ARMY MIDAIR

COLLISIONS

PREPARED BY THE U. S. ARMY BOARD FOR AVIATION ACCIDENT RESEARCH ■ FORT RUCKER, ALABAMA

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PREFACE

While engaged in training, a light observation helicopter was on the downwind leg of a heliport traffic pattern in late afternoon, flying south. The pilot entered a left turn to the eastbound base leg and his helicopter collided with an OH-13 which entered traffic by a straight-in approach to the base leg. Both helicopters crashed, killing the pilots. Visibility was 15 miles and the sun, behind the pilot of the OH-13 and to the right of the other pilot, did not obstruct the visibility of either pilot. This training environment accident occurred because neither pilot saw the other helicopter in time to initiate evasive actions to avoid collision.

During a right echelon formation of four UH-1H's in a combat area, the pilot of the No. 3 helicopter flew too close to the No. 2 helicopter and the main rotor blades collided. The No. 2 helicopter was crash landed, with extensive damage. The No. 3 helicopter fell to the ground and exploded, killing the crew of four. This tactical environment accident occurred because the No. 3 pilot attempted to fly excessively close formation in violation of established rules.

The above excerpts, taken from Army aircraft accident investigation reports, vividly portray the results of midair collisions. There are a few midair collisions recorded wherein only minor damage to one or both aircraft occurred. These are exceptional since most midair collisions are catastrophic, resulting in destruction of the aircraft involved and the death of the occupants. Midair collisions have long been one of the gravest hazards to safe flight. As aircraft density increases in both the combat and noncombat environment, the potential for the occurrence of midair collisions increases correspondingly, requiring of the crew and controller a greater degree of alertness and care in aircraft operations. Because of density, aircraft speed, and persistent hazy conditions, it may well be that aviation in general has passed the point where timely visual detection of other aircraft by the aircrew (see and be seen) is sufficient to insure against the midair collision.

One of the first teaching points voiced by instructor pilots to their students is: "Keep your head on a swivel to prevent collision with aircraft and other hazards to flight." The basic tool used by aviation safety officers to prevent midair collisions is the see-and-be-seen philosophy. This fundamental rule is essential to safe operation of Army aircraft. Yet, it is a fact that aviators inadvertently violate instructor pilots' orders or ignore the see-and-be-seen philosophy and do not see aircraft operating in their vicinity. How many times have you been advised by radar operators that a target is at your — o'clock position and, even after the warnings, been unable to find the other aircraft? I believe the answer is, unfortunately, frequently! It is evident that the see-and-be-seen philosophy is inadequate to prevent midair collisions in training and operational areas which are saturated with military and civilian aircraft.

Technological advancements have proven beneficial in improving the crashworthiness of aircraft and in numerous other areas of the aircraft accident prevention field. Proximity warning devices are presently available which alert aviators of other aircraft in their vicinity. The proximity warning device has been installed in a limited number of Army aircraft. Aviators flying TH-13T helicopters with the proximity warning device installed will respond to any warning received and initiate evasive action necessary to prevent a midair collision. However, they can have confidence in the system only if they know that all other aircraft which may be in the immediate area are similarly equipped. It is apparent that a strong case exists for the installation of proximity warning devices in all Army aircraft. The monetary savings brought about by the prevention of one midair collision involving two UH-1 helicopters would go a long way toward equipping the Army aircraft fleet with proximity warning devices.

Certain constraints make it difficult to modify the Army's aircraft fleet with the proximity warning device in the foreseeable future. It is, therefore, mandatory that all aviators and crewmembers increase their alertness and initiate actions to prevent midair collisions. Aviation unit commanders must also initiate action to insure that conspicuity marking of their aircraft is properly maintained. The commander must be alert and recognize indicators that reflect aviators' inattentiveness to regulations and unit standing operating procedures directed toward accident prevention. Aviation staff officers must consider the probability of midair collisions while planning airmobile operations. Sightseeing in the area of airmobile operations landing zones must be eliminated.

As aircraft and cockpit sophistication increase, requiring more head-in-the-cockpit time, the requirement for rapid and effective scanning of areas outside the aircraft increases. Installation of proximity warning devices holds the only promise for assisting aircrews to avoid collisions, but these devices can only assist. There will always be a requirement for each member of the Army aviation team to be alert, keep his head on a swivel while airborne to see other aircraft in his vicinity, and take necessary actions in his sphere of responsibility to prevent catastrophic midair collision accidents.

EUGENE B. CONRAD
Colonel, Infantry
Director

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ARMY MIDAIR COLLISIONS

I. **ABSTRACT.** This report contains analyses of 56 Army midair collisions which occurred during the period January 1963 to November 1969 and conclusions and recommendations based on the analyses.

II. **SUMMARY.** Analysis of 56 midair collisions experienced by the Army revealed that multiple cause factors were present in each accident. It was found the pilots must shoulder the majority of the responsibility for midair collisions. However, it was also found that other factors contributed to the crew errors which resulted in collisions. The full extent that other factors contributed could not be accurately determined because of the tendency of aircraft accident investigation boards and reviewing officials to accept pilot error as the cause of accidents, without seeking other contributing factors.

General problems encountered in training areas stem from the aircraft saturation within high density areas. Corrective actions to eliminate the problems must be oriented toward reducing aircraft densities in specific training areas. This can be accomplished either by a reduction in the number of aircraft operating in a specific area or through the expansion or relocation of existing facilities.

The most common trend revealed by analyses of accidents in tactical areas was the failure of aviation units to enforce adherence to published regulations. In most cases, adequate operational procedures were established in unit SOP's, field manuals, and technical manuals. Adherence to approved procedures would have prevented most of the midair collision accidents.

Inadequate command, control, and supervision were present in 50% of the midair collisions studied. It was determined that increased command attention must be directed toward the fundamentals of good airmanship, i.e., see-and-be-seen. In addition, new approaches must be taken to improve aircraft visibility and detection. Prominent among these are installation of proximity warning devices, installation of aircraft high intensity lights, and the installation of improved communication systems in air traffic control towers.

III. **INTRODUCTION.** Initially, this study was originated to establish a profile of Army midair collisions. This profile (Annex III) was based on data contained in 56 midair collision accident reports, involving 113 aircraft. Information from the reports was analyzed to determine common factors found in midair collisions. Analysis of the initial study generated the following unanswered questions:

1. Why are numerous midair collisions occurring in the training and troop lift/tactical environments?

2. Why are numerous midair collisions occurring during daylight hours in periods of excellent visibility?

3. What is the impact of inadequate command and control and lack of supervision?

4. What is the degree of violation of instructions or procedures and the principles of good airmanship?

5. What action can be taken to eliminate aircraft density around focal points which seem to attract aircraft at random times? (Focal points could be navigation aids, on-going operations, airfields, etc.)

To answer these questions, further analyses of the 56 reports were accomplished. These analyses revealed that conclusions and recommendations resulting from the study of midair collisions during training missions are not applicable in all respects to midair collisions occurring in a troop lift/tactical environment. For this reason, the study is presented in two parts. Detailed findings and conclusions are contained in Annex I (training) and Annex II (troop lift/tactical).

IV. **CONCLUSIONS.**

1. Conclusions and recommendations drawn from midair collisions during training missions are not applicable in all respects to midair collisions occurring in a troop lift/tactical environment.

2. Training environment conclusions are:

a. There is an ever-present possibility of crews being inattentive in a training environment. Student aviators in the early stages of flight training concentrate more on flying the aircraft and devote less attention to the see-and-be-seen concept. The aviator's failure to keep his head on a swivel increases the probability of midair collisions.

b. Student pilots flying in traffic patterns under the jurisdiction of air traffic control towers often develop a false sense of security. They frequently fail to clear themselves before executing maneuvers in high density areas.

c. Deficiencies in equipment and insufficient number of personnel were contributing factors to nine of the 12 midair collisions which occurred while aircraft were operating in stagefield/airfield traffic patterns.

d. The full impact of supervision and command control shortcomings as cause factors was not fully explored by aircraft accident investigation boards due to the tendency to accept pilot error as the only cause for accidents.

e. Investigation boards and reviewing authorities made a relatively small number (27) of recom-

This UH-1B was one of two which collided and crashed during training, killing all four occupants and destroying both aircraft.

mendations for the 25 training accidents. An apparent trend prevailed for boards to find that only the crew or crewmember was at fault when other factors were present that indicated other deficiencies.

f. Some student pilots failed to take advantage of time provided for crew rest, resulting in fatigue factors.

g. A small percentage of student pilots have a history of unsafe flying practices which may well develop into major contributing factors for midair collisions.

h. Aircraft visibility restrictions contribute to the pilot's failure to see other aircraft in time to avoid collisions.

i. Ten of 13 collisions could have been prevented if a functioning proximity warning device had been installed aboard each aircraft involved.

j. Insufficient use of the Operational Hazard Report (OHR) system may be attributed to a lack of knowledge about its intent and the aviator's fear that the information contained in the report might impinge on his personal reputation or professionalism.

k. Aircraft without distinctive conspicuity markings are more apt to be involved in midair collisions.

l. The intensity of the Grimes anticollision light is not sufficient to insure that student pilots see other aircraft in time to avoid collisions, especially during full daylight hours.

m. The see-and-be-seen concept is still the primary method available for preventing midair collisions.

n. Command emphasis in the form of constant evaluation of air traffic density, revision of air traffic control regulations, and strict control of aircraft operations is mandatory if a reduction in the number of midair collisions occurring in training environments is to be achieved.

o. A rapid turnover of key personnel contributes to a higher number of midair collisions.

p. Formation flight midair collisions do not occur when tightfisted command and control procedures culminate in detailed briefings, maintenance of prescribed separation between the aircraft, and adherence to safe flying practices.

q. Violations of regulations and published SOP's contribute greatly to midair collisions.

r. The fluctuating concentration of aircraft, varying between moderately saturated to highly saturated over such areas as stagefields, airfields, and navigational facilities, increases the probability of midair collision mishaps.

3. Troop lift/tactical environment conclusions are:

a. Loss of visual contact between aircraft during night operations contributes to midair collisions.

b. Aircrews are more susceptible to midair

collisions during prime recovery periods following missions.

c. Cumulative fatigue resulting from excessive flying hours contributes to midair collisions.

d. Inadequate command, control, and supervision constitute a serious problem area. It is not uncommon to have two or more of these elements involved in one midair collision.

e. Supervisory deficiencies receive little or no attention by aircraft accident investigation boards and reviewing officials. The primary emphasis is concentrated on real or assumed faults of the aircrew.

f. The present system for disseminating changes to SOP's, NOTAM's, and other information to individual aviators is inadequate. Aviators often learn about changes in operational procedures and policies through mistakes and experience.

g. Violation of instructions, procedures, and principles of good airmanship are involved in most midair collisions.

h. Midair collisions increase as aircraft inventory increases in a combat zone.

i. Diversion of attention and preoccupation of crews due to concentration on ground actions in combat areas contribute to collisions.

j. There will be no appreciable change in aircraft density in the vicinity of focal points, i.e., landing and pickup zones, tactical areas of operation, base camp heliports, etc., in low intensity warfare operational areas. The concept of providing airmobility to enhance ground operations results in large numbers of Army helicopters and fixed wing airplanes, as well as numerous aircraft of other services and nations, using the airspace above the ground forces.

k. Broad use of the Operational Hazard Report system can become a very effective tool in the prevention of midair collisions by identifying potential focal points.

V. RECOMMENDATIONS.

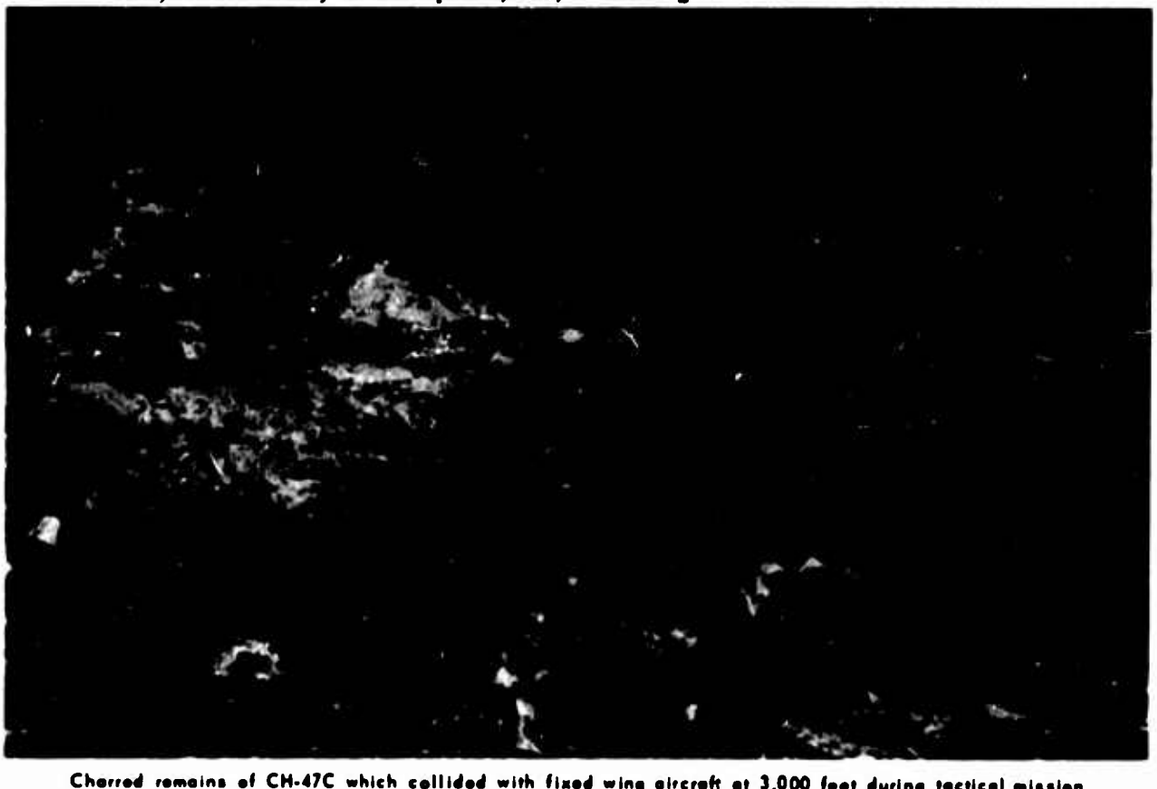
1. Recommendations for the training environment are:

a. Use of buddy riders to increase the number of eyes available for outside surveillance.

b. Increased emphasis on the necessity for student pilots to always clear themselves before executing maneuvers.

c. Command emphasis in the form of constant evaluation of air traffic density, revision of air traffic control regulations, and strict control of aircraft operations.

d. Greater efforts by aircraft accident investigation boards to identify and substantiate all contributing cause factors for each accident.



Charred remains of CH-47C which collided with fixed wing aircraft at 3,000 feet during tactical mission and tumbled end over end to ground, killing all five occupants.

e. Aircraft accident investigation boards and reviewing officials must develop positive and viable recommendations to prevent recurrence of all cause factors associated with every accident.

f. Command insistence that student pilots take full advantage of time provided for crew rest.

g. Greater command emphasis on the detection and elimination of marginally safe students at an early stage of flight training.

h. Elimination of design restrictions to visibility for future aircraft procured for training and modification to eliminate restrictions to visibility for training aircraft in the current inventory.

i. Installation of proximity warning devices in all aircraft.

j. Continuing command emphasis on an education program to promote use of the operational hazard reporting system.

k. Conspicuous markings for all training aircraft in noncombat areas.

l. Use of high intensity strobe lights to increase aircraft conspicuity during daylight operations.

m. Continuous command action to insure the use of the see-and-be-seen concept.

n. Continued command actions to offset the effects of a rapid turnover of key training personnel.

o. Continuous and tight supervision over all formation flights to insure maintenance of at least two rotor discs separation between aircraft.

p. Command emphasis to insure that aviators at all levels know and understand published directives and unit SOP's concerning formation flying.

q. Radar vectoring of traffic in high density areas.

r. Assignment of and adherence to prescribed routes and altitudes in training areas.

2. Recommendations for the troop lift/tactical environment are:

a. Development and use of techniques to avoid loss of visual contact resulting from flare illuminations at night.

b. Improved planning and closer coordination between aircraft crews in fire support teams.

c. Continuing emphasis on increased alertness and aircraft separation during prime recovery periods after missions are flown.

d. Increased command emphasis on adhering to recommended limitations for daily and monthly crewmember flight hours to prevent cumulative fatigue.

e. Command emphasis in the form of constant surveillance of air traffic density, revision of air traffic control regulations, and strict control of aircraft operations. Particular attention must be given to aircraft density during unit buildups in low intensity warfare areas of operation.

f. Deliberate efforts by aircraft accident investigation boards to identify and substantiate all possible cause factors contributing to each accident.

g. Improvements in the publication and dissemination of flight directives, flight information, and SOP's.

h. Continuous command emphasis on adherence to published regulations and SOP's.

i. Command emphasis on continuous alertness of all aircrewmembers to detect other aircraft in the vicinity of their aircraft.

j. Command emphasis on improved selection of landing zones, pickup zones, and staging areas.

k. Command emphasis on an education program to promote full use of the operational hazard reporting system.

l. Increased supervision to prevent close formation flying in violation of published regulations.

m. Prohibition of unplanned formation flights.

n. Elimination of formation flying that is unnecessary to accomplish missions.

o. Improved planning and better supervision while conducting and executing airmobile operations.

Midair collisions most often result in catastrophic accidents, such as this OH-13 which collided with another OH-13 during training.

ANNEX I
(training)

Question: Why are numerous midair collisions occurring during daylight hours in periods of clear visibility?

FINDINGS:

1. Twenty-five midair collisions occurred in the training environment. Analysis revealed that 23 midair collisions occurred during periods of excellent visibility.

2. Aircraft density and the false sense of security of aviators while flying in traffic patterns under the jurisdiction of a control tower were the two major factors in these mishaps, as shown below:

Situation	No. of Mishaps	% of Sampling
Flying in a high density area	24	96%
Flying under jurisdiction of a control tower	12	48%

3. In a training environment, there is the ever-present possibility of crews being inattentive. Student aviators, in the early stages of flight training, concentrate more on flying the aircraft and devote less attention to the see-and-be-seen concept. This increases the probability of midair collisions due to the reduced chances of the aviators detecting other aircraft in time to avoid collisions.

4. In 13 of the 25 training midair collisions, one or both aircraft were flown solo. Only one pair of eyes was available for outside surveillance in 32 of the 50 aircraft involved. The following table shows the numbers of aircraft and occupants:

No. of Aircraft Involved	No. of Occupants Aboard Each Aircraft
21*	1 (solo)
12	2
11	2 (1 was under hood)
6	3 or more

*The average flight experience of solo students involved in midair collisions was 52.1 hours.

CONCLUSION: Careful consideration should be given to the use of buddy riders and their value in preventing midair collisions. This would increase the number of eyes available for surveillance outside the aircraft.

Question: What is the impact of inadequate command and control and lack of supervision?

FINDINGS:

1. Prior to 1966, the number of midair collisions did not appear significant due to the scattered and isolated pattern of occurrences. Following are the numbers of collisions by calendar year:

Year	Number of Mishaps
1963	1
1964	3
1965	2
1966	8 (high)
1967	3 (low)
1968	7 (high)
1969	1 (low)

The increased frequency of midair collisions subsequent to 1965 clearly indicates that command emphasis in the form of constant surveillance of air traffic density, revision of air traffic control regulations, and strict control of aircraft operation is a mandatory requirement. The large number of collisions during calendar year 1968 is attributed to the rapid turnover of key personnel at the aviation training bases. Command actions were initiated in 1967 and again in 1969 which appreciably reduced the number of midair collisions for those two years. Some of the positive actions taken were:

a. Radar vectoring of traffic in areas of high density.

b. Assignment of prescribed routes and altitudes.

c. Overall command emphasis in the elimination of midair collision mishaps.

2. Following are the locations of the 25 midair collision mishaps occurring in a training environment:

Location	Number of Mishaps
Fort Wolters, Texas	10*
Fort Rucker, Alabama	8*
Fort Stewart, Georgia	2*
Fort Benning, Georgia	2
Other CONUS Locations	1
Republic of Vietnam	2**

*Twenty of the 25 midair collisions occurred in ultrasaturated training areas.

**The two collisions in the Republic of Vietnam occurred in a training environment.

3. The 12 training midair collisions which occurred while aircraft were operating in stagefield/airfield traffic patterns revealed that the tower operations and deficiencies in equipment and personnel actions listed below were present and contributing factors in nine accidents.

a. Tower operators did not exercise positive

control of air traffic in their area of responsibility.

b. The communications equipment installed in some towers does not provide transmitting and receiving capability with all aircraft operating in the vicinity of the airfield.

c. The design and location of towers used to control air traffic, particularly at training stagefields, restricts the visibility of air traffic controllers.

d. There were cases where inadequate manning of the control tower with fully qualified air traffic controllers resulted in these personnel being unable to control all the aircraft operating in the vicinity of the airfield.

4. Additional supervisory errors present pertaining to airfield/stagefield areas were:

a. Effective control measures such as establishment of traffic patterns and distribution of traffic pattern diagrams had not been initiated.

b. Standing operating procedures were not published in many instances. SOP's were inadequate to insure separation of aircraft operating in the local area in many accident reports reviewed.

5. Analysis of the 25 training collisions revealed the following additional information:

a. Thirteen collisions occurred in authorized training areas.

b. Six midair collisions occurred over navigational facilities.

c. Only three of the 25 accident investigation reports stated that adequate regulations were published.

d. Nine accident reports stated that a detailed survey of the local training areas should be conducted to prevent recurrences.

6. Formation flying:

a. Primary phase of training: A significant finding was that no mishaps occurred during formation flying in this phase of flight training. This can be attributed to tightfisted command and control, adequate briefings, and adherence to safe flying practices.

b. Advanced phase of aviation unit training: Two midair collisions occurred during formation flight, resulting in the loss of four aircraft and 24 fatalities. Both occurred in an advanced stage of training just prior to unit deployment and involved the No. 2 and No. 3 aircraft in flights of four aircraft. Although responsibility for maintaining proper separation between aircraft under VFR conditions rests with crewmembers, command supervision was determined to be an established factor in both collisions because:

(1) Radio silence was imposed for training reasons and hand signals were being used.

(2) A UHF (primary) radio had been removed from one of the aircraft prior to flight.

(3) SOP's were not adequate to govern formation flights.

(4) An aircraft commander executed flight maneuvers without first notifying the crews of every aircraft in the flight of his intentions. (A pilot error cause factor would be valid in these mishaps if the aircraft were not part of a formation of aircraft under the command and control of a flight leader. Strict discipline and immediate response to the commands of the leader are mandatory during formation flight. Therefore, responsibility for the safety of all aircraft in the flight rests with the flight leader.)

(5) Training missions were conducted in marginal weather, with reduced visibility.

(6) Established safeguards for avoiding pilot fatigue were not adhered to. The crewmembers

AH-1G crashed inverted in marsh and water after collision with OH-13 in photo above. Two occupants were killed and one survived with major injuries.

of two aircraft had exceeded the maximum recommended flight time for a 30-day period.

CONCLUSION: All aspects of command, control, and supervision as accident cause factors were not fully explored by accident investigation boards. The tendency was to accept pilot error as the only cause of the accidents. Investigation boards made only 27 positive recommendations in the reports of investigation of the 25 midair collisions occurring in the training environment. The recommendations included improvement of training areas, regulations, and local SOP's. This is a small number of recommendations, considering environmental conditions in which the accidents occurred. Five of the recommendations made were disapproved by approving authorities. It was noted that a trend prevailed for accident investigation boards to find the crew at fault when other causative factors were present. This is substantiated by the fact that accident investigation boards submitted less than one recommendation per accident that would reduce hazardous environmental conditions.

Question: Wh[illegible]he degree of violation of instructions or proce[illegible]ures and the principles of good airmanship?

FINDINGS:

1. Violation of published regulations and SOP's occurred in nine of the 25 training midair collisions. The following violations occurred:

   a. Prescribed traffic patterns were not followed.

   b. Proper separation was not maintained.

   c. Deviations from designated flight routes.

   d. Communication radios not tuned at designated times.

   e. Noncompliance with control tower instructions.

2. Crewmembers did not insure that there were no other aircraft operating in the area prior to executing maneuvers in a high density area in 13 of the 25 midair collisions occurring in the training environment. Nine midair collisions occurred when one aircraft descended on top of another and four occurred when one aircraft climbed into another. Five of these collisions involved aircraft on approach to the same runway/lane.

3. Crewmember fatigue was an established causative agent in two accidents and present in two others. Ample time was provided for crew rest. The student pilots did not take advantage of this time. Fatigue of any crewmember impinges on the basic principles of good airmanship.

4. One or both student aviators involved in three midair collisions had histories of unsafe flying practices prior to the accidents. This fact was revealed through a review of instructor pilot statements and individual flight records of the students. The unsafe flying practices of these three students were prime contributing factors to the midair collision accidents.

CONCLUSIONS:

1. Student aviators must devote more attention outside the aircraft, rather than concentrating entirely on flying the aircraft and monitoring gauges.

2. Detection and elimination of marginally safe student aviators at an early stage of flight training should receive greater command emphasis.

Question: What action can be taken to eliminate aircraft density around focal points which seem to attract aircraft at random times? (Focal points could be navigation aids, on-going operations, airfields, etc.)

FINDINGS:

1. During the day, aircraft density continuously shifts throughout training areas. Although entire training areas remain areas of high aircraft density, concentrations of aircraft in certain sectors fluctuate from moderately to extremely high saturated areas. Stagefields, established airfields, and navigational facilities are generally in the highly saturated areas.

2. Time of day appeared to have no significance. A greater number of midair collisions occurred, however, during launching and recovery periods, as shown below:

Period of Day	Number of Mishaps
0700-0900 hours	4
0900-1100 hours	5
1100-1300 hours	4
1300-1500 hours	3
1500-1700 hours	8
After 1700 hours	1 (night)

3. An aircraft design deficiency was a contributing factor in three midair collisions involving TH-55's. These mishaps resulted in five fatalities and the loss of four aircraft. The 4-inch metal doorframe of the TH-55 restricts visibility on both sides of the aircraft. This problem, first noted during December 1966, was brought to the attention of appropriate authorities by the training command using the aircraft. The design deficiency remains uncorrected.

4. Conspicuity was reported as a possible contributing factor for 12 of the 25 collisions due to:

Inadequate anticollision lights	7*
Aircraft without distinctive markings	3
Sun	2

*Investigations revealed no evidence that anticollision lights were not in use by either aircraft involved.

5. Installation of proximity warning devices was recommended by boards investigating four of the 13 collisions which occurred in training areas while aircraft were in the vicinity of navigational aids/facilities. Consideration was given to airspeeds, altitudes, locations, and phases of flight to determine how many of the 13 collisions could have been prevented by the warning provided by a proximity

warning device. This analysis disclosed that 10 of the 13 could have been prevented if a functioning proximity warning device had been installed aboard each aircraft. The aircrewmembers involved in these 13 collisions were unaware of the presence of another aircraft.

6. During 1967, the Federal Aviation Agency (FAA) adopted a reporting program for near midair collisions (NMAC) which granted immunity to those involved. An analysis of 2,230 NMAC reports received by the FAA resulted in the compilation of 700 recommendations which would improve operating conditions and assist in preventing midair collisions. The Operational Hazard Report (OHR), DD Form 2696, used by the military services, offers no such immunity. AR 95-1 states that the originator's signature on the OHR is desirable, but not mandatory. Analysis of midair collisions revealed that the OHR is seldom used to report potential midair collision causative agents. An aviator's reluctance to use the OHR may be attributed to his lack of knowledge of its intent and purpose, or his fear that information contained in the report might impinge on his personal reputation or professionalism.

CONCLUSIONS:

1. Serious consideration must be given to eliminating design restrictions to visibility for all future Army aircraft procured for training. Current Army training aircraft should be modified to eliminate design visibility restrictions.

2. Proximity warning devices should be a requirement for all aircraft.

3. Operational Hazard Reports, DD Form 2696, are not being effectively used to identify existing and potential hazardous focal points. The OHR is a very effective tool for preventing midair collisions. Corrective measures must be instituted to eliminate hazards to safe flight that are identified in Operational Hazard Reports.

4. Currently authorized anticollision light systems are inadequate for a training environment. Serious consideration should be given to the use of high intensity strobe lights to increase aircraft conspicuity during daylight training operations.

5. The see-and-be-seen concept is the primary method available for preventing midair collisions.

ANNEX II
(troop lift/tactical)

Question: Why are numerous midair collisions occurring during daylight hours in periods of clear visibility?

FINDINGS:

1. Thirty-one midair collisions occurred in the troop lift/tactical environment. Twenty-three occurred during periods of excellent visibility. This is not unusual because the majority of combat missions flown in the Republic of Vietnam are conducted under these conditions. Following are the conditions and numbers of collisions for each:

Condition	Number of Collisions
Excellent visibility	23
Night/reduced visibility	5
Day, weather/dust	3

Four of the five night collisions involved UH-1B/C armed helicopters. Two factors evident in these mishaps were:

a. Loss of visual contact with other aircraft after flare illuminations.

b. Loss of visual contact between aircraft of the light fire team while conducting fire support missions.

2. The 31 collisions involved a total of 63 aircraft. Seven aircraft were assigned to other services:

Service	Number of Aircraft
Army	56
Air Force	5
Marines	1
Vietnamese Air Force	1

There was no established trend as to locations where a midair collision between an Army aircraft and an aircraft from the other services occurs. As many took place in the vicinity of focal points as there were in operational areas.

3. Time of day appeared to have no great influence on midair collisions. A greater number occurred between 1500 hours and 1900 hours. This is a prime recovery period to base camp heliports after missions are flown.

Time of Day	Number of Collisions
0500-0700 hours	3
0700-0900 hours	5
0900-1100 hours	2
1100-1300 hours	3
1300-1500 hours	2
1500-1700 hours	6
1700-1900 hours	5
After 1900 hours (night)	5

4. Fatigue was an established factor in five of the 31 collisions, according to the aircraft accident

investigation reports. Further analysis revealed that the pilot in command of 37 of the 56 Army aircraft involved had flown in excess of 90 hours during the 30-day period prior to the accident. Of these 37, 29 aviators had exceeded 100 flight hours. Their total flight time for the 30-day period prior to the accident ranged from 101 to 167 hours. There was little or no mention of chronic flight fatigue, living conditions, mission requirements, or the stress of operating in a hazardous combat environment in the reports.

5. The constant requirement for formation flying is evidenced by the fact that 16 of the 31 collisions occurred while formation flying was in progress by one or both aircraft involved.

CONCLUSIONS:

1. There will be no appreciable change in aircraft density in the vicinity of focal points, i.e., landing and pickup zones, tactical areas of operation, base camp heliports, etc., in low intensity warfare operational areas. The concept of providing airmobility to enhance ground operations results in large numbers of Army helicopters and fixed wing airplanes, as well as numerous aircraft of other services and nations, using the airspace above the ground forces. The majority of midair collisions that occur in Vietnam will occur during daylight hours and there will be no severe restriction to visibility.

2. Flight time accumulated in excess of 100 hours per 30-day period is accepted by commanders and aircraft accident investigation boards. This problem can best be summed up by one of the flight surgeon's statements: "Chronic flight fatigue is cumulative and occurs due to incomplete physical and mental recuperation between repeated missions."

3. A requirement exists for adherence to flying hour limitations recommended by Army regulations. Personnel who exceed these maximum limits must be monitored by flight surgeons and aviation unit commanders to insure detection of complacency which could cause the aviator to become prone to accidents.

Question: What is the impact of inadequate command and control and lack of supervision?

FINDINGS:

1. Inadequate command, control, and supervision were present in 27 of the 31 collisions. This is a serious problem area. It was not uncommon to have two or more of these factors present in each midair collision. Following are the most common factors:

a. Laxity in flight control during formation flying.

b. Inadequate planning and proper execution of airmobile exercises.

c. Selection of inadequate landing zones, pickup zones, and staging areas.

d. Absence of adequate published and approved SOP's and directives and inadequate dissemination and enforcement of existing rules and procedures.

e. Absence of or insufficient coordination between different services.

f. Inadequate, or absence of, air traffic control facilities and ATC regulations.

2. Midair collisions between aircraft involved in formation flying accounted for 52% of the 31 mishaps. It is, therefore, necessary to elaborate on this category separately. Twelve of the 16 midair collision mishaps occurred between aircraft within a formation. The remaining four mishaps involved an aircraft not in formation flight with another aircraft which was in a formation. All collisions involved the No. 1, 2, and 3 aircraft, regardless of the size of the formation. Following are the factors revealed by this analysis:

a. Positive control was not maintained. This is evidenced by the flight leader permitting unnecessarily tight formation flying in violation of published regulations.

b. Conducting missions in marginal weather.

c. Conducting formation flights unnecessary to accomplish missions.

CONCLUSIONS:

1. Supervision appeared as a significant causative factor in the 31 midair collisions analyzed. However, these deficiencies received little or no attention by accident investigation boards and reviewing officials. Primary emphasis appeared to be concentrated on aviator factors.

2. The present system for disseminating changes to SOP's, NOTAM's, and other information to individual aviators is inadequate. Aviators often learn about changes in operational procedures and policies through mistakes and experience.

3. Contrary to common beliefs, statistics derived from this study showed the danger area for a midair collision in formation flying centers around the No. 1, 2, and 3 aircraft.

Question: What is the degree of violation of instructions or procedures and principles of good airmanship?

FINDINGS:

1. Crew error was listed as an established cause factor in the reports of 24 of the 31 collisions. Analysis of the 31 reports disclosed that violations of instructions/procedures and principles of good airmanship were present in all cases. Following are the four most prominent violations:

a. Aviators did not clear themselves and/or maintain a careful watch for other aircraft.

b. Adequate separation was not maintained between aircraft in formation flight.

c. Published regulations and SOP's were not followed.

d. Aviators did not maintain visual contact with other aircraft.

2. Five of the formation flight collisions occurred as the result of spur of the moment decisions to fly formation without prior planning. These five mishaps resulted in 18 fatalities, 11 serious injuries, and eight destroyed aircraft. Flights of this nature are in complete disregard for normal margins of safety and good airmanship.

CONCLUSIONS:

1. There is a need for aviators at all levels to know and comply with directives and SOP's pertaining to formation flying.

2. Formation flying that is not necessary for mission accomplishment must be eliminated.

3. Unplanned formation flying must be eliminated.

Question: What action can be taken to eliminate aircraft density around focal points which seem to attract aircraft at random times? (Focal points could be navigation aids, on-going operations, airfields, etc.)

FINDINGS:

1. Midair collisions increased as the aircraft inventory increased in the combat zone. Following are the numbers of collisions by calendar year:

Calendar Year	Number of Collisions
1963	0
1964	1
1965	3
1966	4
1967	7
1968	8
1969	8*

*Includes only the number of collisions through 29 October.

2. Focal points:

a. Navigation facilities. Two midair collisions occurred over navigation facilities; one when the facility was being used as a check point and the other when an aircraft collided with a Air Force aircraft over a navigation facility while the Air Force aircraft was making an instrument approach.

b. Ten midair collisions occurred in the vicinity of airfields, heliports, pickup zones, and staging areas. Cause factors included:

(1) Violations of published procedures.

(2) Regulations governing traffic patterns and air traffic flow around congested areas were not published.

(3) Inadequate communications.

c. On-going operations. Nineteen collisions occurred in operational areas. Aircraft density in these areas is generated by existing combat situations. Paramount cause factors in areas of on-going operations were lack of command and control, observation aircraft flying without a trained observer, and significant ground action present.

(1) Eight occurred during combat assaults with significant ground action present. In five of these reports, it was stated that ground action was distracting and diverted the attention of the crewmembers.

(2) Five occurred between Army aircraft and aircraft of another service with no significant ground action present.

(3) Six occurred after missions had been completed and the aircraft were en route to home bases.

3. It was significant that armed helicopters were involved in 10 of the 31 collisions. This degree of involvement is high with respect to the number of armed aircraft in the tactical zone. Some of the factors revealed by analysis of collisions involving armed helicopters were:

a. Preoccupation of aircraft crews due to significant ground action.

b. Failure to maintain visual contact between aircraft on the same fire support mission.

c. Lack of command and control procedures between armed helicopters and other elements of troop lift flights.

d. Operation of armed helicopters during the hours of darkness without external lighting.

e. Conducting unnecessarily close formation flights which were not required for successful completion of missions.

CONCLUSIONS:

1. There will be no appreciable change in aircraft density in the vicinity of focal points, i.e., landing and pickup zones, tactical areas of operation, base camp heliports, etc., in low intensity warfare operational areas. The concept of providing airmobility to enhance ground operations results in large numbers of Army helicopters and fixed wing airplanes, as well as numerous aircraft of other services and nations, using the airspace above the ground forces. The majority of midair collisions that occur in Vietnam will occur during daylight hours and there will be no severe restriction to visibility.

2. Immediate command attention must be given to strengthening command and control procedures in areas of on-going operations. Measures must be initiated which will insure control of the number of aircraft within an operational area, coordination between all combat elements within the area (including the other services), and individual command and control of organic elements.

3. There is a vital need for controlling agencies of focal points, such as airfields, heliports, and navigational facilities, to insure the establishment of and compliance with the best possible traffic regulations and procedures.

4. All phases of armed helicopter operations must be analyzed to develop corrective measures for reducing the high susceptibility of armed helicopters to midair collisions.

ANNEX III
(midair collision profile)

The aircraft involved will be of the Util-1 type and the collision will occur between two aircraft during daylight hours with the visibility at 10 to 20 miles. There will be 2.4 crewmembers per collision aircraft or 4.8 crewmembers per mishap. There will be 5.03 fatalities (both crew and passengers) in each mishap. The aircraft will be involved in some form of training operations. The crews will have performed 2.7 hours of flight prior to the collision and will have been on duty 5.1 hours of the duty day. The aircraft involved will not be in formation. Neither will they be climbing, nor turning, but will simply converge. They will be in radio communication with each other. The collision will occur between the altitudes of 1,001 feet and 2,000 feet absolute. The two aircraft will not necessarily be using the same navigation facility, and the experience level (flight time) of the aviators in command will not be a factor. The collision will take place in an area of known high density traffic. Inadequate command and control or a lack of supervision will be present in 50% of the mishaps. And some degree of violation of instructions or procedures, or the violation of the principles of good airmanship will exist.

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