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MAJOR ORIENTATION-ERROR ACCIDENTS IN REGULAR ARMY UH-1 AIRCRAFT DURING FISCAL YEAR 1970: ACCIDENT FACTORS

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13. ABSTRACT

This report is the fourth in a longitudinal series of reports dealing with the pilot disorientation/vertigo problem in Regular Army UH-1 helicopter operations. Individual case history data extracted from the USAAAVS master aircraft accident files are presented on major orientation-error accidents that occurred in UH-1 aircraft during fiscal year 1970. Summary data listings involving a variety of operational and pilot-related accident factors are presented for each of the 42 cases. The listings are arranged to distinguish between those factors and events present before takeoff, i.e., the initial conditions associated with a given accident, and those which occurred or were manifested during the actual airborne phase of the accident flight.

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i.b

SUMMARY PAGE

THE PROBLEM

From the military mission viewpoint, the amount of research effort to be expended on the solution of a given aviation medicine problem must be keyed to its operational cost. In the case of orientation-error accidents involving pilot disorientation and vertigo, little quantified data are available to describe either the incidence or cost of such accidents in aviation. In addition, though such accidents have been long recognized as a major aviation medicine problem, there are few data on hand to describe the direct operational setting for these accidents in terms of the pilot, aircraft, mission, and environmental factors which will be present, singly, or in some combination, for each mishap. Until such data are assimilated for a considerable number of orientation-error accidents, determination of the optimal solution route, whether it be, for example, aircraft design, cockpit layout, instrument concept, or matters dealing with pilot selection, training, and utilization, will not be achieved.

FINDINGS

To initiate the action necessary to establish the magnitude of the orientation-error problem in Army aviation, an interservice research program was organized under the joint sponsorship of the U. S. Army Aeromedical Research Laboratory, the U. S. Army Agency for Aviation Safety, and the Naval Aerospace Medical Research Laboratory. The first step was the construction of an operational definition of an orientation-error accident. The assimilation of data pertaining to the incidence and cause of such accidents and their actual and relative costs in terms of fatalities, injuries, and aircraft damage was then set as the working objective of the program using the master USAAAVS accident files as reference. Accordingly, the decision was made to implement a five-year longitudinal study of all major and minor orientation-error accidents involving Regular Army flight operations beginning with fiscal year 1967. Findings are being summarized on a fiscal-year basis in three separate lines of reports: The first line is devoted to defining the over-all magnitude of the orientation-error problem in all aircraft types; the second line to the presentation of similar incidence and cost data for accidents involving only the UH-1 aircraft, the predominant rotary wing aircraft in the Army inventory; and the third line to the description of the various pilot/operational factors found to be present in the major UH-1 orientation-error accidents.

This specific report is the fourth in the series dealing with UH-1 accident factors. A brief case history description is given of each major orientation-error accident which occurred in fiscal year 1970 along with various summary compilations of related background data including pilot experience, psychological and physiological stress variables, mission pressures, visibility conditions, materiel difficulties, facility limitations, and supervisory factors.

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The findings in this report are not to be construed as an official Department of the Army position, unless so designated by other authorized documents.

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INTRODUCTION

To investigate the operational role of pilot disorientation and vertigo in the production of orientation-error type aircraft accidents, the authors have organized an interservice research program under the joint sponsorship of the U. S. Army Aeromedical Research Laboratory (USAARL), the U. S. Army Agency for Aviation Safety (USAAAVS), and the Naval Aerospace Medical Research Laboratory (NAMRL). Since little quantified data were available to describe the actual magnitude of the orientation-error problem in Regular Army flight operations, the decision was made to conduct a five-year longitudinal study, beginning with fiscal year 1967, of all Army aircraft accidents that involved an erroneous judgment of aircraft motion or attitude on the part of the pilot. Two separate, but related, project objectives were set for the longitudinal study. The first was to extract and assimilate the data from the USAAAVS master aircraft-accident files which would define the actual cost and relative cost of orientation-error accidents to Regular Army flight operations. These data, by defining the operational magnitude of the problem, would then serve to define the extent of the research support that should be devoted to its solution. The second working objective was to extract data on a case-history basis which would describe the various pilot/aircraft/mission/environment factors found to be present in each of the orientation-error accidents. Assimilation and analysis of these data over the study period would result in better knowledge of the most common operational causes of orientation-error accidents and thus point out those research directions which offer the greatest potential toward the reduction of accident incidence.

The results of the longitudinal study are being summarized in three separate lines of reports, with one report in each line prepared for each fiscal year of the five-year study. The first line of reports (for example, refs. 1,4,7, and 10) is devoted to defining the incidence and cost of all major and minor orientation-error accidents involving all aircraft types, fixed wing as well as rotary wing, that occurred in Regular Army flight operations for each fiscal year. Since the UH-1 "Huey" helicopter has been, and is, the predominant aircraft in the Army rotary wing inventory, the second line of reports (for example, refs. 2,5,8, and 11) is devoted to defining the magnitude of the orientation-error accident problem in only this aircraft. The layout and format of this line of reports is almost identical to that of the first line. The third line of reports (for example, refs. 3,6, and 9) deals exclusively with the various causal factors found to be present in all of the UH-1 major orientation-error accidents. Typical data to be presented include phase of flight, time of day, type of mission, pilot experience, physiological factors, psychological factors, facility factors, environmental factors, and the like.

This specific report is the fourth in the series dealing with accident factors and concerns only those major orientation-error accidents that occurred in UH-1 aircraft during fiscal year 1970. To facilitate the comparison of these factor data with similar data derived for other fiscal years of the longitudinal study, the layout and numbering of the figures presented in this report are identical to those presented previously (refs. 3,6, and 9). The various rationale involved in both the definition of the orientation-error class of accidents and the analysis of the related accident factors are discussed in

detail in the first report of the series (ref. 3). It is of particular importance that the reader recognize that the accident details contained in this report derive solely from the written records contained in the master file associated with each accident. Accordingly, the extent of the factors that can be listed for a given accident is dependent entirely on the extent of the documentation entered into the record by the field investigation team and its reviewing authorities. The authors wish also to caution against any interpretation of the report data for a given fiscal year that assigns one single factor as the sole causal agent for either a given accident or the entire class of accidents. Though degraded visibility is probably the single most predominant factor in orientation-error accidents, there are usually present additional factors or events, any of which, if eliminated singly, might possibly have prevented the accident. In this context, the listing of a given factor in this reply implies only that it was present -- it may or may not have played a causal role. The weight of a given factor as a contributing element will be best judged upon completion of the five-year data assimilation period.

PROCEDURE

A basic requirement for the commencement of this study was a workable definition of the class of accidents to be defined as involving orientation error. The reader is referred to previous reports (refs. 1,2, and 3) for a comprehensive definition and discussion of its rationale. Briefly, orientation is considered to involve the correct determination of the dynamic position and attitude of an aircraft in three-dimensional space. The key word here is dynamic, which implies that full knowledge of the motion as well as static attitude and position is required to define its instantaneous spatial orientation. Accordingly, a pilot is considered to have made an orientation error whenever his perception of the motion and attitude of his aircraft differs from the true motion or attitude, i.e., the true orientation of the aircraft. An orientation-error accident is then defined as one that occurs as a result of an incorrect control or power action taken by a pilot (or a correct action not taken) due to his incorrect perception (or lack of perception) of the true orientation of his aircraft.

With this definition of orientation-error accidents serving as a classification reference, an experienced classifier read all briefs in the USAAAVS master accident files and selected all major and minor accidents of this type occurring during fiscal year 1970. For redundancy, the entire accident files were also searched by sifting the coded summaries that USAAAVS prepares for each accident for a wide range of indicator terms.

The authors then reviewed the accident briefs independently for the purpose of establishing whether or not an orientation-error accident classification would result. In addition, the comprehensive master file on each suspect accident was obtained and reviewed. Whenever there was serious question as to the contribution of orientation error to the accident or where equally weighted alternative causal factors were present, then the accident was not included in the classification. The net effect of this policy is to give a conservative estimate of the magnitude of the orientation-error accident problem.

From the resulting listing of all major and minor orientation-error accidents that occurred in both fixed wing and rotary wing aircraft, separate identification was made of only those major accidents that occurred in UH-1 aircraft. The master file on each of these UH-1 accidents was then obtained from USAAAVS for review as described previously (ref. 3). In brief, the basic factor data were extracted from the files by the classifier using a combination check-list/narrative type questionnaire developed by the authors of this report. In addition, the classifier and the authors prepared independent check-list summaries of selected accident details represented by the factors data compiled in figures shown later in this report.

RESULTS AND DISCUSSION

The accident data presented in this report pertain to 42 major orientation-error accidents that occurred in Regular Army UH-1 helicopters during fiscal year 1970. Of this total, 17 (40.5 percent) accidents involved one or more fatalities and 28 (66.7 percent) resulted in total strike damage to the aircraft. These accidents accounted for 69 fatalities, 18 major injuries, and 47 minor injuries.

The layout and format of related data to be presented in this report follow those utilized in previous reports (refs. 3,6,9) of this series. Figure 1 summarizes the incidence of fatal accidents, aircraft strikes, day accidents, and night accidents; incidence according to flight phase; and incidence according to assigned mission. In Figure 2A a distribution is given of the number of accidents that occurred during each month of the fiscal year. The incidence of these accidents on a local-time basis is described by the distribution shown in Figure 2B. Comparative cost and flight phase data for accidents that occurred under daylight and night visibility conditions are presented in Figures 3A and 3B, respectively. The relative cost of night accidents continues to exceed that of day accidents. Similar data are presented for accidents involving degraded visibility due to weather and dust in Figures 4A and 4B, respectively. Weather was involved in 17 (40.5 percent) of the orientation-error accidents. The cost of weather accidents remains high in that 64.7 percent were fatal and 88.2 percent resulted in strike damage. Of the nine weather accidents that occurred in daylight, six accidents were fatal. Of the eight night accidents, five were fatal. The total of only three dust accidents is a considerable reduction from the incidence noted in previous years of the study.

In Figures 5 through 9, summary listings are made of various aviator-related background information. For each figure, a separate compilation is made for each of the two Army pilots normally aboard the UH-1 aircraft. The terms "first pilot" and "second pilot" have been arbitrarily selected to identify the commanding aviator (not necessarily the senior-ranked aviator) and his copilot, respectively. Outside of Vietnam, the first and second pilot notation corresponds to the conventional pilot (P) and copilot (CP) identification. In Vietnam, however, the two aviators are usually identified as the air commander (AC) and pilot (P); the air commander rating applies only after an aviator gains a certain minimum of in-country experience within the air unit to which he is assigned. An air commander is thus identified as the first pilot and the pilot as the

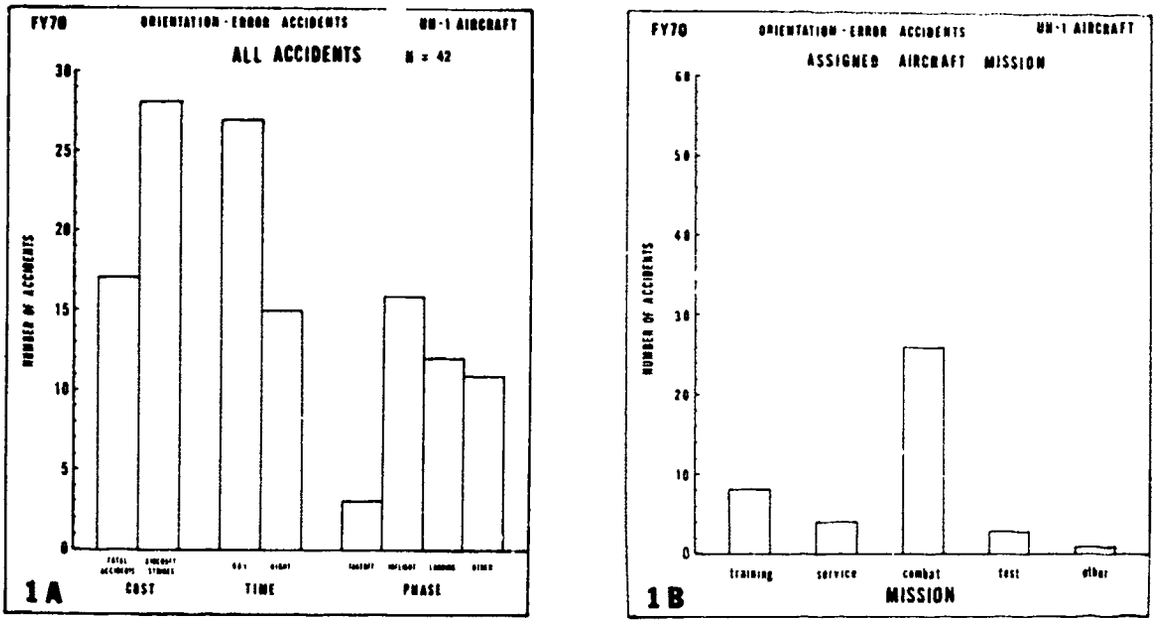


Figure 1

Major orientation-error accidents occurring in Regular Army UH-1 aircraft during fiscal year 1970. Number of fatal accidents, number of aircraft strikes, time of day of the accidents, and the flight phase in which the accident occurred (A); and types of missions assigned to the accident aircraft (B).

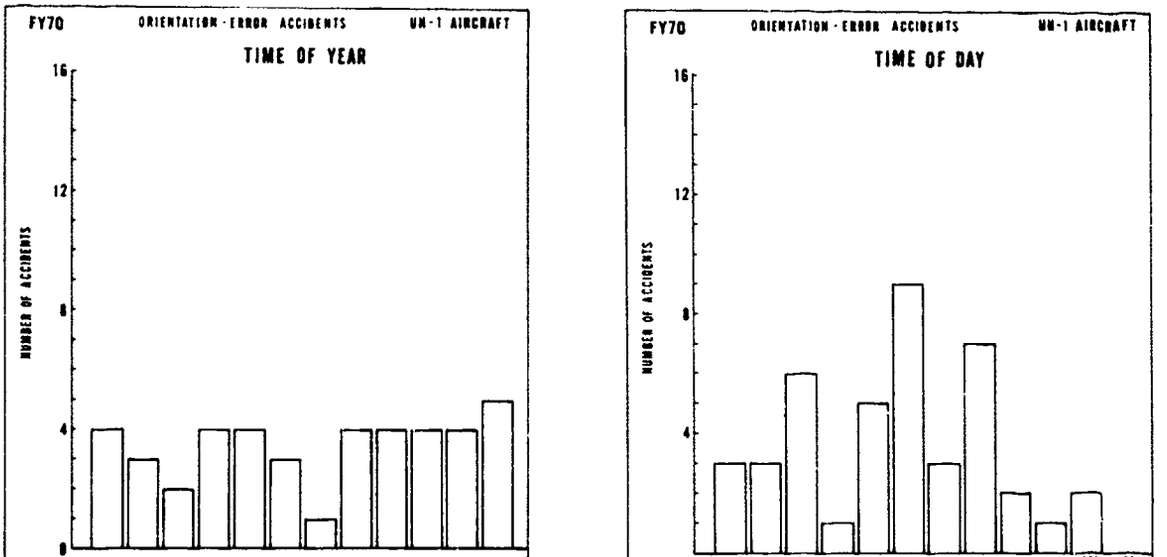
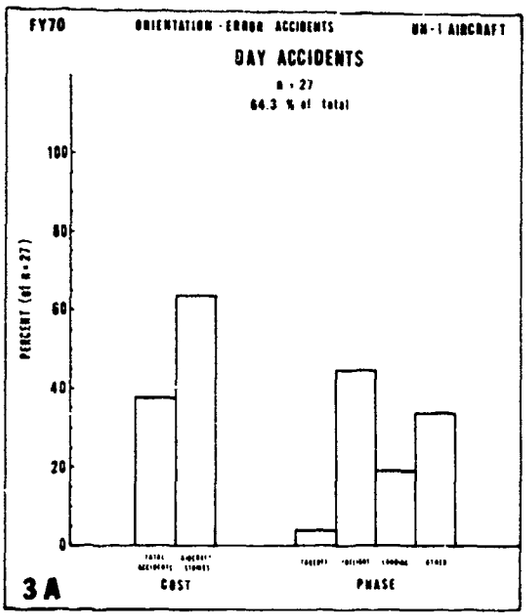


Figure 2

Number of orientation-error accidents as a function of the time of year (A) and the local time of day (B).



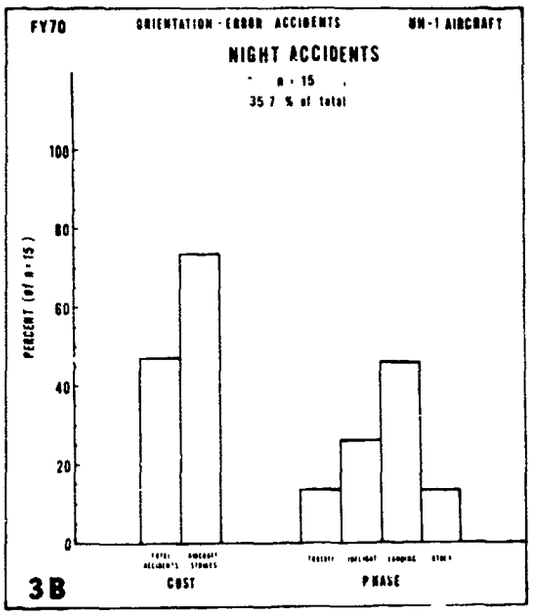
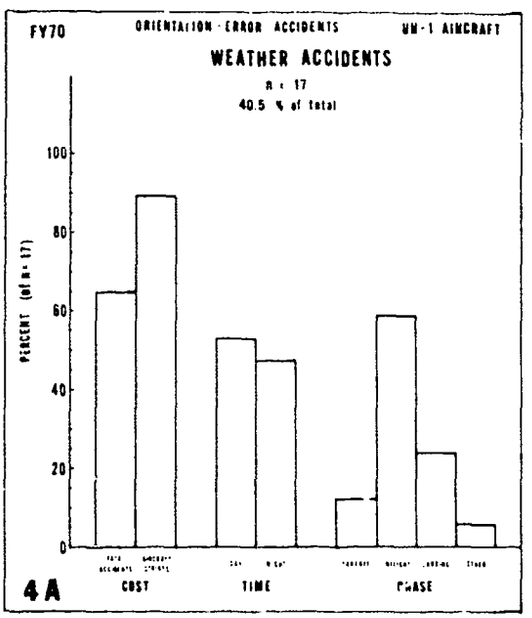


Figure 3

Comparison of percent incidence of fatal accidents, aircraft strikes, and flight phases for the 27 orientation-error accidents that occurred under daylight visibility conditions (A) and the 15 accidents that occurred under night visibility conditions (B).



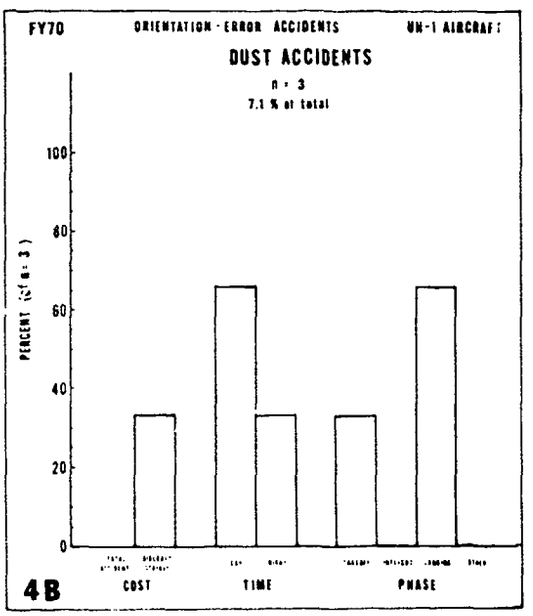


Figure 4

Comparison of percent incidence of fatal accidents, aircraft strikes, day/night accidents, and phases of flight for the 17 orientation-error accidents that involved poor weather (A), and the 3 accidents that involved rotor-raised ground dust or ashes (B). Note the high incidence of fatal accidents and aircraft strikes involved in the weather accidents.

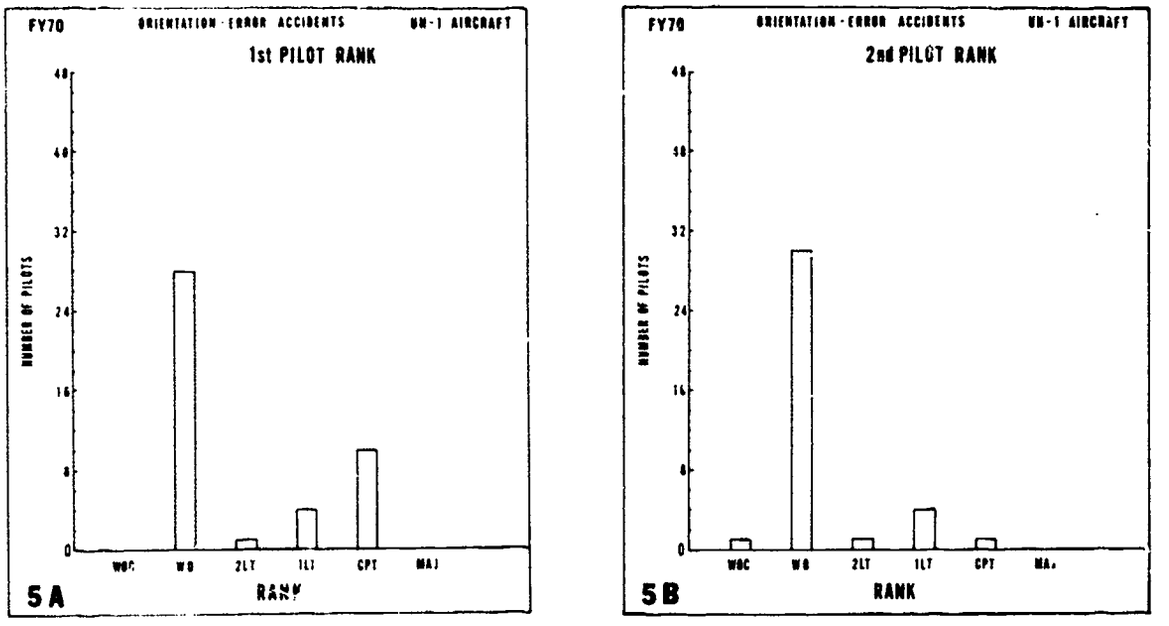


Figure 5

Distribution by rank of 41 first pilots (A) and 38 second pilots (B) involved in the orientation-error accidents. As explained in the text, the first pilot notation is used to describe the commanding aviator aboard the aircraft. In general, for Vietnam accidents, the first pilot is the "air commander" and the second pilot is the "pilot." For accidents occurring elsewhere, the first and second pilot notation usually corresponds to the conventional "pilot" and "copilot" designations, respectively.

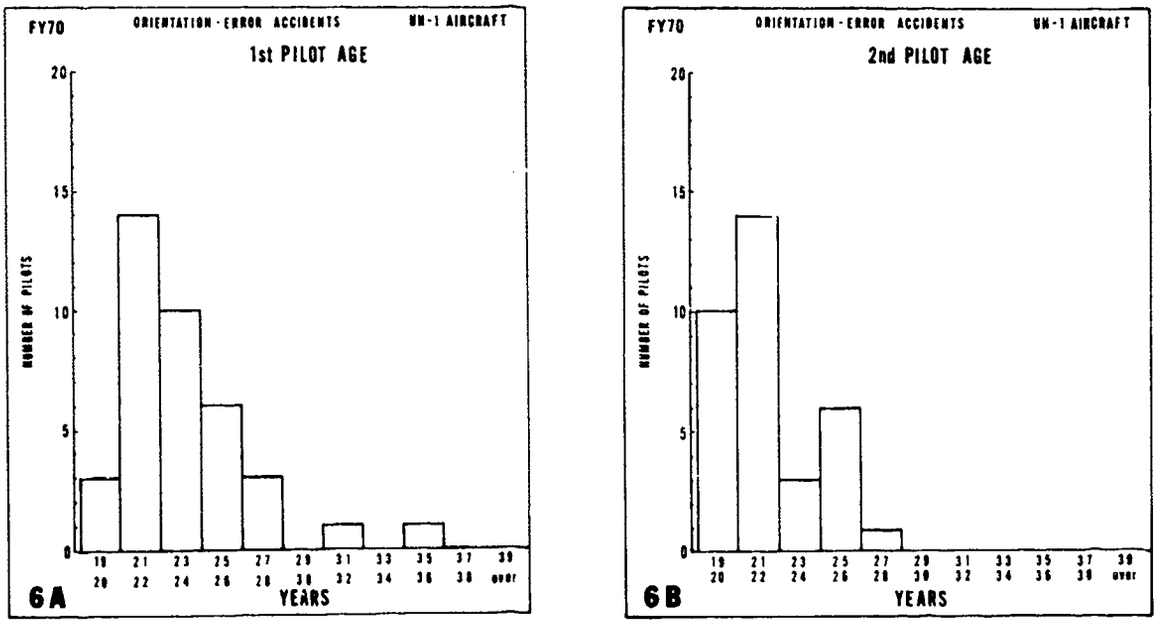


Figure 6

Age distribution of the first pilots (A) and second pilots (B). The median ages were approximately 23.4 and 22.0 years, respectively.

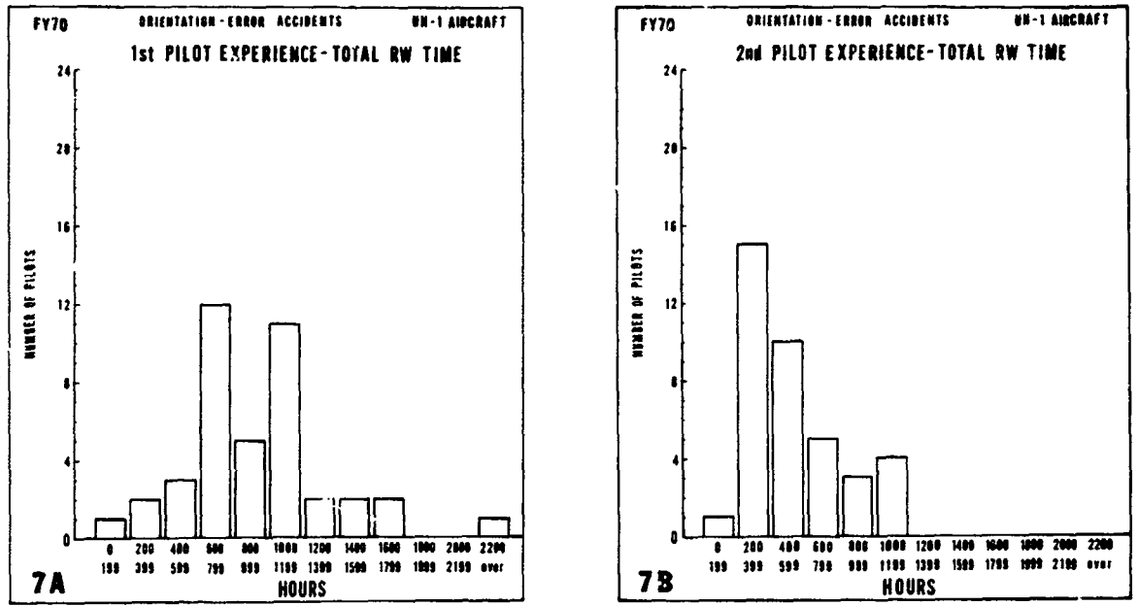


Figure 7

Distribution of total flight hours experience in military rotary-wing aircraft of the first pilots (A) and second pilots (B). The medians were approximately 900 and 460 hours, respectively. These data do not include any additional fixed-wing experience.

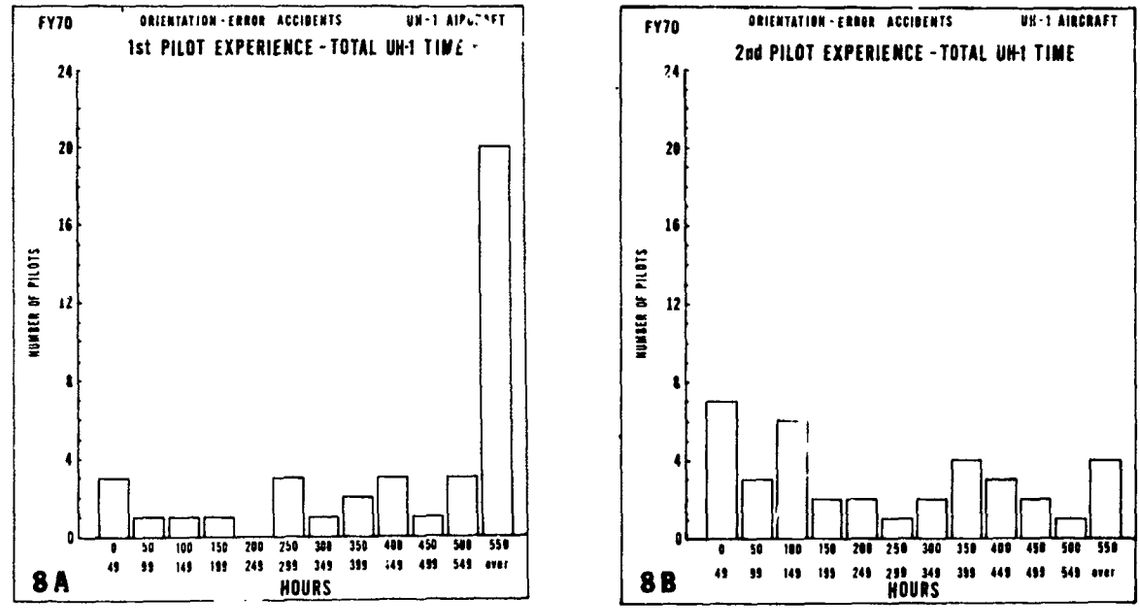


Figure 8

Distribution of total flight hours in the UH-1 aircraft of the first pilots (A) and second pilots (B). The median times were approximately 550 and 212 hours, respectively.

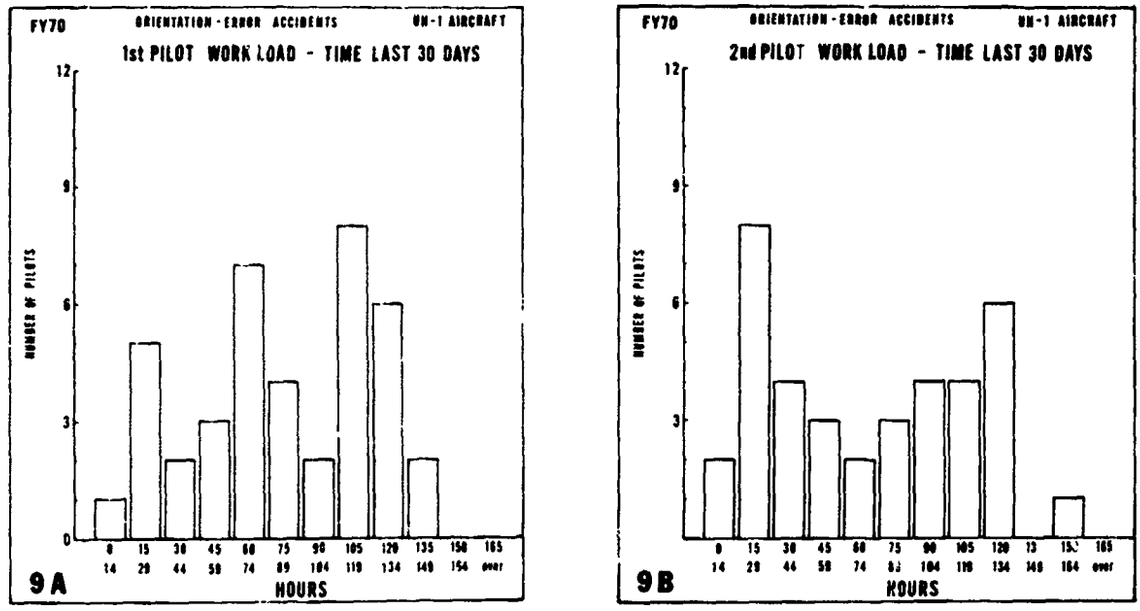


Figure 9

Distribution of pilot workload in terms of the total number of hours flown during the 30 days preceding the accident by the first pilot (A) and the second pilot (B). The median workloads were 82 and 71 hours, respectively. (See Figure 11 for related fatigue data.)

second pilot in this report. In the case of student aviators, the individual assigned to fly the aircraft at the time of the accident is identified as the first pilot.

Data pertaining to the military rank of the first and second pilots are shown in Figures 5A and 5B, respectively. Age distribution data for the pilots are listed in Figure 6. Aviator experience in terms of total flight hours both in all types of military rotary wing (RW) aircraft and in the UH-1 aircraft is described in Figures 7 and 8, respectively. The median for the total recorded RW experience was 900 hours for the first pilots and 460 hours for the second pilots. In terms of UH-1 flight experience, the median time was 550 hours for the first pilots and 212 hours for the second pilots. Workload data concerned with the total number of hours flown by the aviators the 30 days preceding the accident are shown in Figure 9. The median times were approximately 82 hours for the first pilots and 71 hours for the second pilots. Army regulations place 140 hours per 30-day interval as the official upper limit relative to pilot fatigue. After 90 hours, however, observation of the pilot by the air unit commander and flight surgeon is required.

To provide insight into the operational nature of these orientation-error accidents, the following pages contain a cursory case-history description of each individual accident. The first paragraph of each account lists in the designated order: accident location; the type mission assigned to the crew; the phase of flight in which the accident

CASE BRIEF 70-1

Vietnam: test mission--maintenance; flight phase--inflight; night flight; three persons aboard--three fatalities; aircraft strike damage.

Aircraft flying low over water along coastline soon after sunset with instrument lights on full bright. Aircraft slowly descended and impacted water at relatively high speed with evidence indicating aircraft flared at last instant. Pilot (no copilot aboard) had been on duty 13 hours before accident. Other personnel reported pilot had been working 15 hours a day for the previous six weeks and that he had said he was "tired all over" and that it would take many days of rest before he could consider himself normal. Fellow pilot who had recently flown with him said his recent inflight attention level was low--he often had to shout into intercom to get his attention. Earlier on day of accident, pilot reported to have struck revetment while hovering another UH-1. Post flight analysis indicated UHF radio turned off, intercom switch on "PVT" position, and altimeter setting slightly low - all indicators of poor cockpit procedure.

CASE BRIEF 70-2

Vietnam: combat mission--resupply; flight phase--landing; night flight; four persons aboard--no injuries.

Aircraft on night mission to supply ammunition to ground troops engaged in combat. Landing zone illuminated by two ground strobe lights and overhead flares. With ceiling at 1000 feet and rain showers present, AC decided on a lights off approach because of combat situation. Made a 360 degree high overhead approach to landing zone. After completing a 180 degree turn to final, overhead flare burned out and AC lost sight of strobe lights. Continued approach until he picked up one strobe when second flare burned out. AC instructed pilot to turn on landing lights to confirm landing site and found out he was too far right. Had searchlight turned on, then off. In near vicinity of touchdown site, searchlight again turned on. AC stated he lost his night vision as a result of flares and glare of searchlight on rain and thus decided to make a go-around. Aircraft struck ground hard at this time. Board noted AC had little experience landing at strobe-lighted fields. Copilot had flown 93.5 hours during the previous 30 days.

CASE BRIEF 70-3

Vietnam: service mission--courier; flight phase--inflight; day flight; ten persons aboard--eight fatalities and two major injuries; aircraft strike damage.

Because of cloud cover, mission flown at 400-foot altitude under VFR conditions. AC, thoroughly familiar with terrain having flown 40 previous missions over same route, decreased altitude to 50 feet as weather deteriorated. Crew used P attitude indicator during flight since AC instrument not functioning. As ceiling lowered, AC relieved P at controls, started right turn, and called base for weather information. Base reported transmission was extremely garbled/broken and asked for a repeat. After receiving the second request and giving the desired information, the following message was received: "Roger.....Hey! You're in a steep bank.....Hey! Hey! Hey! Hey! Hey!..... Pull up! Pull up! Pull up! Pull up! Pull up!". Aircraft impacted side of mountain.

CASE BRIEF 70-4

Vietnam: combat mission--troop evacuation; flight phase--landing; night flight; four persons aboard--four fatalities; aircraft strike damage.

Six aircraft departed at 1800 for troop evacuation under tactical emergency conditions. Refueled enroute and attempted to reach combat site but had to orbit four miles from site because of weather. After one hour, flight returned to nearby base. One aircraft then flew at low altitude to combat site to check out enroute weather. This crew reported they reached site without trouble with ceiling between 50 and 150 feet and moderate rain at times. Remainder of flight then departed for combat site. When weather started to close in, subject aircraft initiated 180-degree climbing turn while remainder of flight continued on mission. AC of this aircraft notified flight leader of intentions to return to base and requested permission to change radio frequencies to GCA. After receiving permission, AC contacted GCA and began descent to 4800 feet as instructed. Radar controller encountered difficulty with elevation measurement equipment during descent. Eight miles out, GCA and AC agreed to a surveillance approach rather than a precision approach. At approximately five miles, AC asked GCA what his altitude should be. The controller answered 3600 feet. The AC then asked to be advised of recommended altitude every half-mile. At four miles, distance and altitude information was radioed to the pilot. Shortly thereafter, aircraft disappeared from the controller radar impacting ground at altitude far below recommended level. Flight surgeon noted that AC had been grounded in past for failure to follow instructions, was often irresponsible, and had the nickname, "Cloud 6."

CASE BRIEF 70-5

Vietnam: combat mission--medical evacuation; flight phase--inflight; night flight; seven persons aboard--one major injury and six minor injuries; aircraft strike damage.

Crew assigned night medical evacuation mission for four urgent-rated patients. When aircraft arrived at site, ground fog covered area. Fog too thick for searchlight penetration. AC requested hand-held/flare illumination of landing area and began descent. During approach, flares burned out and approach had to be aborted. Second attempt aborted for same reason. AC radioed ground unit that he could not land unless they maintained continuous illumination. On third approach, AC realized that ground unit would again allow flares to burn out before he could touch down. Decision then made to climb out at 60 knots airspeed and 700 feet per minute rate of climb. After traveling approximately 1/2 mile, aircraft impacted ground with both pilots believing they were in a climb. Pilots had made 16 flights during the past 24 hours with less than 5 1/2 hours sleep.

CASE BRIEF 70-6

Vietnam: combat mission--troop assault; flight phase--landing; day flight; twelve persons aboard--no injuries.

Aircraft number three ship in six-aircraft assault team preparing to offload combat troops at landing zone surrounded by fires and smoke from recently completed air strike. Team made a relatively fast and steep single-file approach to field. At about 200-foot altitude, flight leader decelerated resulting in remainder of aircraft closing up on each other. At approximately 60 feet, number three aircraft started to go IFR in smoke and rotor dust of the two lead aircraft. Visibility went IFR approximately 10 feet above the ground and AC decided to land instead of making a go-around. Aircraft impacted ground with high rate of descent and slight forward velocity crushing skids. AC had flown 90.8 hours during the previous 30 days.

CASE BRIEF 70-7

Vietnam: combat mission--tactical; flight phase--landing; night flight; ten persons aboard--two minor injuries; aircraft strike damage.

Three aircraft in V formation approached rice paddy combat site with area illuminated by an overhead lightship. On short final, lead aircraft turned his landing lights on while nearby gunships provided suppressive rocket and mini-gun fire support. Aircraft flying behind and to the left of flight leader flew into the ground approximately 200 meters short of intended landing site. Night vision affected by flashes from exploding rockets, glare from landing lights, light of overhead lightship, and water reflections. AC had only two hours night flying experience during previous five months of Vietnam tour. P had only four hours night time during the past eight months.

CASE BRIEF 70-8

Vietnam: test mission--maintenance checkout; flight phase--inflight; day flight; four persons aboard--four minor injuries; aircraft strike damage.

Test pilot (TP) completed all prescribed flight maneuvers for maintenance checkout of overhauled aircraft. P with 115 hours flight time the previous 30 days asked if he "could take it and see what it could do." P then proceeded to perform a variety of flight maneuvers. At an altitude between 500 and 1000 feet, P executed a diving turn which he claimed to have done "hundreds of times before without difficulty." Aircraft impacted rice paddy during pullup. P stated, "The aircraft was in a steep dive which I misinterpreted as a shallow one."

CASE BRIEF 70-9

Vietnam: combat mission--command control; flight phase--inflight; day flight; eleven persons aboard--one fatality, two major injuries and eight minor injuries; aircraft strike damage.

Aircraft flying at 50 feet over large lake toward a distant horizon partially obscured by fog. Aircraft had been loaded near the forward center-of-gravity limits with a high gross weight. As flight proceeded, AC made comment to P about how one can lose depth perception when flying over smooth water. Shortly thereafter, aircraft impacted water at shallow angle. Wind was calm and water was "glassy smooth." AC had flown 110 hours during the previous 30 days.

CASE BRIEF 70-10

Vietnam: combat mission--troop extraction; flight phase--landing; day flight; four persons abourd--no injuries.

Six aircraft assigned mission to extract troops from water-covered rice paddy area. After completing four extractions, aircraft returned to pickup zone for fifth extraction. Ships approached in trail formation descending from 1300 feet, 90 to 95 knots, and 900-feet-per-minute. At approximately 25 feet and 40 knots, second aircraft was flared preparatory to setdown. Aircraft tail rotor impacted water. AC and P had flown 140 hours and 112 hours, respectively, during the previous 30 days. AC had flown 435 hours during the previous four months.

CASE BRIEF 70-11

Vietnam: combat mission--resupply; flight phase--landing; day flight; five persons aboard--no injuries.

Aircraft enroute to outpost with flight also serving as a check ride for P who was on controls. During a slow and shallow approach over a water-covered rice paddy, the tail rotor impacted water. AC and P had flown 7.4 and 10.9 hours, respectively, during the previous 24 hours--P had flown 100 hours during the previous 30 days.

CASE BRIEF 70-12

Vietnam: combat mission--Nighthawk; flight phase--takeoff; night flight; five persons aboard--three fatalities and two major injuries; aircraft strike damage.

This aircraft and escort Cobra had to return to operations outpost as a result of deteriorating weather. While IFR on final approach, AC experienced vertigo severe enough to require transfer of aircraft control to P. Missed approach executed by P who then landed aircraft safely. Several hours later, crews were dismissed from mission since fog had moved in and covered area. Both crews decided to return to home base at this time. After discussing weather, Huey crew decided to take off first and check out weather--moon could be seen through fog. Aircraft initiated takeoff with navigation lights, rotating beacon, landing light, and searchlight all turned on. At an altitude of approximately 100 feet, the landing light and searchlight were turned off and the aircraft observed to make a descending right turn. The turn was stopped after about 30 degrees but the aircraft continued to descend until ground impact. AC had flown 106 hours during the previous 30 days.

CASE BRIEF 70-13

Vietnam: combat mission--not defined; flight phase--inflight; night flight; four persons aboard--four fatalities; aircraft strike damage.

Aircraft enroute to home base when weather went IFR and crew called base control operator and asked position of aircraft. Pilots stated they were IFR in clouds and unsure of position. An FM fix was then given by control with pilot concluding that base was "to my left and to the rear." Control asked pilot to maintain two-way communication during the remainder of the flight. Shortly after rogering the transmission, a voice was heard, "I've got it! Let go of it; I've got it!" The controller called the aircraft and received the reply, "We are upside down. What's happening? Oh! My God! What do I do?"

CASE BRIEF 70-14

Vietnam: unauthorized mission; flight phase--inflight; day flight; six persons aboard--three fatalities, two major injuries and one minor injury; aircraft strike damage.

After completing 5-1/2 hours of flight in direct combat support of a ground unit, AC elected to fly over a nearby friendly base to drop leaflets concerning football game rivalry. P made three low circling passes over the base which bordered on a river. AC then took over controls to make another low pass so as to determine reaction of ground personnel reading leaflets. He then performed a simulated "gunship rocket run" directly toward the sun. Witnesses observed aircraft to enter water at a relatively steep angle with no apparent attempt to pull up. AC and P had flown 110 and 115 hours, respectively, during the previous 30 days. AC and P had flown 10 and 7.8 hours, respectively, during the previous 24 hours.

CASE BRIEF 70-15

Vietnam: combat mission--resupply; flight phase--inflight; day flight; four persons aboard--four fatalities; aircraft strike damage.

Ground unit requested delivery of noncombat supplies to nearby field. Because of bad weather, AC assigned to perform mission decided not to attempt the flight. Second AC stated he would perform this last sortie for the first AC even though the weather was deteriorating rapidly. First AC told him to wait until he checked out the weather at the drop point. First AC made takeoff and flew through an opening in clouds toward ground unit. He was unable to see the landing zone even though ground flares were fired. As he broke away, second AC radioed that he would attempt to make it. First AC watched second AC fly into clouds and heard him communicate with the ground unit. Even though visibility at the landing site was less than 20 feet, the ground unit continued to direct the aircraft toward their location. AC was heard to say, "I can't see a damn thing!" shortly before ground impact. AC and P had flown 133.3 and 120.5 hours, respectively, during the previous 30 days.

CASE BRIEF 70-16

Vietnam: combat mission--troop transport; flight phase--inflight; day flight; seven persons aboard--six fatalities and one major injury; aircraft strike damage.

During light rain, visibility went IFR as aircraft entered clouds. AC relieved P at controls and stated he initiated a climbing left turn to get out of weather. Since his attitude indicator was inoperative, he had to make visual reference to the P instrument to determine bank angle. Aircraft impacted terrain shortly thereafter. Immediately before impact, AC was looking out of chin bubble in attempt to see the ground. P had flown 95 hours during the previous 30 days.

CASE BRIEF 70-17

Vietnam: combat mission--not defined; flight phase--landing; night flight; five persons aboard--one fatality and four minor injuries; aircraft strike damage.

Upon completion of mission, AC initiated approach to field he had landed at "many times before." Pilots stated they started to relax when they saw ground lights on horizon. The approach to the field was long and shallow from 3000 feet with perimeter lights surrounding the base camp. Aircraft impacted rice paddy approximately one mile short of field. AC had slept three hours the night before the accident, had flown 13 hours during the previous 24 hours, and 133.4 hours during the previous 30 days. This night mission was assigned following 9-1/2 hours of flight time on a command and control mission earlier in the day.

CASE BRIEF 70-18

Vietnam: test mission--maintenance; flight phase--other; night flight; three persons aboard--no injuries; aircraft strike damage.

Pilot lifted aircraft to hover attempting to position aircraft within revetment. During hover, tail drifted right and struck revetment causing aircraft to spin and impact concrete ramp. Pilot had been on duty for 24 hours and had not slept 40 hours prior to the accident. Blood alcohol relatively high.

CASE BRIEF 70-19

Vietnam: combat mission--medical evacuation; flight phase--inflight; day flight; four persons aboard--one fatality, two major injuries, and one minor injury; aircraft strike damage.

Aircraft assigned as gunship escort to med-evac aircraft attempting to make pickup in marginal weather conditions. Enroute to pickup site ground unit radioed that patient status no longer urgent and that weather was starting to close in. However, the AC of the med-evac ship decided to make the pickup before the weather completely closed. As both aircraft entered IFR conditions, escort aircraft made a 180-degree turn to get out of weather. Med-evac aircraft radioed that the escort ship did not have to try again. However, AC of escort ship decided to try a second time. This time the decision was made to climb out immediately if they went IFR again. When aircraft went IFR the second time, AC initiated a straight-ahead climb. During the climbout, crew members other than pilots thought aircraft was in a left bank and losing altitude. AC and P simultaneously saw trees ahead but were not able to react before impacting.

CASE BRIEF 70-20

Vietnam: combat mission--medical evacuation; flight phase--landing; night flight; four persons aboard--four fatalities; aircraft strike damage.

Crew, assigned a night med-evac mission, had to fly approximately 20 minutes in light rain on a dark night to reach site. When aircraft arrived at pickup site, the crew was unable to contact the ground unit for another 20 minutes because of confusion as to the correct radio frequency. With the landing site illuminated by trip flares, the aircraft made two orbits descending to a hover at 300 feet with searchlight on. The aircraft then initialed a descending left turn with the searchlight off. The descending turn increased to a steep bank with the aircraft impacting the ground at a level beneath the landing site. Flight surgeon stated that the AC had reported suffering vertigo on a previous flight where control of the aircraft had to be assumed by the P.

CASE BRIEF 70-21

Vietnam: combat mission--assault; flight phase--landing; day flight; four persons aboard--four minor injuries; aircraft strike damage.

Four aircraft in trail formation returning to field for second pickup of troops. Aircraft in number two position went IFR in dust raised by rotor wash, struck ground hard, attempted to pull up over the dust but drifted backward in a nose-high attitude, and crashed. AC had flown 118 hours during the previous 30 days.

CASE BRIEF 70-22

Vietnam: training mission--check ride; flight phase--other; day flight; two persons aboard--no injuries.

IP assigned to give P standard check ride. During practice straight-in autorotation, P misjudged height of aircraft above ground resulting in tail rotor impact. IP and P had flown 106 and 153 hours, respectively, during the previous 30 days.

CASE BRIEF 70-23

Vietnam: combat mission--transport; flight phase--takeoff; night flight; four persons aboard--two minor injuries.

Crew made uneventful night landing at dusty site. During takeoff with searchlight turned on, visibility went IFR due to reflections off fine white dust which AC reported as having a "blinding effect." Searchlight immediately turned off but aircraft impacted ground in tail-low attitude. AC and P had flown 124 and 119.9 hours, respectively, during the previous 30 days.

CASE BRIEF 70-24

Vietnam: training mission; flight phase--other; day flight; three persons aboard--two major injuries and one minor injury; aircraft strike damage.

Aircraft completed landing approach to field in light rain. During a hovering approach to the parking revetment, P let aircraft yaw left and impact wall resulting in strike damage. P stated, "This was one of my first experiences at flying in the rain." P had flown 93 hours during the previous 30 days.

CASE BRIEF 70-25

Vietnam: combat mission--medical evacuation; flight phase--landing; night flight; four persons aboard--no injuries; aircraft strike damage.

Med-evac aircraft with two gunships as escort made approach to field illuminated by "flashing jeep lights and other steady light sources." First approach, over water, was terminated and go-around initiated by AC who stated that "...the jeep lights blinded me and I quickly realized that I had been concentrating on these lights too long." After completing a left climbing turn, AC made second approach turning landing lights off since they did not help visibility. During the approach the AC stated the ground lights appeared to go out. In actuality, the aircraft had gradually lost altitude with the trees onshore blocking off the line of vision to the field lights. Aircraft impacted water in shallow descent angle.

CASE BRIEF 70-26

Vietnam: combat mission--assault; flight phase--other; day flight; four persons aboard--one minor injury; aircraft strike damage.

On second flight to small landing site, AC turned controls over to P who had been in country for only 12 days. During approach, P required some assistance from AC but did successfully bring aircraft to a hover. AC cautioned P of aircraft drift combined with a slight yaw. Aircraft setdown and troops offloaded. P lifted aircraft to a hover prior to takeoff but did not detect drift to the right. Skids impacted a nearby stump and aircraft overturned. AC had flown 91.7 hours during the previous 30 days.

CASE BRIEF 70-27

Vietnam: combat mission--undefined; flight phase--inflight; day flight; four persons aboard--two fatalities and two minor injuries; aircraft strike damage.

At an altitude of 400 feet, crew detected a sampan on river and descended to an altitude of 15 to 20 feet at an indicated airspeed of 90 knots. As aircraft passed sampan, AC and P turned their heads to obtain a closer look. Almost immediately thereafter, aircraft impacted water. AC and P had flown 109 and 105 hours, respectively, during the previous 30 days.

CASE BRIEF 70-28

Vietnam: combat mission--command/control; flight phase--takeoff; day flight; six persons aboard--three major injuries and three minor injuries; aircraft strike damage.

Aircraft flying above mountain combat site monitoring weather for tentative troop lift. Two tactical commanders aboard aircraft, both senior to pilots, placed indirect pressure on crew due to their disappointment in weather conditions. Following decision to cancel mission, AC was instructed to land at mountain site to pick up 12 rucksacks since weather had temporarily cleared. Slope of site such that AC had to maintain hover in mountain turbulence with front of skids resting partially on slope. After loading rucksacks, one commander disembarked and started talking to ground personnel at site as weather started closing in. AC told crew chief to tell commander to hurry. After several minutes, weather closed in and signal was given to pilots to take off without commander. Climbing IFR takeoff made with updraft turbulence causing rapid climb. AC experienced vertigo and requested P to come on controls. AC later stated that "With that turbulence I almost thought I was experiencing vertigo. But I've never had it before." AC relieved P at controls when he thought aircraft was in a left bank of 15 to 20 degrees while P thought they were in a right bank. Aircraft impacted trees shortly thereafter on downward slope of mountain. P had flown 130 hours during the previous 30 days, had only three hours sleep during the previous 24 hours, and had experienced diarrhea for four days.

CASE BRIEF 70-29

Vietnam: service mission--personnel pickup; flight phase--other; day flight; four persons aboard--no injuries.

After completing landing approach to a hover, AC moved aircraft toward a nearby vehicle parking lot for setdown. Prior to setdown, aircraft drifted backward and struck fence with tail rotor. Neither AC nor P detected drift. AC had flown 117 hours during the previous 30 days.

CASE BRIEF 70-30

Vietnam: combat mission--command/control; flight phase--landing; day flight; four persons aboard--no injuries.

To avoid enemy gunfire, AC flew aircraft low-level to landing site with entire flight over water or over water-covered rice paddies. As landing site approached, AC flared aircraft at low altitude resulting in the tail rotor impacting water. AC and P had flown 127 and 120 hours, respectively, during the previous 30 days.

CASE BRIEF 70-31

Vietnam: service mission; flight phase--inflight; day flight; nine persons aboard--nine fatalities; aircraft strike damage.

After completing their last mission of the day, crew decided to return to home base even though bad weather forecast for route. Aircraft made takeoff in light rain between two thunderstorms. In heavy rain and turbulence, aircraft made a near-vertical descent from several hundred feet altitude striking the ground in a right turn, nose-low attitude.

CASE BRIEF 70-32

Vietnam: combat mission--reconnaissance; flight phase--inflight; day flight; seven persons aboard--seven fatalities; aircraft strike damage.

Crew had completed mission and decided to return to home base even though weather had closed in. AC radioed that he was misoriented relative to home base but would attempt to "home in" on the position. Maintaining radio contact, flight continued into thunderstorm area and shortly thereafter crashed in a near-vertical descent indicating loss of control. P had flown 127.6 hours during the previous 30 days.

CASE BRIEF 70-33

Vietnam: service mission; flight phase--other; day flight; one person aboard--no injury.

P, only person aboard, attempted to move aircraft from one revetment to another. As P lifted aircraft to a low hover and started moving out of the revetment, tail drifted left and impacted wall. Pilot reported, "The tail boom drifted to the left but at a gradual rate I did not notice."

CASE BRIEF 70-34

Vietnam: combat mission--rocket run; flight phase--inflight; day flight; four persons aboard--three fatalities and one major injury; aircraft strike damage.

Aircraft initiated rocket run on enemy position from approximately 300 feet altitude. Because of surrounding trees, AC used steep dive angle. Aircraft impacted trees during pullout and began tumbling before impacting ground in an inverted position. Board of opinion that AC watched rocket until it detonated to check his accuracy before he began a second run on position. Surviving crew member thought AC "just flew it into the ground." AC had flown 106 hours during the previous 30 days. Flight surgeon of opinion that the day-to-day stress of pilots living in tents adjacent to runway made these individuals susceptible to fatigue. He also stated that in the past two months, 16 lives had been lost in this company due to three aircraft accidents where two accidents had been due to pilot-error and the third was still under investigation.

CASE BRIEF 70-35

Vietnam: service mission; flight phase--inflight; night flight; six persons aboard--six fatalities; aircraft strike damage.

Upon completion of assigned missions involving approximately 8 hours of flight time, AC decided to return to home base while P elected to remain overnight at forward station. AC failed to obtain advance weather information and took off with three other aircraft returning to same home base. AC flew aircraft from left seat even though the attitude indicator on this side was known to be defective. Flight encountered thunderstorms enroute and two aircraft elected to land. AC continued flight radioing that he was IFR. Shortly thereafter another communication was heard with a voice shouting, "Get off the controls!" Aircraft impacted ground at relatively high airspeed. AC had flown 126.1 hours during the previous 30 days.

CASE BRIEF 70-36

Vietnam: training mission--check ride; flight phase--other; day flight; two persons aboard--no injuries; aircraft strike damage.

IP demonstrating various maneuvers over airfield when tower instructed aircraft to clear runway for an approaching FW aircraft. In order not to waste time holding, AC decided to demonstrate a simulated anti-torque failure using a smooth river sandbar as the terminal point. Intending to make a go-around at the end of the maneuver, IP approached sandbar and demonstrated the slow swing of the nose to the right. During the hovering swing, the skids contacted the sand and aircraft rolled over. IP and P had flown 135 and 134 hours, respectively, during the previous 30 days.

CASE BRIEF 70-37

Vietnam: combat mission--medical evacuation; flight phase--other; night flight; five persons aboard--two minor injuries.

Aircraft was at a high hover waiting for tower clearance to take off. There was a heavy mist present and the only lighting was from the aircraft searchlight. Pilots were in a hurry to depart area since tear gas in area was starting to move toward aircraft. With the P at the controls and the AC adjusting the radios, aircraft began an undetected rearward drift which resulted in a tail rotor strike on a nearby fence. AC and P had flown 7 and 13 hours, respectively, during the previous 24 hours. AC and P had flown 125 and 126 hours, respectively, during the previous 30 days.

CASE BRIEF 70-38

United States: training mission--autorotation; flight phase--other; day flight; two persons aboard--no injuries.

IP demonstrating autorotations to P receiving check ride. IP misjudged altitude of aircraft and tail rotor impacted ground during flare.

CASE BRIEF 70-39

United States: training mission--autorotation; flight phase--other; day flight; two persons aboard--no injuries.

IP demonstrated four autorotations to relatively experienced P. The P then began to duplicate the maneuvers. On the third autorotation, P misjudged altitude and tail rotor impacted ground. Both the AC and P thought that it was a normal autorotation.

CASE BRIEF 70-40

United States: training mission; flight phase--landing; night flight; three persons aboard--no injuries.

After completing night training mission, flight of aircraft in hurry to return to home base because of deteriorating weather. IP made approach to landing site in moderate rain. As approach terminated, aircraft drifted right with right skid low and main rotor impacted ground causing aircraft to roll over. IP stated, "I was terminating and started to pull final when I picked up a red glare. Just from thinking about it, I say it was the glare off the left navigation light....it seemed to me like for half a second everything was red....I then felt the impact."

CASE BRIEF 70-41

Europe: training mission; flight phase--inflight; day flight; six persons aboard--six minor injuries; aircraft strike damage.

Aircraft descended to 300 feet to maintain VFR conditions on routine orientation flight. As aircraft flew along a valley between two tree lines, both pilots sensed that they were descending. Ground was covered with snow and sky was hazy white resulting in poor definition of the horizon. AC initiated a right turn and aircraft soon thereafter impacted ground. Snow-covered terrain had a slight upward incline at point of impact. P had a sensation of falling when turn initiated.

CASE BRIEF 70-42

United States: training mission; flight phase--other; day flight; two persons aboard--no injuries.

SP on third training mission of day completed approach and brought aircraft to a standing hover prior to setdown. Aircraft started drifting laterally in both directions and impacted ground with left skid low. Flight surgeon indicated SP had lack of confidence in ability which tended to create anxiety during flight.

occurred; the time of day of the accident in terms of either night or daylight visibility conditions; the number of persons aboard the aircraft; the number of fatalities, major injuries, and minor injuries; and the presence of aircraft strike damage. The second paragraph presents a brief narrative of the accident proper.

A selected listing of the various factors derived from the review of the master accident files for these accidents is presented in Figures 10 through 14 on an individual case history basis. Once again the reader is reminded that the listing of any factor or event for a given accident is limited by the amount of data actually contained in the related master accident jacket. The format used in the preparation of Figures 10 through 14 is keyed to the identification of factors and events on an individual accident basis. In each of these figures, a separate vertical column is assigned to each accident where the number at the top of each column corresponds to the accident number used to sequentially identify the individual case history briefs presented earlier. An alphanumeric index code is used to identify selected accident factors where an x-entry denotes the presence of the related factor. In addition to these individual listings, the total number of accidents in which a given factor was present is tabulated in a separate column. Reference should be made to the first report (ref. 3) of this series for details pertinent to the basic classification criteria used for the listed factors.

Figure 10 summarizes various accident/aviator background information associated with these 42 fiscal year 1970 orientation-error accidents. The location of each accident is denoted in rows A1 through A3. For that fiscal year, 88.1 percent of the UH-1 orientation-error accidents occurred in Vietnam. As denoted by the A4-A8 entries, the greatest number (73.8 percent) of the accidents occurred in the H model of the UH-1. Rows A9-A13 indicate the mission assignment, rows A14-A17 the phase of flight in which the accident occurred, and rows A18 and A19 the time of day in terms of daylight or night visibility. Under the miscellaneous heading, A20 denotes those accidents in which one or more fatalities were involved. Row A21 indicates those fatal accidents in which all personnel aboard the aircraft were killed. Entries in row A22 indicate accidents resulting in a total loss or strike of the aircraft. In contradistinction, entries in A23 denote accidents resulting in minimal damage, i.e., the accidents in which the total dollar damage was less than $25,000, which amounts to approximately 10 percent or less of the replacement cost of the aircraft. The B and C headings in Figure 10 give data relative to the background and experience of the first and second pilots, respectively. The interpretation of the experience data contained in rows B5-B9 and C5-C9 should be related to the data previously presented in Figures 7 and 8, which pertain to only total RW time and total UH-1 time. Rows B5 and C5 denote those aviators who had a total FW (fixed wing) and RW experience of 1000 hours or more. In terms of only RW flight time, entries B6 and C6 denote those aviators with 1000 hours or more of RW experience. In the opposite direction, entries B7 and C7 identify aviators with less than 400 hours RW time, denoting minimal experience. Relative to total time in the UH-1 aircraft, entries B8 and C8 denote aviators with greater than 500 hours, while B9 and C9 denote those with less than 100 hours. To gain insight into the availability of post-flight data from the aviators involved in the accident,

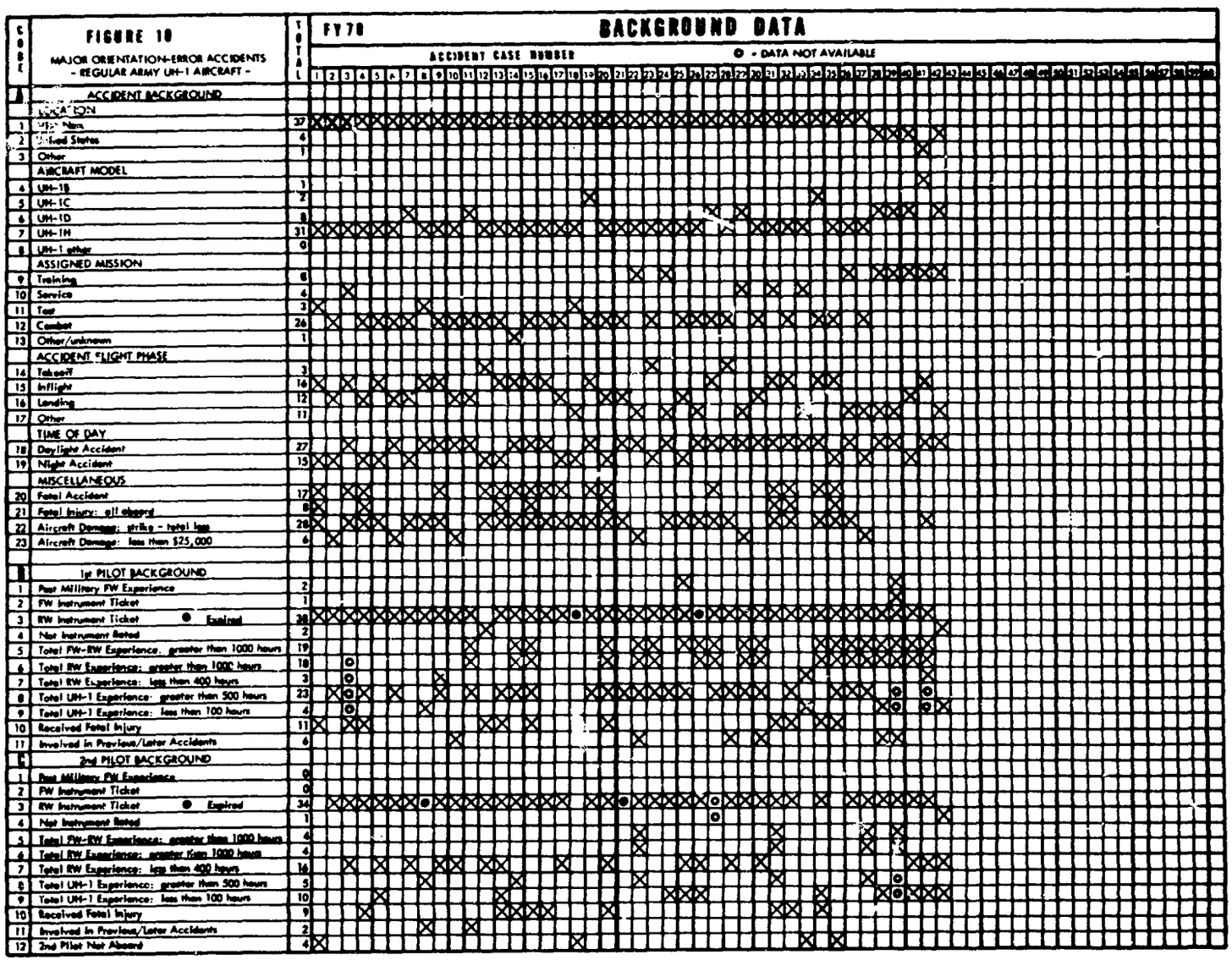


Figure 10

Individual case history listing of basic accident details and selected aviator background information.

entries B10 and C10 indicate those pilots fatally injured. Data pertaining to other accidents the pilots may have been involved in are listed in entries B11 and C11.

The factor and event data presented in Figures 11 through 14 follow the Figure 10 format with the row entries continuing to be identified in alphanumeric sequence. It should be observed that Figures 11 and 12 are concerned with factors and events which were listed as being present, or having happened, in the time period preceding takeoff; Figures 13 and 14 list factors and events which occurred, so far as the crew were concerned, only after the aircraft became airborne. This approach has been selected with the long-term objective of possibly distinguishing between accidents that may occur as a result of initial conditions existing before flight, and accidents that may occur seemingly as a result of only some inflight event or factor.

In Figures 11 and 12, factors and events which were present before takeoff are listed under physiological, psychological, facility, supervisory, materiel, mission pressure, pilot preflight, and miscellaneous factor headings. The D and F headings pertain to physiological and psychological factors, respectively, associated with the first pilot while the E and G headings list the same factors for the second pilot. This separate listing allows a heavier weighting to be given these factors when both pilots, rather than only one, experience the related difficulties.

Relative to physiological problems that existed prior to takeoff, fatigue was found to be the most obvious factor. Four entries, D1-D4 for the first pilot and E1-E4 for the second pilot have been allotted to the description of this problem. Entries D1 and E1 denote aviators with greater than 140 total flight hours during the 30 days preceding the accident. Army regulations for Vietnam flight operations set this figure as the upper limit which cannot be exceeded except during tactical emergencies. Although it is possible to obtain permission at the battalion level to exceed this limit, the regulations direct the commanders to use the utmost discretion when granting this waiver. For fiscal year 1970 there were two accidents in which at least one pilot had flown more than 140 flight hours the preceding 30 days. The same Army regulations also state that a crew member who accumulates 90 hours in a 30-day period will be closely monitored by the unit commander and the flight surgeon. This monitoring requirement is thus an implied recognition of individual susceptibility to fatigue. For this reason, the authors have chosen to also identify those accidents involving aviators with a workload greater than 90 hours, and less than 140 hours during the preceding 30 days. The related D1-D2 and E1-E2 fatigue entries indicate 18 first pilots and 16 second pilots experienced this workload. There were 25 (59.5 percent) accidents in which either one or both of the aviators had flown more than 90 hours during the 30-day period preceding the accident. Of this total, 9 (21.4 percent) accidents involved the case where both aviators had flown more than 90 hours during the preceding 30 days. A third fatigue classification, D3 and E3, involves the identification of aviators who had flown 8 hours or more the 24 hours preceding the accident. Three first pilots and 4 second pilots experienced this workload. In entries D4 and E4, miscellaneous fatigue factors mentioned by the accident board, for example, long duty hours or interrupted sleep, are listed. Treating the four fatigue entries as a group, there were 28 (66.7 percent) accidents in which at least one aviator was exposed to one or more of the stated fatigue listings.

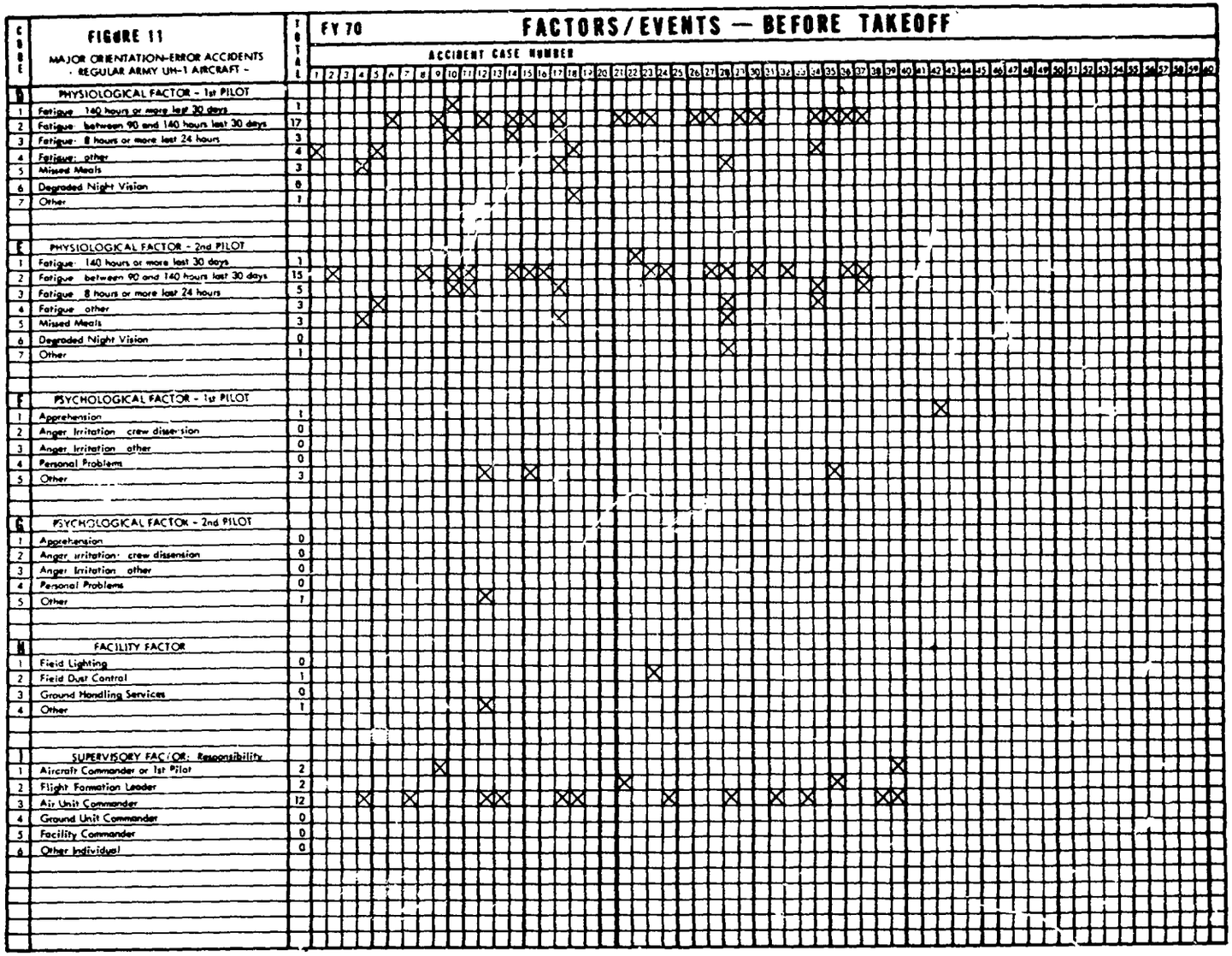


Figure 11

Individual case history listing of selected accident factors and events present before, or at the instant of, takeoff on the accident flight. See text for details.

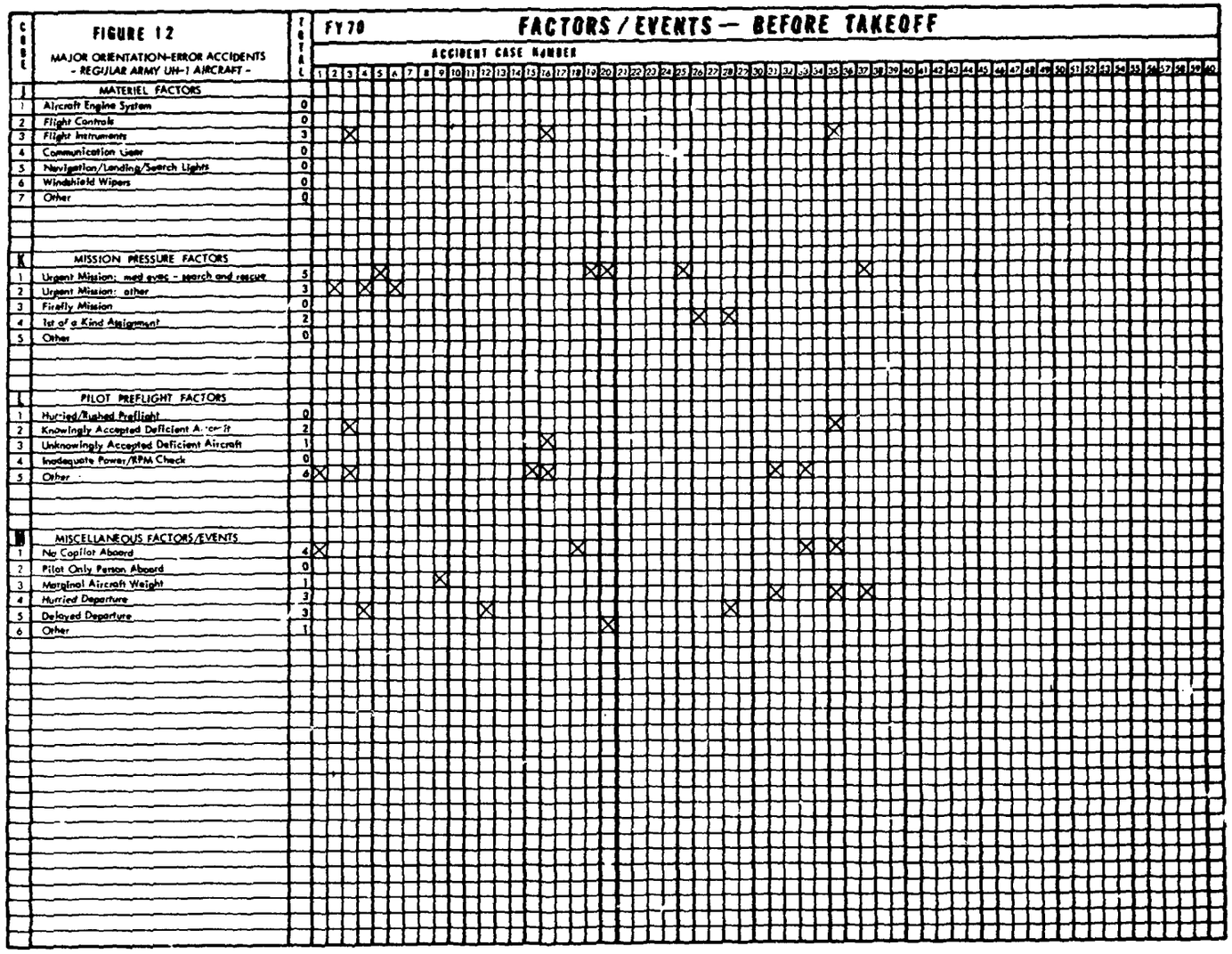


Figure 12

Continuation of the Figure 11 listing of before-takeoff factors and events.

FIGURE 13

MAJOR ORIENTATION-ERROR ACCIDENTS - REGULAR ARMY UH-1 AIRCRAFT -

FY 70 — FACTORS / EVENTS — INFLIGHT

ACCIDENT CASE NUMBER (cases 1–30)

Code	Factor	Total	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
N	PHYSIOLOGICAL FACTOR - Either Pilot																															
1	Degraded Night Vision	8	X	X			X		X					X								X			X		X					
2	Other	1																		X												
O	PSYCHOLOGICAL FACTOR - Either Pilot																															
1	Apprehension	4													X															X		
2	Irritation	1																												X		
3	Reached Panic State	1													X																	
4	Other	2									X											X										
P	FACILITY FACTOR																															
1	Field Lighting	6		X			X		X								X					X					X					
2	Field Dust Control	3						X															X		X							
3	Ground Handling Services	1																													X	
4	Other	4				X											X					X								X		
Q	SUPERVISORY: Responsibility																															
1	Aircraft Commander or 1st Pilot	10								X		X	X			X								X				X	X		X	
2	Flight/Formation Leader	1						X																								
3	Air Unit Commander	2																												X		
4	Ground Unit Commander	1					X																									
5	Facility Commander	1																								X						
6	Other Individual	0																														
R	MATERIEL FACTOR																															
1	Engine Malfunction/Failure	0																														
2	Flight Controls	0																														
3	Flight Instruments	0																														
4	Communication Gear	2			X	X																										
5	Navigation/Landing/Search Lights	0																														
6	Windshield Wipers	0																														
7	Other	0																														
S	COMMUNICATION FACTOR: Nonmateriel																															
1	Wrong Frequency Used/Assigned	1																				X										
2	Voice Procedures	0																														
3	Language Difficulties	0																														
4	Other	3	X																					X								
T	SPECIAL DISTRACTING EVENTS																															
1	Nearby Combat Action	4		X				X	X																							X
2	Danger of Mid-Air	0																														
3	Other	10					X									X							X					X		X	X	

ACCIDENT CASE NUMBER (cases 31–60)

Code	Factor	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
N	PHYSIOLOGICAL FACTOR - Either Pilot																														
1	Degraded Night Vision																														
2	Other																														
O	PSYCHOLOGICAL FACTOR - Either Pilot																														
1	Apprehension										X		X																		
2	Irritation																														
3	Reached Panic State																														
4	Other																														
P	FACILITY FACTOR																														
1	Field Lighting																														
2	Field Dust Control																														
3	Ground Handling Services																														
4	Other																														
Q	SUPERVISORY: Responsibility																														
1	Aircraft Commander or 1st Pilot						X			X																					
2	Flight/Formation Leader																														
3	Air Unit Commander									X																					
4	Ground Unit Commander																														
5	Facility Commander																														
6	Other Individual																														
R	MATERIEL FACTOR																														
1	Engine Malfunction/Failure																														
2	Flight Controls																														
3	Flight Instruments																														
4	Communication Gear																														
5	Navigation/Landing/Search Lights																														
6	Windshield Wipers																														
7	Other																														
S	COMMUNICATION FACTOR: Nonmateriel																														
1	Wrong Frequency Used/Assigned																														
2	Voice Procedures																														
3	Language Difficulties																														
4	Other											X																			
T	SPECIAL DISTRACTING EVENTS																														
1	Nearby Combat Action																														
2	Danger of Mid-Air																														
3	Other				X		X	X			X																				

Figure 13

Individual case history listing of selected accident factors and events considered to have occurred, or to be first manifested to the crew, while the aircraft was in flight.

FIGURE 14

MAJOR ORIENTATION-ERROR ACCIDENTS
- REGULAR ARMY UH-1 AIRCRAFT -

FY 70 **FACTORS / EVENTS — INFLIGHT**

ACCIDENT CASE NUMBER

CODE		TOTAL	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
[illegible]	VISIBILITY FACTORS/EVENTS																																																												
1	Degraded Night Vision	8	X	X			X		X					X								X			X		X																																			
2	Darkness: no visible horizon	9		X		X	X		X					X								X					X										X					X																				
3	Weather: clouds, fog, haze	18		X	X	X	X				X			X	X		X	X			X	X			X					X			X	X			X					X	X																			
4	Weather: rain, thunderstorms	9		X		X												X				X				X							X	X			X					X																				
5	Weather: other	1																																									X																			
6	Ground Dust/Ashes	3						X															X		X																																					
7	Poor Field Lighting	6		X			X		X								X					X					X																																			
8	Landing/Search Lights: reflections	2		X																					X																																					
9	Landing/Search Lights: did not use	0																																																												
10	Cockpit Reflections	2	X																																							X																				
11	Water Glare/Reflection	2							X							X																																														
12	Firefly Lights Involved	1							X																																																					
13	Glaring/Blinding Ground Lights	1							X																																																					
14	Windshield/Chin Bubble Obscured: other than rain	0																																																												
15	Windshield Wipers: malfunction	0																																																												
16	Windshield Wipers: did not use	1																																								X																				
17	Other	0																																																												
V	MISCELLANEOUS FACTORS/EVENTS																																																												
1	Weather: poor visibility	17		X	X	X	X							X	X		X	X			X	X				X				X			X	X			X					X	X																			
2	Weather: turbulence gust; winds	2																												X							X																									
3	Weather: other	0																																																												
4	Flight Over Water Involved	12	X						X	X	X	X	X			X			X								X		X			X						X																								
5	Down Wind Takeoff/Landing Involved	0																																																												
6	Go-Around Involved	3		X			X																				X																																				
7	Formation Difficulties	1						X																																																						
8	Navigation Difficulties	2													X																			X																												
9	Prolonged Flight/Behind Schedule	0																																																												
10	Marginal Fuel	1																												X																																
11	Inflight Engine Failure Occurred	0																																																												
12	Rotor Downwash Present: other aircraft	0																																																												
13	Given Improper Order	0																																																												
14	Disobeyed Specific Order	0																																																												
15	Inflight Turn: in progress	8			X							X			X				X				X								X			X										X																			
16	Inflight Turn: just completed	2		X																							X																																				
17	Hovering Turn: in progress	0																																																												
18	Aircraft Drift From Hover	11																		X			X		X	X		X			X				X			X	X			X		X																		
19	Erratic Flight Motion Observed	1																				X																						X																		
20	Misleading Ground Lights Present	2		X															X																																											
21	Misleading Visual Horizon Present	1									X																																																		
22	Misleading Visual Motion Cue Present	0																																																												
23	Misleading Body Motion Sensation Present	0																																																												
24	Inflight Crew Report of Vertigo/Disorientation	3												X	X															X																																
25	Postflight Crew Report of Vertigo/Disorientation	2																					X							X																																
26	Accident Board Mention of Vertigo/Disorientation	19	X		X				X	X	X			X	X	X		X				X	X						X	X			X	X			X			X		X	X																			

Figure 14

Continuation of the Figure 13 listing of inflight factors and events.

The F and G psychological factor listings are intended to identify any unusual mental attitude or condition that existed before the aircraft actually became airborne. As stated previously, it is the opinion of the authors (at this point in the analysis) that the field accident investigation teams seem to be reluctant to enter psychological information into the written record. Very little information has been gained under this classification.

The H facility factor heading is used to denote any airfield shortcomings which the accident board considered to have some effect on either the accident proper or the course of flight action available to the pilot. The facility factors listed under this heading, distinct from those listed under the P heading in Figure 13, relate to shortcomings present before actual takeoff of the aircraft. Factor I deals with supervisory errors which were considered by the accident board to have taken place before the flight became airborne. The listings under this heading denote the individuals assigned primary responsibility for this error.

Materiel deficiencies that existed before takeoff are listed under the J heading in Figure 12. The function here is to identify the accident situation where a materiel factor was known to be present, but not necessarily known to the aviators, before the aircraft became airborne. These factors are distinguished from the materiel failures that may have occurred while inflight and are listed under the R heading in Figure 13. It should be observed that an entry in one of the J listings does not imply that the materiel deficiency necessarily affected or effected the accident. The only implication is that there was some difficulty associated with the listed materiel item.

The K mission pressure heading is included as a preflight factor in an attempt to weight the crew's concept of the importance, the uniqueness, or the urgency of the mission. Though such a stress factor could be properly listed under the psychological heading, a separate listing is provided to distinguish among various operational situations. Section L deals with the crew preflight of the aircraft. The L1 entry denotes a hurried or rushed preflight situation, and as noted previously, entries L2 and L3 indicate the pilot's knowledge of any materiel problems that existed prior to takeoff. The objective here is to establish different factor weights for the situation where the pilot knows in advance that his aircraft is not fully operational, and for the situation where this operational deficiency is not recognized until after the flight becomes airborne. The section M heading is reserved for miscellaneous factors, events, or conditions that may have been present at the time of or before takeoff.

Factors similar to those in Figures 11 and 12 are outlined in Figures 13 and 14 but apply to the inflight phase of the 42 accidents. The N physiological factor and O psychological factor headings pertain to either pilot in this section since the preliminary accident review indicated that, in general, the inflight occurrence of such factors affected both pilots. Section O is a listing of psychological factors that were coded as occurring inflight. A point of consideration relative to the minimal number of listings contained under the inflight psychological factors heading is that all of the non-normal incidents and events that occur inflight, whether they involve some materiel

problem, some communication difficulty, or some change in visibility, can certainly affect the mental outlook of the crew. In this respect, the majority of the factors listed under all the other headings will have some psychological input.

The P facility factor heading denotes airfield shortcomings or limitations that affected the accident proper, or the course of action available to the pilot, while the flight was airborne. Though certain of these facility factors involved field sites rather than established heliports, it was the opinion of the accident board that it was reasonable to expect that the specific difficulty could have been prevented. Personnel responsible for inflight-related supervisory errors are denoted under the Q heading.

Section R deals with materiel malfunctions or difficulties that were encountered while the flight was airborne. Materiel malfunctions outlined previously in the before-takeoff phase under the J heading are not entered here unless an attempt was made to use the defective material while inflight. Section S describes inflight communication factors that were nonmateriel related. Only one accident involved this factor. Section T deals with special distracting events that the pilots encountered while airborne.

Section U deals with the key initiating factor in orientation-error accidents -- pilot visibility. In 25 (59.5 percent) of the 42 accidents, degraded visibility in one form or another was involved. A variety of miscellaneous factors and events related to the accidents is listed in section V. The V24 entries indicate that in 3 accidents, the crews recognized, while inflight, that they were experiencing orientation error manifested classically as vertigo or disorientation. As shown by V26, the accident investigation teams or reviewing authorities made specific mention of either pilot vertigo or pilot disorientation in 19 (45.2 percent) of the 42 orientation-error accidents.

As has been stated before, this longitudinal study is aimed at the compilation of accident factor data over a five-year period. Discussion or interpretation of these data beyond the above will await the assimilation of additional data for subsequent fiscal years.

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