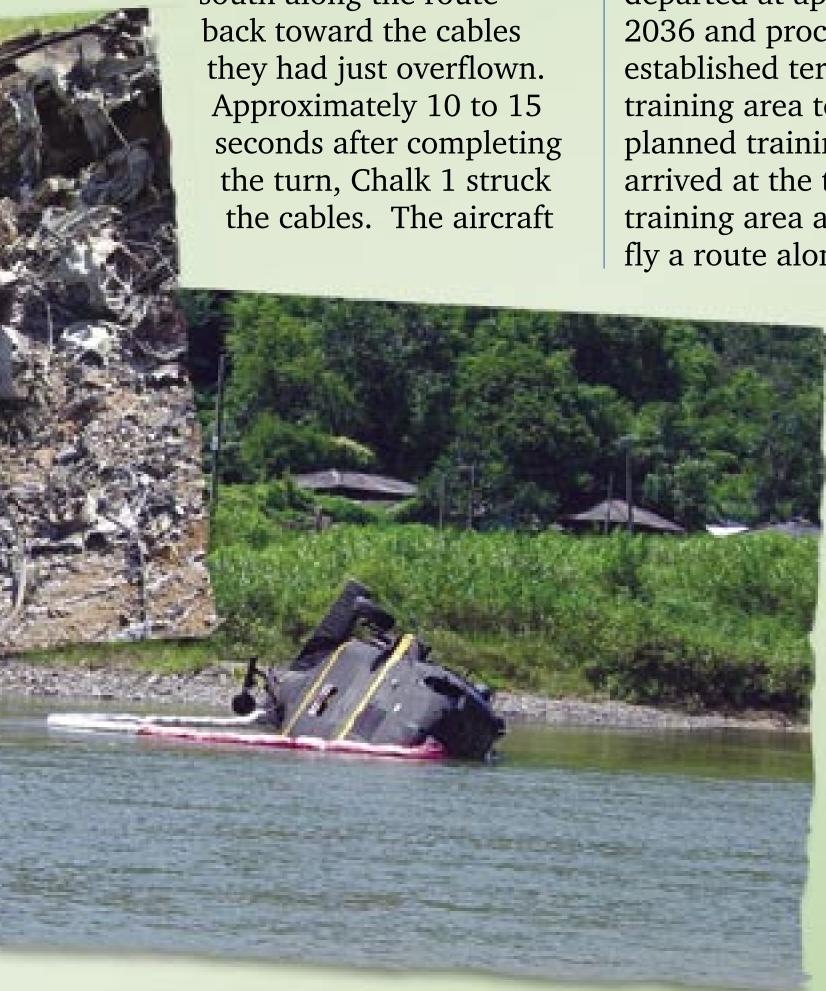
Accident 1

The mission was an ongoing reconnaissance and surveillance (R&S) of 20 named areas of interest (NAI), which was to be conducted over a 9-day period. The unit was tasked to be prepared to increase their day and night R&S patrols to support intelligence collection within the area of operation (AO).

The concept of the operation was for two aircraft to conduct the R&S during the day, followed by two aircraft to complete the same R&S plan at night. The aircrews were required to R&S a northern and southern sector, with one refuel stop between the sectors.

The day crew completed their R&S patrol with no issues and debriefed the night crew of a large set of cables located along their route of flight on the northern route. The crew cross-referenced the flight operations hazard map and noted the hazards were indeed plotted; thus, they updated their map accordingly. This particular set of cables was suspended approximately 150 feet above ground level (AGL) and was difficult to see even during the day.

The night crew departed the airfield at 2130L. The first leg of the mission covered the first 12 NAIs in the southern AO. After approximately 2.6 hours, the crew returned for refuel without incident. After refuel, the flight departed to survey the remaining eight NAIs in the northern AO. After completing the R&S of their sixth NAI, the flight proceeded north along the route, which required them to overfly the large cables that were discussed after the day mission. The flight proceeded over the cables, completed their R&S, and departed the NAI executing an airspeed over-altitude takeoff. They then turned left 180 degrees around a hilltop and proceeded south along the route back toward the cables they had just overflown. Approximately 10 to 15 seconds after completing the turn, Chalk 1 struck the cables. The aircraft was destroyed, and both crewmembers were killed.



Accident 2

The purpose of the mission was to conduct aircrew continuation training using night vision goggles (NVGs) and non-rated crewmember NVG readiness level (RL) progression training.

As part of the requirements to conduct NVG terrain flight training, the accident crew coordinated with a previous aircrew to conduct a day route recon of the authorized terrain flight route.

The accident aircraft departed at approximately 2036 and proceeded to an established terrain flight training area to conduct the planned training. The aircraft arrived at the terrain flight training area and began to fly a route along a roadway. However, due to excessive lights, the crew elected to start a second terrain flight route through an adjacent valley. The crew decided they didn't like the second route and chose instead to fly a third route, which was along a river. After crossing over a high set of cables, the crew selected a sandbar from which to conduct hoist operations.

At an altitude of 40 feet AGL and 40 knots and just prior to the sandbar, the crew chief saw a reflection of two cables crossing the river and immediately shouted, "Climb! Climb! Climb!" However, it was too late; the main rotors came into contact with the cables. Subsequent control inputs resulted in the aircraft traveling backwards and descending until the stabilator struck the riverbed. The aircraft continued down until settling in the river on its left side. The aircraft was damaged severely, and the crew suffered minor injuries.

Accident 3

The mission was to conduct a medical evacuation (MEDEVAC) of an "urgent-surgical" patient. As part of standing operating procedures (SOPs) for MEDEVAC operations, two MEDEVAC aircraft were launched to provide support for the evacuation. As with many MEDEVAC and quick reaction force (QRF)-type missions, the crew did not have access to a hazard map of the area they were to be operating in.

The flight of two aircraft arrived at the scene without incident and proceeded to upload the patient. Flight lead landed in the pickup zone (PZ), while Chalk 2 orbited the PZ at an altitude of approximately 300 feet AGL. While flight lead loaded the patient, Chalk 2 departed its orbital pattern, descended to approximately 50 to 55 feet, and began flying up a river located east of the PZ. Approximately 1 kilometer north of the PZ and out of

sight of flight lead, Chalk 2 struck a cable suspended over the river. The aircraft was destroyed, and the three crewmembers were fatally injured.

Lessons learned

These are three examples of wire strike accidents that are attributable to human error. Other than the commonality of the wire strike, these three accidents provide a contrast and comparison to the importance of maintaining hazard maps when conducting terrain flight operations. Accident 1 depicts an aircrew that had a current hazard map, as well as a briefing on the known obstacle, but chose not to use the map to maintain navigational orientation. Accident 2 illustrates the hazards of not performing terrain mission planning, in particular not updating the hazard map, even though the information was available. And Accident 3 demonstrates the hazards of operating in an area with no hazard map and no control measures to prevent wire strikes.

Wire strike avoidance

Although wire strike avoidance procedures have remained relatively unchanged over the years, their effectiveness is still as valid as they were during their development.

- Always remain oriented on the map. All things being equal, if you are not where you think you are on the map, neither are the wires.
- Update and post hazard maps.
- Conduct thorough terrain flight mission planning when operating at terrain flight altitudes.
- Conduct flight, map, or photographic wire hazard recons to include reviewing the currency of recon products and wire hazard information.
- Establish minimum en route altitudes when operating in unfamiliar environments.
- Always associate wires with manmade features and long linear areas such as fields.
- Reduce airspeeds at lower altitudes.
- Never assume the aircraft in front of you sees the wires.
- If possible, post wire hazard markers.
- Utilize proper scanning techniques for wire hazards in the high and low recon of your intended flight path. ♦

Editor's note: These accidents are currently under investigation.

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Brownout: Reducing the Risk

LTC Daniel L. Ball
War College Fellow @ University of Texas

Operating in limited-visibility conditions caused by blowing dust can be challenging, risky, and potentially destructive. In this article, one commander shares his unit's success in search for safer brownout operating techniques and provides a sample of their Eight Step Training Model in the hope that others may find his unit's experience and techniques helpful.

After returning home from Operation Iraqi Freedom and quickly changing command, I had the opportunity over the summer to reflect on our 5-month deployment and assess what I thought was our greatest accomplishment as a unit. For the 1-227th, or "First Attack," was it the many successful missions conducted in support of the 11th Attack Helicopter Regiment, 82d Airborne Division, 2d Armored Cavalry Regiment, and the 101st Airborne Division during combat? Those successful missions were very rewarding indeed, but merely the culmination of the expectations required by our senior leadership and the soldiers we lead. No, the real reward was seeing the faces of the families and parents of my soldiers as I brought them home safely. This final task is made all the more challenging in combat since the enemy has a vote.

While we all agree with this, we must never lose sight of the fact that, during war, accidents often cause more fatalities than the enemy. This has proven especially true in Army Aviation since operations began in Iraq almost a year ago.

According to data gathered at the Army Safety Center, a large percentage of the accidents in Iraq were attributed to environmental factors. In Iraq, as one might imagine, the biggest culprit is brownout. I feel extremely fortunate and blessed that First Attack is not a statistic, and I would like to share a couple of ideas that I feel helped us during our training over the past 2½ years to get to this point.

First, let's make the assumption that every unit out there has the same quality junior leaders, NCOs, warrant officers, and commissioned officers First Attack does. Then, let's assume the higher chain of command, like that in the 1st Cavalry Division, is focused on fundamentally sound collective training. The difference, then, is found in how well the unit is able to integrate risk management in their training planning process.

In the September 2003 issue of *Flightfax*, BG Joe Smith, Army Safety Center Commander, discusses in his monthly column that, as a whole, units do a fine job in the early stages of the risk management process—identifying and assessing hazards. It is at these steps, though, where most units stop. They simply fail to cross the chasm and integrate steps three through five into their training plans. LTG Richard Cody, Deputy Chief of Staff, G-3, makes the same assertion later in the article. First Attack crossed this chasm, and in the following paragraphs I will explain how.

Training guidance

As a commander, your annual and quarterly training guidance is a critical step toward developing control measures (step three). The standards and goals established in this document lay the groundwork for the training events your unit will focus on in the near-term. My guidance habitually contained three important elements: establishing one major event that provides unit direction during the training period; emphasis on collective training; and emphasis on night training.

■ **Establishing one main event**. At the battalion level, your unit is only capable of properly executing one, or possibly two, events in a given period. Any more and its focus is lost, causing distraction and indecisiveness, which in turn leads to accidents. As a commander, you provide this main effort focus, ensuring all training objectives support this training event. This is the initial step in making the first decision and developing the control measures for risk reduction.

■ **Emphasize collective training**. My guidance for collective training events revolves around a class given by LTG(R) Dan Petrosky when he was commander of Fort Rucker. He emphasized the standards required for aviation battalions to conduct battle drills. His requirements included: a set minimum for the number of iterations and number of helicopters per unit involved; use of forward area refueling points (FARPs) and operations forces (OPFOR); battalion command and control (C2) node; observer/controllers (O/Cs); and an after action review (AAR).

Using these guidelines as a template for our training, my standard was for each company to execute one battle drill per month, with the battalion executing two per quarter. This schedule required the unit to plan and resource each event well in advance, thereby highlighting risk and resource shortfalls early so leaders could continue to develop positive control measures. It also set the stage for step five, supervising and evaluating, during training execution.

■ **Emphasize night training**. The final element in training guidance that helped prevent accidents for First Attack is our dedication to night training. I made a commitment to conducting 60 percent of our training at night. While we never reached 60 percent (our annual average was 57), I believe that without that goal we never would have come close.

Let me also point out that I'm not discussing night vision goggle (NVG) training here. First Attack did not use NVGs while I was in command. I know I'm in the minority concerning the use of these devices, but I do not feel our young aviators are ready for that additional burden in the aircraft. We must first teach them to be proficient with the system they have and understand its limitations, as well as their own, so they can make prudent decisions in the cockpit. Without a good base of 200 to 300 hours of night system time (aviator dependent), we are setting our younger aviators up for failure by letting them use NVGs. An aviator proficient in the use of the Apache Forward-Looking Infrared (FLIR) system and the improved symbology of the Longbow significantly reduces his or her risk of brownout.

Integrating step four of the risk management process into our training plans can be illustrated best by the chart on the next page.

Proper use of the eight-step training model is the best way I've found for not only completing the training process, but also the risk management process. The example above is representative of the thought process First Attack went through for every major training exercise. Linking this back to commander's guidance, this document provides the single-event focus a battalion needs in order to continue developing controls and begin implementing them. Notice the early involvement by the commander in identifying and assessing hazards during the planning phase, and then the educating of key leaders about the hazards during their certification and leader's recon.

As we move up the training model ladder, the extensive use of simulators and rehearsals is critical to the integration process to help leaders refine those control measures already in place and determine their validity. Finally, the most important part of the training model is the involvement of the chain of command in the AAR process. By default, if the chain of command is responsible for the AAR, then they must be present for mission execution. I'm not just talking about the battalion commander: ALL senior leaders, including the command sergeant major, field grade officers, and senior warrant officers should place themselves at critical points on the training field. (Remember LTG(R) Petrosky's requirements for training, which included a battalion C2 node?)

Completing the eight-step training model also achieves integration with the risk management model. As we retrain, we also re-evaluate the hazards and begin the process again—if not for the current exercise, then for the next major training event.

This article is not meant as a lockstep solution to prevent brownout during aviation operations.

I simply will tell you that it worked for 1-227th. We aggressively flew more than 5,000 hours each year for the past 2½ years, including three National Training Center (NTC) rotations, a Roving Sands exercise, a Joint Task Force (JTF) mission along the Texas border, two major deployments to Fort Bliss for gunnery, and numerous exercises at Fort Hood. Throw combat operations during Operation Iraqi Freedom into the mix and there were plenty of opportunities for brownout accidents, but none occurred. Good pilots, yes; an understanding chain of command who supported quality training, yes; but all units start there. To get to the next level, though, you must fully integrate the risk management process into your training plan.

Hopefully this article demonstrated a way to do this by focusing on commander's training guidance and the eight-step training model. Let me close by saying Army Aviation safety is important and indeed the focus of this article, but ground safety is enhanced with this process as well. Oftentimes the most dangerous place on the training field or the battlefield is the FARP. Everyone understands that if you can't get your maintenance to the battle, you won't be flying long. Using this same focus on commander's guidance and the eight-step training model, First Attack also enjoyed success in ground safety. During all our major training exercises and combat operations (where our FARP assets traveled extensively on unimproved surfaces), we had zero ground accidents in our FARP or on our convoys.

There is no substitute for quality training done to standard that replicates, as closely as possible, the conditions where the chain of command can expect to fight. Focusing training on your commander's guidance and integrating risk management with the eight-step training model ensures this training is done safely, thereby enhancing our chances of bringing our most precious resource—our soldiers—home safely. ♦

—LTC Daniel Ball has completed his command after redeploying First Attack safely back from Operation Iraqi Freedom. He has been selected for War College and is attending a fellowship at the University of Texas this fall. LTC Ball holds a Masters degree in Aerospace Engineering from Auburn University. He is qualified in the AH-64 Apache Alpha model and Longbow, a distinguished honor graduate of the Air Assault School, and Airborne qualified.

Human Factors in Aviation Maintenance

SFC Scott E. Cornelius
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Human error is cited as a major cause of aviation mishaps. When it comes to human error, the blame has traditionally been laid on flight crews rather than on maintainers. Although human factors-related maintenance failures are not always evident, the National Transportation Safety Board (NTSB) and the U.S. Army Safety Center (USASC) routinely investigate maintainers' performance.

The human factors that can affect aviation maintenance include: (1) environmental factors; (2) individual human factors; and (3) human-factors training for maintenance personnel. Let's look at these in more detail.

Environmental human factors

The aviation mechanic works in a variety of environments. Maintainers work on aircraft not only in hangars, but also on flightlines in all types of weather at any time of the day or night. In the case of military aviation, mechanics may even have to work in a chemical environment which could drastically affect their performance. Categorized more broadly, these environmental factors can be broken into noise and weather conditions.

■ **Noise.** The noise an aviation mechanic may encounter varies considerably, but is universally loud. It's not unusual for the noise on an airport ramp or apron area to exceed 85dB to 90dB, loud enough to cause hearing damage if exposure is prolonged. Turbine engine, rotor blade, and transmission noise can contribute to distraction, stress, and fatigue. If not closely supervised, a distracted mechanic could be killed or injured, or could severely damage an aircraft.

■ **Weather conditions.** Environmental temperatures vary depending on the time of year and the region of the world and whether the workplace is climate controlled. The physical effects of working in conditions that are too hot or too cold can substantially decrease a mechanic's performance.

When working in extreme temperatures, a mechanic may rush through the task and overlook an important step. Supervisors should do everything possible to provide adequate shelter from inclement weather so that mechanics can work effectively. If this is impossible, mechanics should take breaks to either warm up or cool down. Hangars with climate control are the ideal working environment as long as the doors remain closed.

Individual human factors

The leader or supervisor must be able to differentiate between errors and violations when considering a mechanic's performance. Individual factors such as physical fitness, fatigue, and stressors must be taken into account when considering what might lead a person to make errors or violations. The leader or supervisor should consider these factors seriously before assigning a mechanic to work on a multi-million dollar aircraft.

■ **Physical fitness.** A physically fit mechanic has more energy and tends to be more productive than a deconditioned mechanic who may not be able to do what is required for a particular task. Fitness and health can have a significant effect upon a mechanic's physical and cognitive job performance.

Several conditions can affect health and fitness and diminish a mechanic's ability to perform proper maintenance. These include physical illnesses, mental illnesses, and injuries and can range from a winter cold or flu to a sprained or broken ankle.

■ **Fatigue.** Another factor affecting maintenance errors is fatigue. One can not overemphasize the importance of getting a good night's sleep to do a good job the next day. Unlike their civilian counterparts, military aviation mechanics have many other duties in addition to the task of maintaining an aircraft. It's not unusual for a military mechanic to work a 10-12 hour workday. Habitually long work days can cause confusion and fatigue increasing the chance of human error. To prevent fatigue-related accidents, leaders and supervisors must understand how fatigue and the body's sleep and wake cycles affect each other.

■ **Stress**. Everyone experiences stress in one form or another. Aviation mechanics are stressed by the demands placed upon them. Problems develop when mechanics are unable to control their reactions to job demands. This is why it's important for supervisors to recognize the symptoms of stress in their employees. Money problems, marriage conflicts, a new baby, or death of a family member can all increase stress and worsen the problem. Although it is impossible to eliminate human error, learning to effectively manage stress can reduce human errors.

Some ways to manage stress include relaxation techniques, counseling, a good sleep and a healthy diet. Making resources available and encouraging mechanics within your organization to learn to cope with stress can decrease human error.

Human factors training

Effective organizations realize that leaders need to understand human factors training so they can recognize the role that good or bad planning has on the performance of maintenance. The vitality of a human factors program depends upon proper planning in hiring qualified, alert individuals, and maintaining tools, equipment, materiel, maintenance data, and facilities. This can be achieved by incorporating organizational safety, qualified trainers, and error management into the human factors training program.

■ **Organizational safety.** Human factors play a huge role in the quality of maintenance training. Statistics show that 18 percent of all accidents are due to maintenance factors. To reduce errors and make aviation maintenance more reliable, human factors training and research must be an ongoing effort. The following are steps organizations can take to do this:

- Provide and share knowledge with maintenance personnel.
- Develop skills.
- Positively influence attitude.
- Positively influence behavior.
- Practice daily what is taught and learned.

■ **Trainer.** An effective human factors training program begins with a good trainer thoroughly knowing the subject. Some guidelines to look for when choosing a trainer are formal education on the subject, training to teach the subject, and at least 3 years experience with a maintenance organization. The trainer must be able to motivate people, not just pass on knowledge.

The training program should include initial and sustainment training to keep employees current in human factors, target areas where training is needed, and evaluate the training program's effectiveness. The best training is tailored to each organization and presented by an instructor from within the organization. This way the trainer will know the areas within the organization needing the most focus.

■ **Error management.** This concept focuses on eliminating errors and can be broken down further into error management and error containment. By monitoring and documenting incidents and accidents, organizations can compile information helpful in predicting and preventing these errors in the future.

Human factors play a huge role in the quality of maintenance training. Statistics show that 18 percent of all accidents are due to maintenance factors.

On June 10, 1990, the left windscreen on British Airways Flight 5390 blew out shortly after takeoff. Although the pilot was sucked halfway out of the hole, other crewmembers held onto him until the co-pilot could land the airplane. In this incident, the windscreen had been replaced using the wrong size bolts. The shift maintenance manager was so short staffed that he replaced the windshield himself. He used the bolts that held the old screen in place for comparison as he looked for new bolts the same size. He ended up using bolts that were longer and thinner than the ones he needed. He also failed to notice that the countersink was too low. He signed off the job himself without any type of pressure check or duplicate check. Eighty-four of the ninety bolts holding the new windscreen were too small.

The employees in this incident were considered qualified, competent, and reliable. This situation could have been avoided had the employees practiced error management. With today's technology, there is little room for error and human factors training is vital to reducing the aviation accident/incident rate.♦

—The author wrote this article while attending Embry-Riddle Aeronautical University, Fort Rucker, AL. He can be reached at (334)255-3422/3406 or e-mail CorneliusS@rucker.army.mil.

Wanted: Safety Successes

LTC Robert Black
Training Director
U.S. Army Safety Center

Attention commanders, safety managers, unit safety officers, and NCOs at all levels! Do you know a MACOM, installation, military organization at division or below, or an exceptional Army member or DA civilian doing great things to further Army safety or with an outstanding safety program? Sure you do! Would you like to see your organization or that individual recognized at Army level for their accomplishments? Sure you would!

With the ever-increasing OPTEMPO and the worldwide high-risk environments our units and personnel are operating in, it is critical as safety leaders that we take time to recognize those who are getting it right. And while unit- and MACOM-level safety awards can be appropriate, another venue is available for those who clearly are the Army's best. The Chief of Staff, Army (CSA), and the Director of Army Safety (DASAF) both have awards for recognizing outstanding achievements in Army Safety.

These prestigious awards are available from the MACOM level down to individuals. Included are awards presented for annual achievements and those presented for specific events or acts. The regulation governing these awards is Army Regulation (AR) 672-74. Below is a list of the Army-level awards available.

■ The **Chief of Staff, Army, MACOM Safety Award** is presented annually to MACOMs that make significant improvement in evaluated areas. The award nomination is initiated by a MACOM commander or safety manager, or the DASAF. The nominations are due to the U.S. Army Safety Center (USASC) by 1 December each year. A USASC panel meets in January to determine the winner.

■ The **Chief of Staff, Army, Award for Excellence in Safety** is presented annually to Army personnel and DA civilians who make significant contributions to accident prevention. The award nomination is initiated by a brigade or higher commander, or MACOM or installation safety manager. The nominations are due to USASC by 1 December each year. A USASC panel meets in January to determine the winner.

■ The **Director of Army Safety Award** is presented annually to Table of Distribution and Allowances (TDA) or Table of Organization and Equipment (TOE) detachments through division-level units, or activities or installations that make significant improvements in accident and injury rates. The award nomination is initiated by the unit commander, or installation or unit safety manager. The nominations are due to USASC by 1 December each year. A USASC panel meets in January to determine the winner.

■ The **United States Army Safety Guardian Award** is presented to Army personnel or DA civilians who take extraordinary action in an emergency. The nomination is initiated by the unit commander, or installation or unit safety manager. A USASC panel meets quarterly to determine recipients.

■ The **Army Aviation Broken Wing Award** is presented to Army and DA civilian aircrew members for outstanding airmanship while preventing or minimizing aircraft damage or personnel injury. The nomination is initiated by the unit commander, or installation or unit safety manager. A USASC panel meets as needed to determine recipients.

■ The **Director of Army Safety Special Award for Excellence** is presented to Army personnel and DA civilians who demonstrate exemplary leadership in safety programs in the field. This is a DASAF impact award. The award is initiated by the DASAF; however, nominations are encouraged from the field.

In order to breed safety success, you must foster it and then reward those who achieve it. The CSA and DASAF want to help reward your successes.

Your Awards Program

While the purpose of the awards program is to recognize deserving individuals, groups, and units for their mishap prevention efforts, we also want to give our readers the who, what, when, where, why, and how things turned out. In addition to serving as recognition, award nominations and write-ups provide valuable lessons learned for our readers. The information could save another soldier from a similar situation or hazard mishap. ♦

—POC: CW4 Paul Clark, (334) 255-3712, DSN 558-3712, e-mail clarkp@safetycenter.army.mil

ACCIDENT BRIEFS

Information based on preliminary reports of aircraft accidents

AH-64

A Model

■ **Class C:** Aircraft experienced an embedded global positioning system/inertial navigation system (EGI) failure during a mission. The crew unsuccessfully attempted a reset and landed the aircraft on a 10,400-foot pinnacle. The aircraft made a hard landing, which compressed the right strut. The 30mm gun also hit the ground, and the overhead windshield cracked. The crew flew the aircraft back to their base camp.

D Model

■ **Class B:** Aircraft reportedly made a hard landing following settling with power condition. No crew injuries were reported.

■ **Class E:** The PC noticed a slight electrical burning odor in the cockpit during a daytime multi-ship mission. Immediately after noticing the odor, the #1 generator failed in flight. The crew performed a precautionary landing at the airfield for possible smoke in the cockpit due to failure. The aircraft landed without incident. Maintenance determined the #1 generator was inoperable and replaced it. The aircraft subsequently was released for flight.

CH-47

D Model

■ **Class A:** Aircraft encountered dust conditions during landing at a refuel point and crashed, coming to rest on its right side. The crewmembers suffered treatable injuries.

OH-58

A+ Model

■ **Class C:** During reconnaissance flight, aircraft's MASTER CAUTION and ENGINE OIL lights illuminated, followed by a loss of engine oil pressure and torque reduction readings. Subsequent inspections revealed more than $100,000 in related and collateral component damage.

D(R) Model

■ **Class B:** Aircraft reportedly made a hard landing and suffered damage. No other details were provided.

D(I) Model

■ **Class C:** Aircrew had been practicing environmental flight operations and landings in a dusty area. After completing the third landing, the instructor pilot (IP) suspected that a hard landing might have occurred. The IP inspected the aircraft and found damage to the lower wire cutter. The IP declared a precautionary landing and secured the aircraft.

■ **Class C:** Aircraft experienced an engine over-temperature on first start after a 600-hour engine service.

UH-1

H Model

■ **Class E:** The aircrew heard a loud bang during low-level flight. The crew suspected that they had a compressor stall and immediately landed the aircraft. A post-flight inspection revealed the inlet guide vane actuator was out of rig. During the maintenance operational check (MOC), the bleed band closure setting also was discovered to be out of parameters. The aircraft was repaired, checked again, test flown, and released for flight.

UH-60

A Model

■ **Class C:** On start-up engine turbine gas temperature (TGT) rose to 1,005 degrees. The pilot in command (PC) initiated emergency shutdown procedures.

L Model

■ **Class A:** Aircraft was Chalk 2 in a flight of three when it encountered heavy dust conditions during an approach to a landing zone and impacted the ground, coming to rest inverted. One passenger was thrown from the aircraft and suffered fatal injuries, and the aircraft was damaged extensively.

■ **Class E:** During visual meteorological conditions (VMC) approach to a sod area at an airport, aircraft was allowed to descend without proper pilot control inputs to cushion the aircraft while landing. During a PMS-1 inspection, maintenance found rotor blade paint on the ALQ-144 top screws. It was suspected that the main rotor blades contacted the ALQ-144 during landing and was not noticed during aircrew post-flight inspection. No other damage was found during aircraft inspection.

C-23

■ **Class C:** While conducting aircraft qualification course (AQC) training, the left main tire blew during a night landing, causing damage to the honeycomb around the wheel well and tire rim.

Editor's note: Information published in this section is based on preliminary mishap reports submitted by units and is subject to change. For more information on selected accident briefs, call DSN 558-9552 (334-255-9552) or DSN 558-3410 (334-255-3410). There have been numerous accidents in Kuwait and Iraq since the beginning of Operation Iraqi Freedom. We will publish those details in future Flightfax articles.

Hi, I'm Joey, the Army's newest aviator. I've had excellent training, but these brownouts are tough! Maybe you have some ideas to keep me and my buddies from bustin' up our helicopter while flying in the "sandbox." I could sure use your experience to pass along to other crewmembers to help reduce the accident rate by 50% during the next 2 years.

Learned a lesson lately?

Tell Joey

We don't have to learn our lessons the hard way through accidents. We can also learn from close calls, near misses, and minor mistakes both our own and those of others. This is an opportunity for us to share experiences with each other. They can be long or short, recent or from the past. Share your lessons learned with Joey, as well as all of Army Aviation. Send your story to U.S. Army Safety Center, ATTN: "Joey," Bldg. 4905, 5th Ave., Fort Rucker, AL 36362-5363 or fax to DSN 558-3003 (334-255-3003), ATTN: "Joey." You can also e-mail joey@safetycenter.army.mil.