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PILOT-ERROR ACCIDENTS AREN'T ALL PILOT

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PAM 75-05

PILOT-ERROR ACCIDENTS AREN'T ALL PILOT

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FOREWORD

Three articles, prepared by this agency, titled "Pilot Error Accidents Aren't All Pilot" appeared in the January, February, and March 1975 issues of the U.S. ARMY AVIATION DIGEST. These articles documented the beginning of a new approach to the problems of identifying, investigating, and preventing human error (pilot error in particular) as a cause of Army aviation mishaps. The ultimate objective of this approach is to attack the human-error problem in a manner that is as systematic as the attack on materiel/machine failure.

This new approach to the human-error problem is called for in chapter 11 of the 1 July 1975 revision to AR 95-5, Aircraft Accident Prevention, Investigation, and Reporting. Because the articles provide background and how-to-do-it examples that complement chapter 11, it was decided to reprint them. It is hoped that personnel responsible for identifying, investigating, and preventing human error that is a cause factor in Army aviation mishaps will find this pamphlet helpful.

EDWARD E. WALDRON II
Colonel, TC
Commanding

PILOT-ERROR ACCIDENTS AREN'T ALL PILOT

PART I

DURING THE 15-year period from 1958 to 1972, human error by itself or in combination with other factors caused or contributed to more Army aircraft accidents than any other factor. In fact, pilot error by itself was a factor in 80 percent of all accidents and cost an average of $58 million per year in terms of injuries, fatalities and aircraft damage. When accidents caused or contributed to by supervisory and maintenance error are added, almost all accidents involve some human-error factor.

What is so striking about the human-error problem is its persistence. The proportion of accidents due to human error has not changed more than 10 percent in any of the last 15 years. However, in the same time span:

1. The orientation of aviation operations changed from peacetime to combat and back to peacetime.
2. Annual flight time ranged more than 5 million hours from the lowest to the highest year.
3. Annual accidents ranged more than 800 from the lowest to the highest year.

In sum, human error has been a large and stable cause of accidents in a very unstable aviation environment.

Man: Strongest and Weakest Element. The magnitude and persistence of human error as a cause of aircraft accidents might lead one to wonder about the quality of Army aviation personnel. Fortunately, the quality of personnel is not the problem. The problem is that most expect maximum mission performance from the aviation system and place demands on it accordingly. In truth, however, one or more of the basic system elements will be operating below maximum performance at any given time during the mission and it is this submaximum performance that causes or contributes to accidents.

In almost all instances man is the system element that causes or contributes to accidents by what he does/does not do or can/cannot do. This is true because man is simultaneously the strongest and weakest element in the aviation system. He is the *strongest* because he can learn, has diverse skills and knowledges, is adaptable and can share his attention between several on-going tasks. These attributes are why he has been made the overall manager and manipulator of the aviation system. He is the *weakest* because his performance is unreliable, i.e., he cannot perform the same task in the same manner time and time again.

His performance is unreliable because it is subject to the influences of his widely varying psychological and physiological limitations. His performance is also unreliable because of his unique troubleshooting role; when anything goes wrong in the system, he must continue his normal tasks and simultaneously correct or adjust for mistakes imposed on his duty position by all elements in the Army aviation system. It is not surprising then that man, who has the most important and demanding role in the system, is unreliable in the performance of his duties and this unreliable performance causes or contributes to more aircraft accidents than the performance of any other element in the aviation system.

The Human-Error Accident. We have seen that human error results from man's psychological and physiological limitations and his demanding role in the aviation system. The next step is to show what causes man's limitations to be exceeded, his system role to be overloaded and human-error accidents to result.

Figure 1 provides a functional definition of the human-error accident. Items 1 through 8 are the basic man-machine-environment elements of the aviation system. When these elements get out of tolerance, an overload (item 9) is put on man's system role (item 10) in that he must continue to perform his normal tasks while correcting or adjusting for the abnormal system condition. When this overload becomes too large or occurs at a critical time, man starts making errors (item 11) in his normal tasks and/or in his handling of the abnormal system condition. Most of these errors slip by without causing an accident (item 12). But, when lady luck frowns, the error results in an accident (item 13).

It should be emphasized that the overload (item 9) placed on man's role in the system (item 10):

1. *May originate with man* because of his inherent psychological (item 7) and physiological (item 8) limitations, e.g., distraction and fatigue, or

2. *May be imposed on man* because of his managerial/troubleshooting duties, e.g., improper maintenance (item 3) can lead to an overload (item 9) in the form of equipment/vehicle failure that man must correct or adjust for, or

3. *May be both* imposed on the man and originated by the man, e.g., improper supervisory practices (item 6) may allow personnel to be worked too long or too hard which produces fatigue (item 8) and a system overload (item 9) in the form of a decreased capacity of the man to perform his duties.

In sum, human error results from man's system role being overloaded and this overload can be the fault of man, other system elements or a combination of both.

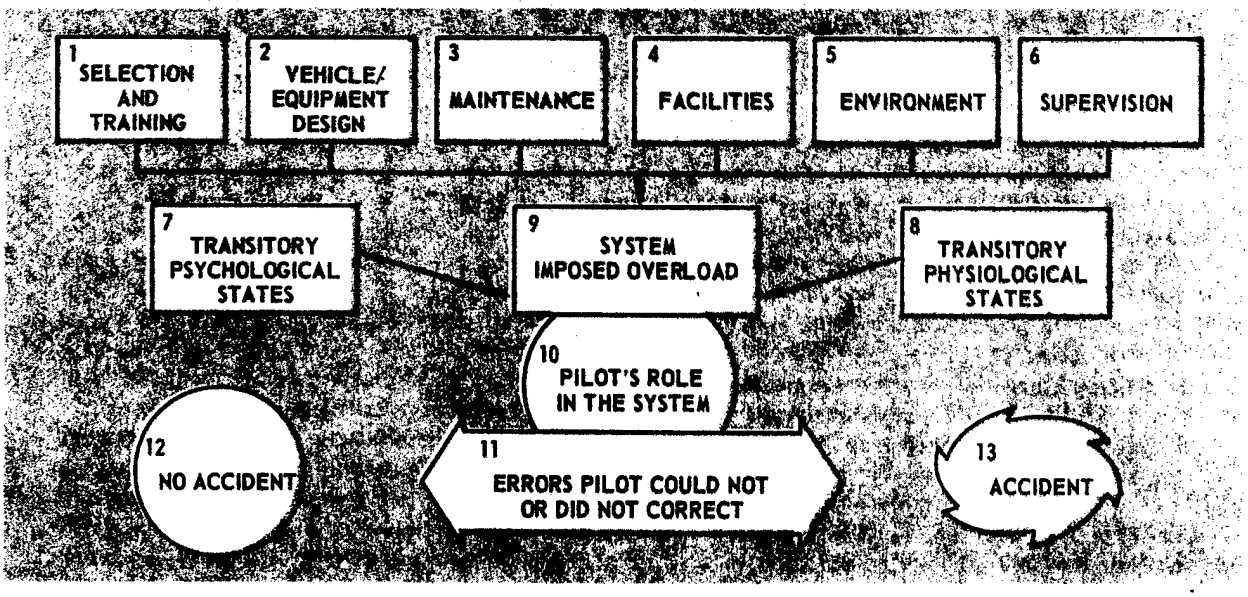

FIGURE 1—USAAAVS Model of the Human-Error Accident

PILOT-ERROR ACCIDENTS AREN'T ALL PILOT

PART II

IT MUST BE emphasized that the human-error accident is a definite indication that at least one element of the Army aviation system is not operating at maximum efficiency. It also must be emphasized that the accident report can be an outstanding source of information about what went wrong, what caused it and what can be done to correct it. Such information can be used to improve the efficiency of operations at unit and higher levels. However, potential benefit of this information "bought" by injuries, fatalities and aircraft damage is tied directly to the quality of the report, that is, how well the accident investigation team identifies, reports and develops recommendations to deal with inadequacies in the Army aviation system. Unfortunately, most reports of human-error accidents leave much to be desired in each of these investigative areas. We will explain here what you, as part of the accident investigation team, can do to help cure the problem by precisely identifying, reporting and recommending remedies for human errors.

Identifying human error. From 1958 through 1972 accident boards identified pilot error as a factor in 80 percent of all Army aviation accidents. Unfortunately, reports submitted on many of these accidents indicate the boards, after discovering pilot error as a factor, were satisfied to let it go as such because "everybody knows you can't do anything about pilot error." What these boards frequently fail to realize is that some errors are imposed on the pilot and some are originated by the pilot. The causes of both can be traced back to correctable inadequacies in the aviation system, i.e., selection and training, vehicle/equipment design, maintenance, facilities, environment, supervision and changing psychological and physiological states of the man. In other words, accident boards have been more than willing to identify pilot error as a factor but have stopped short of identifying mistakes of others which caused or allowed the pilot to err.

Reporting human error. Unfortunately, even when accident boards properly identify the pilot and nonpilot human errors involved in accidents, many times they fail to properly report the relevant information. For example, instructions to DA Form 2397-1 direct that for personnel cited as a definite or suspected cause factor, DA Forms 2397-8 (personal data) and -9 (psychophysiological/environmental data) should be completed.

However, -8 and -9 forms are almost never completed on nonpilot personnel, e.g., mechanics, maintenance officers, unit commanders, operations officers, safety officers, air traffic controllers, ground unit commanders, higher level commanders, etc. When -9 forms are completed for similar duty positions (e.g., pilot and copilot) in the same accident, accident boards often "score" the accident instead of the person, i.e., the same -9 items are checked for both persons although some apply to only one. Many times boards complete a -9 form and, contrary to -1 instructions, fail to complete the -8 form which is the only source of personal and duty-background information to assist in determining why errors were committed. Even when a -8 form accompanies a -9 form, it frequently is not completed in full. For example, a recent review of -8 information revealed only 41 percent of the items on this form were completed when it was submitted. However, the U. S. Army Agency for Aviation Safety (USAAAVS) must also share the blame for shortcomings in accident report information about human error. For example,

TABLE 1
Tasks and Task Errors

SUPERVISORY TASKS

Providing or managing information
1. Providing or managing publications
2. Providing or managing forms and records
3. Providing or managing regulations/SOPs/policies

Providing or managing procedures/applications
4. Performing required inspections
5. Monitoring organizational performance (personnel and equip)
6. Accepting tasks or missions (comparison of task requirement to personnel and equipment capabilities)
7. Assignment of personnel
8. Assignment of equipment
9. Task/mission briefing
10. Task/mission coordination

CREW COORDINATION TASKS

11. *Inspection of:*
    1. Components and systems (vehicle, equip, tools)
    2. Forms and records (vehicle, equip, tools)
    3. Personal and required equipment
12. Performing weather analysis
13. Filing flight plan
14. Revising flight plan
15. Flight departure
16. *Transmission/receipt of communication*
    1. Crew-to-crew
    2. Crew-to-external (LZ control, ATC, Flights, etc.)
       a. Transmitting task assignment
       b. Receiving task assignment
       c. Transmitting status report of task assignment
       d. Receiving status report of task assignment

PSYCHOPHYSIOLOGICAL TASKS

Collecting information
17. Monitoring field of view
18. Monitoring performance of equipment (engines, instruments, machines, etc.)
19. Monitoring performance of others (students, other crew, subordinates, etc.)
20. Identifying/recognizing equipment (switches, controls, machines, tools, etc.)
21. Identifying/recognizing geographic elements (landmarks, stars vs. lights, etc.)
22. Analyzing meteorological conditions (wind, clouds, temperature/density altitude, etc.)
23. Collecting information using required/accepted procedures
24. Estimating clearance (vehicle-to-objects/vehicle)
25. Estimating rate of closure

Using information and procedures
26. Selecting course of action using formal procedures (AR, FM, TM)
27. Selecting course of action using SOP or accepted procedures
28. Selecting course of action for which there is no established procedure

Operating controls, equipment or tools
29. Coordination of actions (tool, equip or control)
30. Timing of actions (tool, equip or control)
31. Direction of actions (tool, equip or control)
32. Selection of proper (tool, equip or control)

Maintaining attention
33. Readiness (not daydreaming)
34. Focusing attention (not being distracted)
35. Dividing attention (proper attention given to required tasks)

Maintaining orientation
36. Maintaining spatial orientation
37. Maintaining geographic orientation

TASK ERRORS

1. Failed to perform required action
2. Performed nonrequired action
3. Performed required action but out of sequence
4. Performed required action but out of tolerance
5. Performed nonrequired/required action in wrong direction

A.	Action Sequence	1. Too soon 2. Too late
B.	Action Magnitude	1. Too much 2. Too little
C.	Action Duration	1. Too long 2. Too short
D.	Action Manner	1. Inadequate 2. Abrupt 3. Inaccurate 4. Incorrect 5. Unauthorized 6. Inadvertent

USAAAVS is now revising the -8 and -9 forms to eliminate items that are of questionable value and add items which will allow accident boards to clearly and accurately report what happened and why it happened for pilot *and* nonpilot personnel.

Recommending remedies for human errors. The accident report should tell what happened, why it happened and what must be done to reduce the chances of it happening again. Where human error is concerned, most accident reports leave much to be desired in recommending remedies. One of two things usually happens. If "what happened" and "why it happened" information is reported on the -8 and -9 forms, it may not even be mentioned in the findings and recommendations (-2) beyond the fact that human error was a causal factor. Or, if a recommendation is written against human error, it usually states that a certain procedure was not complied with, that it should be complied with in the future and that the facts and circumstances surrounding the accident should be made available to other aviation personnel. What is needed are findings and recommendations that (a) provide a precise statement of the man's task and how it was incorrectly performed, (b) identify each inadequacy in the aviation system that played a role in the accident and explain how it caused or allowed human error, and (c) state who is to do exactly what to correct each system inadequacy.

From the above discussion it should be obvious that, where human error is concerned, the accident board should concentrate on the man and not on the accident. In other words, the accident board's job is not only to describe the accident but also to describe what part of the man's job was performed incorrectly, why it was performed incorrectly and what can be done to reduce the probability that others will commit similar errors. For all Army aviation personnel who may at sometime be a member of an accident board, the following information is offered as a means of increasing the ability to identify, report and recommend remedies for human error.

First, when a man's performance of his job deviates from that required by the operational situation and causes or contributes to a mishap, DA Forms 2397-8 and -9 should be completed on this individual. Performance "required by the operational situation" includes that governed by formal or on-the-job training, by regulation, by standard operating procedures or by other directives in the context of the particular operational situation.

Second, the duty positions of personnel whose job performance should be checked for possible contribution to the mishap are listed in the Guidelines for Completion of DA Form 2397-2. It is suggested this task be directed by the flight surgeon with cooperation of experienced operational personnel. For example, if maintenance error was suspected, the flight surgeon would enlist the aid of a maintenance specialist knowledgeable of the type of vehicle/equipment, mission and operational environment involved in the mishap. The flight surgeon is best qualified to detect and report human error factors from information collected jointly with the expert who best understands the job from an operational standpoint. Table 1* presents a list of tasks and task errors which will help in identifying the man's task and how it was performed incorrectly.

Third, once the flight surgeon and operational expert have identified a task which was performed incorrectly and caused or contributed to the mishap, a precise statement of the man's task and how it was performed incorrectly should be written.

Fourth, inadequacies among basic elements of the aviation system which caused or allowed the human error should be determined. Table 2 provides a checklist that can be used to assist in identifying system inadequacies which played a role in the mishap.

Fifth, for each system inadequacy identified, a statement should be written which explains the causal relationship between the system inadequacy and the resulting human error.

Sixth, one or more remedial measures should be selected for each system inadequacy identified. Table 3 is a checklist which will assist in this task. Each remedial measure should be written to clearly state who is to do exactly what to correct the system inadequacy.

Last, this information should be reflected in the findings and recommendations (-2). Specifically, they should indicate (a) the duty position of the person committing each task error, (b) the checklist item and written description of the task error, (c) the checklist item and written description of each system inadequacy that caused or allowed the task error, and (d) the checklist item and written statement of remedial measures for each system inadequacy.

It should be obvious that when the above steps are properly executed and the personal data (DA Form 2397-8) recorded, the human-error portion of the accident investigation will have been completed, including all of the findings

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**Tables 1, 2 and 3 show experimental checklists that USAAAVS is testing using actual accident report information. Final revisions of these checklists are intended to replace DA Form 2397-9*

TABLE 2
System Inadequacies

Inadequate School Training
1. This duty position/MOS
2. Other duty position/MOS
3. Vehicle, equipment, or tool

Inadequate Informal/OJT Training
4. This duty position/MOS
5. Other duty position/MOS
6. Vehicle, equipment or tool

Inadequate Experience
7. This duty position/MOS
8. This type mission/task
9. This operational area (geographic or work/duty)
10. Type/designation vehicle, equipment or tool (R/W, F/W, torque wrench, etc.)
11. Model/series vehicle, equipment or tool (UH-1A, MD 3 generator, ft.lb. or in.lb. torque wrench, etc.)

Inadequate Psychophysiological State
12. Rest (sleep, breaks, working hours)
13. Nutrition (meals, snacks, etc.)
14. Illness or temporary discomfort (headache, flu, hangover, motion sickness, dysentery, etc.)
15. Stimulants/depressants (drugs, alcohol, caffeine, etc.)
16. Motivational level (excessive or insufficient)
17. Mood (tension, anger, depression, get-homeitis, boredom, preoccupation with personal problems)
18. Self-discipline level (apprehension to panic)
    1. Maintaining cool/composure
    2. Attention
    3. Judgment
19. Overconfidence
    1. In own ability
    2. In others
    3. In vehicle, equipment or tool
20. Underconfidence
    1. In own ability
    2. In others
    3. In vehicle, equipment or tool

Inadequate Environmental States
21. Light (man-made or man-induced)
22. Light (natural, day, lightning)
23. Vision restrictors (dark, haze, precipitation, exterior smoke, clouds, dust, glare, etc.)
24. Interior smoke, fumes or ventilation
25. Hail, icing, sleet, tornado, earthquake (other natural phenomena not vision restricting)
26. Temperature or density altitude
27. Altitude or oxygen
28. Sound or noise
    1. Internal (in earphones, in vehicle or in confined work area, etc.)
    2. External (outside vehicle or outside confined work area, etc.)
29. Geographic area
    1. Water (ocean, lakes, rivers, etc.)
    2. Terrain (jungle, desert, arctic, mountainous, etc.)
30. Wind, turbulence
    1. Natural
    2. Induced (rotorwash, etc.)
31. Vibration
32. Speed, acceleration, or deceleration

Inadequate State of Vehicle/Equipment Structure due to Production (from concept to manufacture)
33. Arrangement of components/parts (for operating, use)
34. Standardization (vehicle-to-vehicle)
35. Design (size, shape, anthropometry)
36. Manufacture (process or materials)
37. Legibility (readability)
38. Identification (marking, coding, etc.)
39. Accessibility (installing, removing, maintaining)
40. Lack of desired or state-of-art equipment (CWFS, radar, etc.)

Inadequate State of Vehicle/Equipment due to Maintenance
41. Scheduled inspection
    1. No provision for scheduled inspection or inadequate interval
    2. Not accomplished
42. Malfunction isolation or troubleshooting
43. Installation, removal, servicing
44. Repair, adjustment
45. Inspection of work completed (correctness, police of FOD, etc.)
46. Parts/equipment supply

Inadequate Facilities
47. Airfield/LZ
    1. Physical aspects (lighting, taxi lines, FOD, etc.)
    2. Personnel (tower operator, dispatcher, wx forecaster)
48. Flight planning/operations (charts, approach plates, NOTAMS, wx info, etc.)
49. POL
50. Medical (personnel, dispensary, equipment, supplies, etc.)
51. Overnight accommodations for transients (lodging, meals, etc.)
52. Navigational aids
53. Maintenance equipment/vehicle
54. Maintenance area
55. Crash rescue/emergency equipment or personnel
56. Unit supply (flight equipment, protective, life support)

Inadequate Written Procedures
57. This duty position/MOS
58. Other duty position/MOS
59. This phase of mission (preflight-to-after-action report)
60. This task/maneuver
61. This weather environment
62. This vehicle
63. This equipment/tool
64. This operational area (geographic or work/duty)

(57–64)
1. Not Clear
2. Incorrect
3. Incomplete

Inadequate Supervision or Coordination
65. Command
    1. This unit
    2. Other
66. Maintenance
    1. This unit
    2. Other
67. Operations
    1. This unit
    2. Other
68. Medical (other than facilities)
69. Armament/munitions
    1. This unit
    2. Other
70. Immediate level
    1. Flight leader, platoon leader, etc.
    2. Instructors/SIPs
    3. Crew or vehicle commander/supervisor
    4. Safety personnel
71. In-flight command/control
    1. This unit
    2. Other
72. Terminal guidance (pathfinder, ground guide, etc.)
    1. This unit
    2. Other

Inadequate Air Traffic Control
73. Flight following (unit, TOC, FOC, FSS, etc.)
74. Ground control/guidance (GCA, DEP control, center, etc.)
75. Tower

and the recommendations.

An example of better information. After reviewing more than 1,500 mishaps in which human error was a factor, USAAAVS analysts constructed a hypothetical example which is typical of many such accidents (table 4).

However, table 5 presents the narrative, findings and recommendations of this accident that USAAAVS could expect to receive.

TABLE 3
Remedial Measures

Reallocate this function/task/responsibility from this:

1. Duty position to another duty position
2. Duty position to a machine/device
3. Manually activated machine/device to an automatically activated machine/device

Redesign or provide to facilitate use by man

4. Controls
5. Instrumentation
6. Markings, decals, placards
7. Switches, knobs, dials
8. Work area, environment
9. Tools, job equipment
10. Basic vehicle
11. Major vehicle component
12. Protective equipment/clothing/life support equip
    1. Personnel
    2. Vehicle mounted
13. Organizational structure (informal or TOE, TDA)
14. Procedures for normal operation
15. Procedures for emergency or contingency operation
16. Checklists
17. Responsibility requirements
18. Training requirements
19. Qualification requirements (MOS, IP, slingload)

Modifiers (14–19): 1. TMs 2. FMs 3. ARs 4. SOPs 5. Directives

Modifiers (4–19): a. Redesign b. Provide

Improve monitoring of activities, missions, tasks, and compliance with procedures to increase/quicken error detection by:

20. Self monitoring
21. Crew or buddy system monitoring
22. Supervisory monitoring
    1. Unit commander
    2. Higher command
    3. Instructor/SIP
    4. Crew/vehicle commander/supervisor
    5. Operations, safety, others
    6. Flight surgeon
    7. Maintenance
23. Warning device monitoring

Inform others of errors detected, error consequences, and error remedies to increase sensitivity to problem areas in activities, missions, tasks or procedures by:

24. Work group briefings (oral or written) of same duty position/MOS/work group personnel
25. Individual counseling or briefing
26. Unit level briefings or meetings (safety, commander, etc.)
27. Wide distribution reporting (OHRs, EIRs, AVIATION DIGEST, etc.)

Provide timely and appropriate performance incentives

28. Encourage safe, efficient performance with praise, awards, promotions
29. Counsel "honest" mistakes with constructive discussion of remedies
30. Discourage flagrant or repeated unsafe performance with warnings and/or disciplinary action

When assigning personnel to any duty, mission or task, consider strengths and weaknesses of man assigned and manner in which assignment is made.

31. Training
    1. This duty position/MOS
    2. Other duty position/MOS
    3. Vehicle, equipment or tool
    4. Task/maneuver
    5. Environment (tactical, geographic, wx, night)

    Modifiers: a. School b. Unit/OJT
32. Experience
    1. This duty position/MOS
    2. Other duty position/MOS
    3. Vehicle/equipment or tool
    4. Task/maneuver
    5. Environment (tactical, geographic, wx, night)

    Modifiers: a. Recent b. Total
33. Psychological state
34. Physiological state

Develop, improve, upgrade, or provide unit/OJT and school training:

35. Determine training requirements by careful entrance interview of personnel
    1. School
    2. Unit/OJT
    3. Individual
36. Determine training requirements by periodic survey of qualifications of personnel in each duty position
    1. School
    2. Unit/OJT
    3. Individual
37. Develop sound programs where shortages of qualified personnel exist or are expected and carefully control MOS awarding
    1. School
    2. Unit/OJT
38. Do not attempt to OJT highly technical areas
39. Provide feedback to schools on acceptability/nonacceptability of school-trained personnel
40. Upgrade existing training programs to provide more emphasis, instruction or practice
    1. School
       a. Task/maneuver
       b. Vehicle, equip, tool
       c. Environment (operational or atmospheric)
    2. OJT/unit
       a. Task/maneuver
       b. Vehicle, equip, tool
       c. Environment (operational or atmospheric)
41. Provide for schooling opportunities to insure proper qualification and proficiency of assigned personnel
    1. School
    2. Unit/OJT

TABLE 4
Example of a Human-Error Accident: What Really Happened

At 1500 hours on 2 March 1974, Operations Officer posted an attack helicopter mission in support of a field training exercise (FTX) to be held the following day. However, he incorrectly posted 0830 as the takeoff time instead of 0730. He made this mistake because he was constantly too busy personally scheduling and coordinating all missions in addition to his other duties. He was "spread too thin" because operations was undermanned (the assistant operations officer was also the battalion instrument examiner). The negative impact of this situation on operations efficiency was not recognized by Unit Commander because he did not personally monitor operations and considered undermanning reports by staff officers as "empire building" or excuses to "cover up."

At 1830 hours, Pilot entered operations after an all-day mission to check the next day's schedule. He noted his 0830 FTX mission for the next day but was unable to get a mission briefing because Operations Officer was in a unit staff meeting and Clerk said it would go "on and on."

At 0800 hours on 3 March 1974, Pilot and Copilot completed preflight of AH-1G, SN 6900000, and proceeded to operations for the mission briefing they missed last night. Pilot had instructed Crew Chief to close and secure the inspection panels and cowlings. Crew Chief was about to secure the last of these (left-side engine and transmission cowling) when Platoon Sergeant asked him to get an auxiliary power unit (APU) and start another aircraft down the line ASAP. Thinking he would return prior to takeoff, or at least the pilots would finish securing during the final walkaround inspection, Crew Chief departed to get the APU.

At 0805 hours, Pilot and Copilot entered operations and approached Operations Officer who was on the phone. As soon as Operations Officer saw Pilot and Copilot, he put his hand over the phone and told them a mistake had been made in their takeoff time. He gave them a mission sheet with the correct takeoff time, coordinates and a contact radio frequency. He told them the CO was "having a fit" on the phone because Battalion had been "bad mouthed" by high-level Ground Commander whose FTX was being held up.

Thinking they would get the mixup straightened out when they returned, Pilot and Copilot ran back to the flight line, intent only in getting airborne. When they arrived at the aircraft, Pilot handed the mission sheet to Copilot and said he would crank the aircraft while Copilot plotted the coordinates and planned navigation. Caught up in the urgency of the situation and thinking of the map work ahead, Copilot gave his side of the aircraft a quick look as he climbed in. He either did not see the open latches on the transmission and engine cowling or they just did not register in his mind. Pilot saw the rotor was clear and untied, glanced down his side of the aircraft and, thinking everything was O.K., got into the cockpit.

At 0811 hours Pilot began starting procedures without a fireguard because no one was immediately available and time was essential. They hurried through the runup and were cleared into position for immediate departure. On climbout, at about 150 feet and 40 knots, the left-side engine cowling opened, broke loose and struck the tail boom, vertical fin and tail rotor, causing separation of the 90-degree gearbox. The pilots heard the noise and felt a shudder, and the aircraft yawed to the right. Pilot immediately entered autorotation and elected to land on the remaining runway. At about 20 feet, Pilot increased collective to check the rate of descent and simultaneously reduced throttle to establish alignment for touchdown. These coordinated throttle and collective actions failed to align the aircraft with the path of flight. The aircraft touched down in a level attitude at 5-8 knots of ground speed with a 60-degree right yaw. After touchdown, the left skid dug in, the cross tube collapsed and the aircraft rolled on its left side, sustaining major damage. Pilot closed the fuel and electrical switches and both pilots exited the aircraft uninjured and unassisted. There was no postcrash fire.

TABLE 5
Example of Human-Error Accident: Information USAAAVS Would Probably Receive

Narrative

At 0800 hours on 3 March 1974, Pilot and Copilot completed preflight of AH-1G, SN 6900000, and went to operations for a mission briefing while Crew Chief closed the cowlings. At operations they discovered a mistake in their takeoff time. Takeoff should have been at 0730 hours.

Pilot and Copilot rushed back to flight line, and, because Crew Chief was not there and time was short, cranked without a fireguard. They hurried through the runup and, at 0815, were cleared into position for immediate departure.

At about 150 feet on climbout, the left-side engine cowling tore loose and struck the tail rotor, causing separation of the 90-degree gearbox. Due to the low airspeed, Pilot entered autorotation to counter the nose-right condition. On touchdown, the aircraft rolled over on its left side, causing major damage. The crew sustained no injuries and exited the aircraft unassisted. There was no postcrash fire.

Findings

1. Pilot failed to comply with preflight checklist.
2. Pilot failed to post fireguard in accordance with starting procedures outlined in -10 checklist.
3. Pilot allowed aircraft to touch down with excessive forward motion for the right-yaw condition.

Recommendations

1. Recommend pilots follow prescribed preflight and starting procedures and that these topics be made the subject of the next monthly safety meeting.
2. Recommend Pilot receive postaccident checkride with emphasis on simulated antitorque failure maneuvers.
3. Recommend the facts and circumstances surrounding this mishap receive widest dissemination.

This is the typical "everybody-is-clean-except-the-pilot" accident report.

By contrast, table 6 presents an analysis of table 4 information that identifies what happened, why it happened and what can be done about it. This analysis was completed by using tables 1, 2 and 3 and following the "how-to-do-it" steps outlined above. It should be noted that job performances of the unit commander, operations officer and crew chief contributed to the pilot's task error. Therefore, human-error analyses (table 6) were performed on the role of each of these duty positions but are not presented because of space limitations.

From this analytic example, it should be obvious that "pilot-error accidents aren't all pilot," that accident boards can generate and report quality information and that something can indeed be done about "pilot-error" accidents. The objective in requiring full and complete accident information is not to single out any one individual. The objective is to help fulfill Army aviation's responsibility for maximum possible efficiency by squeezing out of each accident all information that can be used to increase proficiency at each duty position.

TABLE 6

Example of a Human-Error Accident: Information USAAAVS Should Receive

Name	SSAN	Duty
Buck Pilot	000-00-0000	P

Item	Code	Explanation
Task	11.1	Insure complete preflight inspection performed on AH-1G helicopter.
Error	4.d.1	Performed task inadequately: did not insure left-side engine and transmission cowling was secured prior to flight.
Inadequacy	67.1	Operations Officer assigned the mission in an angry, urgent manner.
Remedy	33	In making assignments, it should be kept in mind that the manner in which the assignment is made can affect the chances for a mission to be successful. Operations Officer should have told Pilot there had been a mistake in scheduling the takeoff time. To preclude any more mistakes, he should have stressed the need for Pilot to take the necessary time, even though the mission was already late, to insure that the aircraft was ready for flight and that he understood the mission before takeoff.
Inadequacy	18.3	Pilot allowed urgency imposed on him by operations to cloud his judgment: he did not inspect (trusted that Crew Chief had closed and secured as instructed) and cranked without a fireguard.
Remedy	20	When faced with unusual/urgent situations, pilots must remind themselves to follow sound, established procedures. In those rare emergencies where established procedures must be compromised, pilots must carefully evaluate the alternatives and associated risks when selecting a course of action.
	40.1.C	Schools should emphasize to pilots that operation urgency can be as catastrophic as in-flight emergency and train to follow sound accepted procedures in the face of both.
Inadequacy	67.1	Operations Officer posted incorrect takeoff time because he was too busy to be efficient. He personally scheduled and coordinated all missions in addition to his other duties because operations was undermanned.
Remedy	22.1	Unit Commander should personally monitor unit personnel. Personal monitoring of operations personnel would have revealed impact that assigning assistant operations officer as battalion instrument examiner had on efficiency of operations.
	26	Through unit level briefings, Unit Commander should assure his staff officers that he has an "open door policy" concerning operational difficulties and that each problem will receive his personal attention according to priority.

COMMENTS

From gearbox separation until the aircraft finally came to rest, it was found that Pilot's reactions to this emergency were proper and in accordance with the -10 instructions for this situation: (1) Touchdown should be executed in as level an attitude as can be achieved, and (2) ground speed should be as low as possible to minimize the possibility of turnover.

PILOT-ERROR ACCIDENTS AREN'T ALL PILOT

PART III

PART III WILL analyze the role of all personnel whose errors were significant factors in an actual accident. This analysis requires complete accident information but accident reports are privileged and strictly regulated. Therefore, it was decided to select an accident on which a full collateral investigation was performed and use this information in the analysis. Presented below is a narrative of the collateral board's findings with dates, places and persons changed. Tables 1 through 4 show human error reports on personnel whose execution of duties/responsibilities (tasks) was found to cause or contribute to the accident. (The codes contained in these tables appear in tables 1, 2 and 3 of Part II.) These reports demonstrate that a large amount of specific constructive information can result from careful analysis of actual accidents. Last, it is hoped this series shows that "pilot-error accidents aren't all pilot" and that each member of the team must "do it right," in order for Army aviation to measure up to standards of professionalism.

Collateral board narrative of accident. In February 1971, the 555th Aviation Company (AH) was reactivated at Fort Nix, TN, to be a highly proficient antiarmor attack helicopter company. The unit was to engage in 15 weeks of intensive antiarmor training prior to deployment to Europe. However, the aircraft were not received until July 1971, so the intensive antiarmor training was never accomplished. From February through June, the pilots did essentially nothing but read the technical manuals on the AH-1G. When the aircraft did arrive, only limited flying was performed and there was no meaningful training. These conditions caused a feeling of frustration among the aviators and a sense of futility within the unit.

The main body of the unit departed for Europe on 17 October 1971. But the aircraft were not available

TABLE 1
Human Error Report: Pilot

Name	SSAN	Duty
Flier, R. G.	000-00-0001	P

Item	Code	Explanation
Task	26	To fly the AH-1G within maneuver limitations of TM 55-1520-221-10 during a demonstration flight.
Error	2.D.5	Pilot performed an unauthorized aerobatic maneuver at an altitude insufficient for safe recovery, a violation of par. 3-2, chapter 3, AR 95-1.
Inadequacy	19.1	Pilot felt that during the demonstration flight by another crew, capabilities of the AH-1G had not been fully demonstrated to the spectators and decided he would show them what it was really capable of doing. Following mishap, pilot stated he was "showing off" the capabilities of the AH-1G.
Remedy	20	Aviators must control emotional impulse to impress others of their flying ability and perform only maneuvers for which they are trained.
Inadequacy	19.3	Pilot was overconfident in the capabilities of the AH-1G. Following mishap, pilot stated he had successfully executed this maneuver "many times" in AH-1G aircraft.
Remedy	40.1.B	Formal schools should place more emphasis on maneuver limitations outlined in TM 55-1520-221-10 and the consequences of exceeding these limitations.
Inadequacy	18.3	Pilot used poor judgment in his decision to execute the so-called "return to target" maneuver, which was not in the planned demonstration flight, and the altitude (400-500 feet) from which the maneuver was initiated.
Remedy	30	Unit commander initiate appropriate action against the pilot in accordance with findings of the board.
Inadequacy	17	Limited flying, no meaningful training and rumors of an impending unit move resulted in a general feeling of frustration and unrest among unit aviators.
Remedy	18.B	Commander should take immediate action to initiate a meaningful training program and provide a suitable location for implementation.
Inadequacy	65.1	The unit accident prevention program was ineffective due to lack of a safety SOP, infrequent safety meetings and a lack of emphasis on safety by unit commander.
Remedy	14.B	Unit commander should ensure development and implementation of an accident prevention program and monitor unit compliance in accordance with par. 3-1, chapter 3, and par. 4-3, chapter 4, AR 95-5.
Remedy	27	USAAAVS should make wide dissemination of board's findings via AVIATION DIGEST and FLIGHTFAX.
Task	13	To file a flight plan in accordance with par. 4-6, section 2, chapter 4, AR 95-1.
Error	1	Pilot failed to file flight plan or receive appropriate clearance for flight.
Inadequacy	18.3	Lack of unit emphasis on abiding by regulations resulted in a low self-discipline level of pilot, hampering his judgment on the necessity of coordinating with unit operations.
Remedy	20	Pilots must recognize that the responsibility for proper flight coordination rests as much with the aviator as with operations and supervisory personnel in accordance with par. 1-17, section 2, chapter 1, AR 95-1.
Inadequacy	65.1	Lack of emphasis on enforcement of regulations by the unit commander resulted in frequent violations of AR 95-1 by unit aviators.
Remedy	22.2	Appropriate commander should monitor unit's compliance with AR 95-1.

TABLE 2
Human Error Report: Commander

Name	SSAN	Duty
Leader, J. J.	000-00-0002	CO

Item	Code	Explanation
Task	5	To monitor unit performance in accordance with regulations and standing operating procedures.
Error	4.D.1	Failed to ensure unit performance and training were conducted in accordance with AR 95-1, AR 95-5 and standing operating procedures.
Inadequacy	18.3	Unit commander permitted flight demonstration to be conducted without proper authority in accordance with par. 6-11, chapter 6, AR 95-1. Also, unit commander displayed an unprofessional attitude and set an improper example for unit aviators by participating in a similar demonstration prior to the mishap, even to the extent of letting unauthorized passengers ride in front seat of the aircraft, some with small children sitting on their laps in violation of par. 1-15B, chapter 1, AR 95-1. These actions contributed to laxity in conformance with regulations and a general feeling of apathy among unit aviators.
Remedy	30	Appropriate commander should initiate action against the unit commander in accordance with findings of the board.
Inadequacy	43	Salt water damage resulted in aircraft being grounded for extended period of time, hampering training.
Remedy	22.7	Appropriate maintenance personnel should ensure that proper preservative and preventive measures are taken to avoid salt water damage when aircraft are transported or stored where salt water damage may occur.
Inadequacy	47	Unit was unable to conduct desired training program at home station due to a civilian noise abatement program.
Remedy	8.B	Appropriate commander should initiate action to ensure that unit is relocated to a permanent location where required training can be accomplished.
Inadequacy	65.2	Higher command failed to provide adequate guidelines for training and monitoring of unit's activities during training in accordance with par. 4-2, chapter 4, AR 95-5.
Remedy	22.2	Aviation officer of appropriate command should monitor unit's activities to ensure compliance with AR 95-1, AR 95-5 and appropriate directives.
Task	3	To provide a written SOP governing unit's activities and training in accordance with par. 3-1, chapter 3, AR 95-5.
Error	1	Unit had no written unit SOP, safety SOP or training SOP.
Inadequacy	18.3	Unit commander's disregard for regulations, safety, command responsibilities and staff advice resulted in an unprofessional attitude among unit aviators and staff, affecting their motivation, judgment and performance.
Remedy	22.2	The command to which a unit is assigned should ensure unit has an accident prevention plan and required SOPs and provide necessary assistance for implementation. It should also ensure units are following prescribed procedures after implementation in accordance with chapter 4, AR 95-5.
Remedy	14.B.4	Unit commander should ensure that written SOPs covering all aspects of unit activities and training are provided and implemented.

until the middle of November when they arrived in Le-Harve and were flown to Etian Army Post, France. Because of salt-water damage, the aircraft were then grounded until December, at which time the condition was remedied and the USAREUR checkrides were started. Other than the checkrides, most of the flights were "do nothing flights" with little or no training value.

The unit's arrival at Etian Army Post coincided with, and proved to be the deciding factor in, an antinoise campaign/demonstration led by a local district magistrate. This resulted in more stringent local flight regulations which curtailed night flying, eliminated weekend flying and significantly reduced training flights in the Etian area. This prompted the unit to move to Verdon during 3-14 May 1972 to accomplish unit training and complete semiannual flight minimums.

Due to noise abatement problems, unit relocation sites had been under constant consideration since the unit's arrival. Rumors of a pending unit move caused further unrest in the unit.

Repeated testimony by witnesses from the 555th disclosed that no adequate aviation safety program existed. Although the unit was formed in February 1971, there was no aviation safety SOP and safety briefings were rare. Witnesses also testified there was great difficulty in obtaining current flight publications, technical manuals and Army regulations. This, coupled with the commander's apparent disregard for regulations, command responsibilities and the advice of the unit safety officer (e.g., clearing his own flight demonstration and flying of dependents), contributed to an unprofessional environment, laxity in conformance with regulations and a general sense of apathy within the unit.

The unit mission as given in the TO&E was "to increase the combat effectiveness of the unit to which assigned or attached by the employment of direct aerial fires in offensive and defensive action." Although a true mission statement, it was not an antiarmor mission, as understood by personnel within the unit. The prevailing feeling within the unit was that there was no real mission.

In sum, the main problems encountered by the unit were lack of an explicit mission, nonavailability of regulations, few opportunities to fly or train, an impending unit move within USAREUR and no active aviation safety program. These problems and lack of their solution by the unit commander, MAJ Joe J. Leader, created the atmosphere which led to the events of 8 and 10 May 1972.

On 8 May 1972, the unit commander organized and led an unauthorized aerial demonstration with four AH-1G aircraft. Following this demonstration, three of the aircraft, piloted by MAJ Leader, CPT Appleton and CWO Claus, were used to give pleasure rides to unit dependents and French Nationals, which is in direct violation of Army regulations.

The events leading to this accident were initiated on 8 May 1972 when WO Jones approached CPT Planner, the unit operations officer, and requested per-

TABLE 3
Human Error Report: Operations Officer

Name	SSAN	Duty
Planner, L. E.	000-00-0003	OPS OFF

Item	Code	Explanation
Task	27	To advise the unit commander on the authenticity (legality) of a planned demonstration flight, either before or after the unit commander approved the mission.
Error	1	In accordance with par. 4-7c 13, section 3, chapter 4, FM 101-5, operations officer failed to inform unit commander that the planned demonstration flight was not properly authorized.
Inadequacy	16	Motivation of the operations officer in performing his duties was affected by the attitude and leadership of the unit commander.
Remedy	20	Self-monitoring of operational requirements by the operations officer would result in better control and coordination of unit's mission.
Inadequacy	65.1	Operations officer received no formal briefing on unit operating procedures or his duty position when assigned, and unit had no SOP covering operational requirements available for operations officer to read.
Remedy	22.1	Unit commander should ensure that when personnel are assigned to a duty position they are fully briefed on all aspects of their duty and should have appropriate literature, such as SOPs, FMs, ARs and unit policies, relating to their duty position.

mission to conduct a flight demonstration and static display for members of a French glider club who wanted to get a close look at the AH-1G. This request was relayed by CPT Planner to the unit commander without reference to the authenticity (legality) of the mission. The flight was approved by the unit commander and was to include a demonstration of nap-of-the-earth tactics, normal flight around the airfield and landing near the glider club for a static display.

On 10 May 1972, WO Smith and WO Jones preflighted the AH-1G and found it to be in flyable condition. They performed the flight as planned and landed in the vicinity of the assembled club personnel. Upon completion of the demonstration, CWO Flier, who had observed the flight from the glider club area, felt the capabilities of the AH-1G had not been fully demonstrated and asked if he could fly the aircraft for an additional demonstration. WO Jones agreed. CWO Flier was the pilot and CWO Ryder was the copilot during this demonstration. (After the mishap, CWO Ryder stated he was only ballast for the aircraft.)

Their flight began with two right 360-degree hovering pedal turns, followed by a takeoff to the west until reaching an altitude of approximately 50 feet. The pilot then made a sharp right turn and a low-level (50 feet), high-speed (100 knots) pass on a heading of 120 degrees, within 15 meters of the crowd. The pilot proceeded 1 mile on this heading and then performed a quick stop maneuver. The aircraft rose to approximately 100 feet above ground level while the pilot was executing a right turn which essentially reversed the heading. The pilot then placed the aircraft into a dive toward the crowd at speeds up to 110 knots at a very low altitude (3 to 5 feet) on a heading of approximately 320 degrees. Passing the crowd, the pilot initiated an abrupt cyclic climb to roughly 400 to 500 feet above ground level, approaching zero knots airspeed and possibly a negative g condition.

This was followed by a 180-degree right pedal turn which, because of an already excessive nose-high pitch attitude, placed the aircraft in a steep dive of from 50 to 70 degrees on a heading of 170 degrees directly toward the crowd. The aircraft remained nose low for approximately one-half of the dive and then rotated upward to a slightly nose-high attitude, remaining in this pitch attitude until impact. Upon impact, the aircraft struck and killed four people. The aircraft slid 420 feet from the point of impact, and the cockpit section eventually came to rest in an upright position. The aircraft was totally destroyed upon impact with a minor postcrash fire resulting. Both pilots were assisted from the wreckage by U. S. Army personnel at the scene and were taken by UH-1 helicopter to an Army hospital.

TABLE 4
Human Error Report: Copilot

Name	SSAN	Duty
Ryder, B. O.	000-00-0004	CP

Item	Code	Explanation
Task	26	To maintain strict air discipline regarding regulations and rules governing AH-1G maneuver limitations (TM 55-1520-221-10) and spectator safety during flight demonstrations (par. 6-20a, c and e, section IV, AR 95-1).
Error	1	Copilot failed to indicate disapproval in accordance with Army aviator's duties (par. 4-4c, chapter 4, AR 95-5) even after the pilot had initiated a third unauthorized, unsafe maneuver.
Inadequacy	16	Copilot stated after accident that he was only ballast in the aircraft and in no way was associated with the accident, which indicates lack of initiative and motivation.
Remedy	30	Unit commander should consider performance of copilot and take action necessary to prevent reoccurrence.
Inadequacy	58	Lack of specific Army personnel responsibilities in current Army regulations applicable to instances where others violate regulations and/or place the aircraft, crew or others in jeopardy.
Remedy	17.3.B	Include in appropriate regulations responsibilities for Army personnel to indicate disapproval when others violate regulations or otherwise jeopardize the aircraft, crew or others.